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REVIEW

A Review of the Largest Online Teaching in China for Elementary and Middle School Students during the COVID-19 Pandemic

Longjun Zhou,[1,2] Fangmei Li[3]

1. *Jiangsu Second Normal University, Nanjing 211200, Jiangsu, China*
2. *Engineering Research Center of Digital Learning Support Technology, Ministry of Education, Changchun 130000, Jilin, China*
3. *Nanjing Dianji Institute of Psychological Education, Nanjing 210000, Jiangsu, China*

Abstract*. In order to reduce the impact of COVID-19 Pandemic on teaching, online teaching with the goal of "School is Out, but Class is On" was launched throughout China, and had achieved the "School is Out, but Class is On" of more than 200 million people. This special period of education has attracted great attention from Chinese scholars, and has conducted research on the theme of online teaching during the pandemic. Based on the relevant data of CNKI and other foreign open databases, this article reviewed and summarized the relevant researches of COVID-19 pandemic online teaching by survey and analysis. Through the statistical analysis of related research, the current research on online teaching mainly focuses on the selection of online teaching platforms and resources, the overview of online teaching organization, the implementation and the evaluation of problems.*

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About the Author: *Fangmei Li, Nanjing Dianji Institute of Psychological Education, Nanjing 210000, Jiangsu, China. Email: 1037576462@qq.com;*

Correspondence to*: Longjun Zhou, Professor, Jiangsu Second Normal University, Nanjing 211200, Jiangsu; and Research Scientist, Engineering Research Center of Digital Learning Support Technology, Ministry of Education, Changchun 130000, Jilin, China. Email: 294437034@qq.com.*

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Background

COVID-19 has engulfed most countries and regions in the world. According to the statistics of the World Health Organization (WHO), as of April 20, 2020, 211 countries and regions have reported confirmed cases, and the cumulative number of confirmed cases has reached more than 2.3 million (WHO, 2020). Affected by COVID-19 pandemic, a record number of students worldwide cannot continue their normal school life. According to the monitoring of the United Nations Educational, Scientific and Cultural Organization (UNESCO), as of April 20, Beijing time, 191 countries have implemented nationwide school suspensions, affecting approximately 1.575 billion students which accounting for 91.3% of the total number of registered students worldwide (UNESCO Institute for Statistics, 2020).

Because of it, countries began to seek respond ways actively to minimize the impact of the pandemic on education. Among them, online teaching has become an important measure for many countries to learn during the school suspension. They had deployed distance education and tried to solve its complexity to promote the "Class is On" during the COVID-19 pandemic. In this process, from elementary, middle school to college, from Europe, Asia to North America, all countries affected by the pandemic have become large-scale experimental sites for online teaching.

The Chinese government launched "School is Out, but Class is On", integrating all teaching resources, using the Internet and informatization technology, implementing distance learning and home learning for over 200 million students during the delayed spring semester period, which greatly guarantees the continuity of learning during the pandemic (Ding & Yu, 2020).

With the continuous spread of the pandemic, the global school suspension has become server. Many countries and education researchers pay attention to how China conducts online teaching during the pandemic, and it has become a hotspot in the fields of education management, information technology, policy science and decision-making consulting around the world.

Based on this, the research on Chinese online teaching during COVID-19 pandemic needs to be analyzed and reviewed. So that to further summarize the hotspots, difficulties and the existing problems during the pandemic, and to reflect on the weak points in order to conduct a more in-depth study. This review is based on the published data from CNKI, foreign open databases, and relevant official websites of China. It combined with relevant research reports, and provides a reference for the current implementation of global online teaching.

Literature Retrieval

This article reviewed and summarized the relevant researches of COVID-19 pandemic online teaching by survey and analysis.

We conducted research on the CNKI database and foreign open databases represented by SSRN, use "School is Out, but Class is On", "COVID-19", and "Online

Teaching" as keywords to search public information on other related websites. After screening irrelevant documents, as of April 18, 2020, a total of 156 articles were obtained (103 from CNKI, 42 from foreign open database, and 11 from other valid documents), of which there are 105 articles related to "elementary and middle school". After reviewed and analyzed these 156 articles, we found that the research on online teaching has developed rapidly and continuously.

As far as research objects, they include national or local education departments, college education researchers, elementary and middle school teachers, and social education researchers. Among them, college educators, elementary and middle school teachers are the major.

As far as the number of journal articles, before March 2020, there were 34 relevant articles in the CNKI database, only 8 were journal articles, and most of them were reported by newspapers. However, after a month and a half, the number of related research journal articles had reached 48, and there were 8 research reports published on related websites. So we can see that the number of research about COVID-19 had developed rapidly, and the research quantity and quality had also increased constantly.

As far as the research types, they were more diversified, including research on the specific description of online education, survey reports through questionnaires on the implementation of online teaching, and experimental research on the effects of online teaching.

As far as the research content, the main points were the construction of online teaching environment and resources, and how to carry out teaching guidance. "Cloud classroom", "Network environment", "Live broadcast class", and "Teaching strategy" are high-frequency keywords, which indicate that the teaching platform, resource content, school (teacher) and family-related guidance were the primary concern during the pandemic.

Online Teaching Platform and Resources

As a new type of teaching method, online teaching provided students with real-time and non-real-time teaching guidance. In this pandemic, national, local or educational informatization companies had provided a variety of platforms and resources, and provided teachers with different possibilities. Therefore, it is one of the research key points.

Classification of Online Platform

The rich types of online teaching platforms allow teachers to have more choices. Teachers can choose different types of platforms to carry out teaching activities according to their individual teaching needs and preferences.

Yutong Zhao once divided common online teaching platforms into three types in his research: Communication platforms, such as QQ, WeChat, etc.; Document delivery platforms, such as email, Dingtalk, Moodle, Micro-classes, etc; and Webcast platforms, Such as TikTok, Kuaishou, OBS, Zoom, etc. (Zhao, 2017)

The outbreak of the pandemic has made online teaching more popular. Therefore, the researchers have further subdivided their classification. For example, in a report on interactive research on online education jointly published by the New Media Communication Research Center of Beijing Normal University and Guangming Daily Educational Research Center, 39 online education products that are widely used in the market are divided into the following seven categories:

(i) Social tool: Social software that supports daily communication and corporate office. A variety of teaching functions such as WeChat, QQ, and Dingtalk are realized through the integration of group chats, video and audio conferences, and extension programs.

(ii) Communication tool: With online video conference as the core, it supports simultaneous live teaching, such as Zoom and Xiaoyu link.

(iii) Platform service: Provide a digital teaching environment to assist teachers to complete the entire process of online teaching, and realize functions such as course selection, course scheduling, announcement, online interaction, batch assignments, data management and analysis, such as Seewo and Xueleyun Platform etc.

(iv) Teaching tool: A tool that assists offline or online teaching to realize the digitization and high efficiency of one or several links in teaching, such as 17zuoye.

(v) Public resource: Provide digital public teaching resources such as micro-classrooms and teaching materials, the national elementary and middle school network platform and the People's Education TV station.

(vi) Subject content: Subjects' Online learning resources which based on the learning courses, such as Tencent Classroom and People's Open Class.

(vii) Comprehensive tutoring: Online education institutions independently developed online teaching platforms, teaching aids and curriculum systems. It integrates education and scientific research and teaching together, and the institutional teaching team provides students with a comprehensive learning experience, such as Zhibozuoyebang, TAL Education etc.

According to this statistic (teacher's choice of educational products are multiple choices), among these seven types of online teaching platforms, social communication software such as WeChat and QQ, mobile office platforms represented by Dingtalk and National elementary and middle school network platforms, became the first choice for teachers to carry out online teaching. In addition, Zuoyebang, Tencent classrooms, TAL Education, and electronic textbooks from People's Education Press have all become important products for the online teaching (New Media Communication Research Center of Beijing Normal University, Guangming Daily Education Research Center, 2020). The specific analysis statistics are shown in **Figure 1**:

At the same time, the East China Normal University Curriculum and Teaching Research Institute also investigated the specific use of online teaching platforms by elementary and middle school teachers. According to the questionnaire analysis of elementary and middle school teachers in 23 provinces and cities in the report,

Dingtalk(56.65%) and WeChat group (52.75%) were the primary choices for teachers' online communication and management; As far as live broadcast platforms, more teachers chosed platforms such as Tencent Classroom (36.95%), Zoom (27.72%), Tencent Conference (26.01%), Mooc(13.55%), CCTalk (8.54%). (Yang & Zhang, 2020)

Through the above several research reports, it can be seen that before the "School is Out, but Class is On", online education platforms and related tools had been enriched and expanded. In addition to the country, more education information companies focused on online teaching environment and the development of tools, provided a richer supplement to the online teaching support platform during the pandemic. In addition, teachers had a deeper understanding of the new online teaching technology and functions. In addition to common social tools such as WeChat and QQ, Dingtalk and the National elementary and middle school network platform, Tencent Classroom, etc. had also become the main choice (**Figure 1**).

Strategy Selection of Online Teaching Platform

Huang (2020) believed that the choice of online teaching tools should consider the convenience, that is, the tools should help teachers to quickly and easily produce and manage resources, publish notifications and manage students; Help students obtain resources and participate in learning activities quickly and easily; Help teachers and students to communicate conveniently and quickly; Help teachers, parents, and schools to keep updated of students' learning dynamics, and better communications.

From the perspective of overall regional planning, Qing Zhang and others believed that the network platform was the carrier and means of online teaching. Choosing a suitable platform and being able to operate proficiently have a great significant meaning for smoothly developing online teaching. Therefore, it is recommended that each subject in the same grade of each school can only use one platform for online teaching, to avoid switching back and forth during learning, increasing the difficulty of operation, but meanwhile it is allowed one or two assistant platforms for announcement (Zhang & Wu, 2020).

More research was focus on how online education was implemented in schools. For example, Daxiang Dai's research specifically explained how the school used the teaching platforms at all levels to solve the learning needs of different grades during the outbreak (Dai & Lin, 2020). The article introduced that for the review stage of the first and second year of middle school students, they were required to watch the local TV education channel (Jiangsu Education Channel) and listen to the "Gulou Online Review Course" to conduct home-based independent review. For ninth grade students （the last year of middle school), the school organized students to learn independently by watching the news channels of local TV stations. In the new content teaching stage, on the one hand, the school used the teaching platform like "Jiangling Teachers' Class in the air-Jinling Micro School" in Jiangsu Province, "Pukou Eqixiao" in Pukou District, and the online learning mobile app "Wosu" in Jiangsu to conduct online teaching, on the other hand, use the office communication platform "Dingtalk" to carry out online group live broadcasting, and online interactive teaching through the network live broadcasting

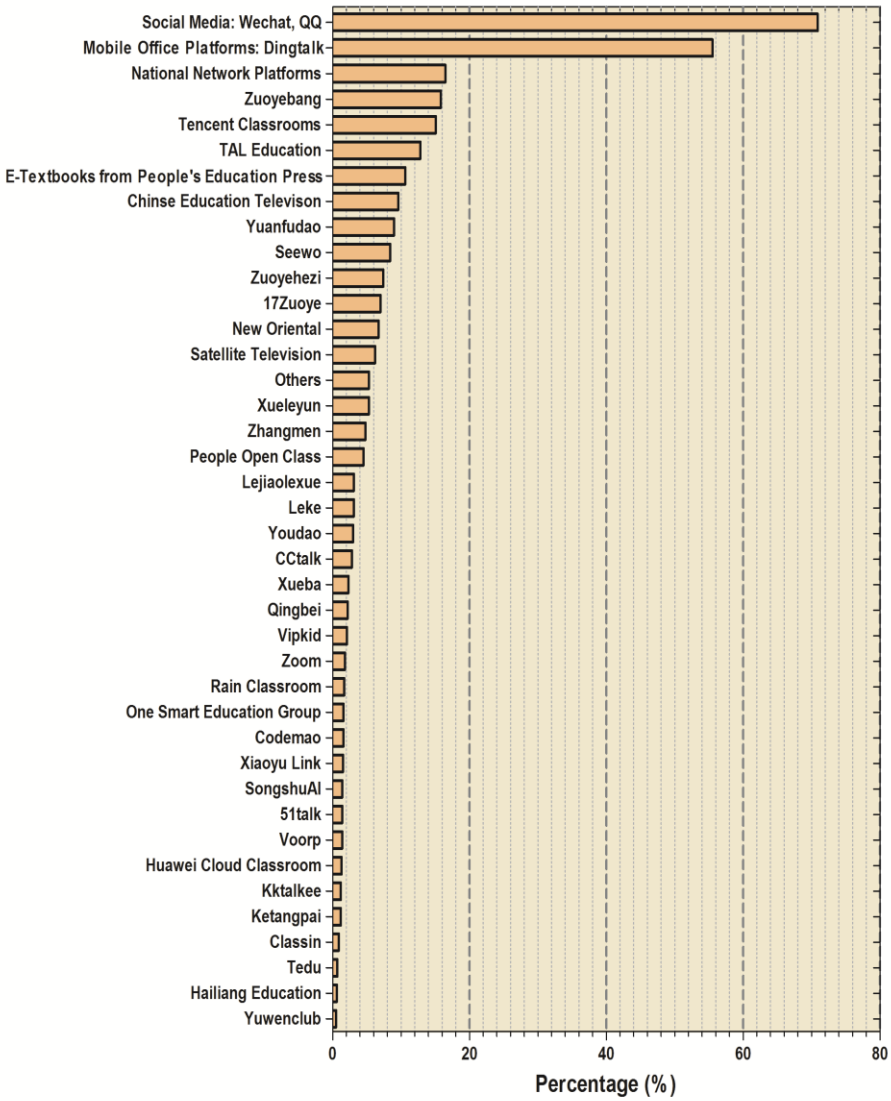

Figure 1. Statistics of Online Learning Platforms in China.

platform. At the same time, the school also used public communication platforms such as QQ or WeChat to establish a communication group for each class, so that teachers can answer and solve questions in a timely manner.

The Construction and Development of Online Resources

The quality of teaching resources has an important influence on the effect of online teaching. Therefore, in addition to online teaching platforms, the development and integration of online teaching resources had also attracted the attention of researchers.

The construction of online teaching resources was not an overnight effort. Some scholars had done research on the basis of online teaching resources in China this time. According to the data of the Ministry of Education's Cyber Security and Informatization Leading Group in 2020 quoted by Longjun Zhou, as of 2019, the national system has launched a comprehensive collection of high-quality basic education resources for the entire society, bringing 290 units together and a total of 457 teaching applications. Through the activity of "One Teacher One Excellent Class, One Excellent Teacher One Class", it attracted more than 2.28 million teachers to participate, collected 3.14 million online courses, recommended 17,312 provincial excellent courses, and selected 1,005 ministerial excellent courses, and generated 8 million resources. Therefore, the article claimed that the achievements of the construction of digital teaching resources from the beginning of this century have provided strong resource support for the large-scale online teaching activities during the pandemic (Zhou, et al, 2020).

Researchers have also seen that during the pandemic, the large-scale online teaching has benefited from the interaction of various parties in the society. In order to provide rich online teaching resources, the state, local governments and enterprises had made efforts.

As reported in the 11th edition of the People's Daily on February 3, the Chinese government has, since February 17, opened the national elementary and middle school network cloud platform and online courses for free to students from elementary to high school.

On the other hand, China Education Television provided to nationwide elementary students, 8th and 12th grade students with free "New Education Elementary School Edition Textbook Synchronization Class", "Mathematics, Physics, Chemistry courses". At the same time, for some rural areas and remote poverty-stricken areas where there is no Internet or slow Internet speed, courses and resources will be broadcast through TV channels to ensure that the essence and effect of online and offline teaching are the same (Zhao, 2020).

In addition, local governments have also organized teaching and research teams to study teaching methods and learning resources suitable for the region. For example, Tianjin Municipality organized kindergarten teachers and researchers in response to the needs of young children's family education, based on "Guidelines to Learning and Development for Children Aged 3-6"; they recorded 10 video games for young children (Tianjin Education Commission, 2020). For the 8th and 12th grading student, Fujian Province organized teaching and research teams to develop suitable teaching methods and learning resources, and sent the course content to students as "curriculum" to ensure that those students can successfully pass the End of Grade test (Fujian Education Department, 2020).

In addition to national and local governments, educational information-based enterprises such as Bytedance, Yuanfudao, Zhibozuoyebang, VipKid and other compa-

nies provided free online live teaching systems to all elementary and middle students. The provision of a large number of high-quality online teaching resources provided a solid foundation for this large-scale online teaching activity (Zhao, 2020).

The Selection Strategy of Online Teaching Resources

High-quality and rich learning resources were not equivalent to effective learning. They need to be closely related to the teaching object and content, and match the physical and mental characteristics of the learner. Therefore, how to choose appropriate online teaching resources was also one of the major focuses.

Regarding how to select appropriate online teaching resources, Huang et al. (2020) believed that the following points should be considered:

(i) Appropriate content, that is, the learning resources must be highly related to the learning object and content and can arise the interest of the students, or they are necessary to solve the problems;

(ii) Appropriate difficulty, that is, the content is moderate in difficulty and moderate in size, and will not make students overloaded;

(iii) Appropriate structure, that is, the structure of the learning content is clear and the organization is reasonable, and it will not make students confused;

(iv) Appropriate media, the presentation form of the media is easily accepted by students to prevent visual fatigue, especially for young students;

(v) Proper resource organization. That is to effectively organize the selected learning resources (such as video, animation, text, electronic textbooks, virtual reality, etc.) to ensure that the navigation layout is clear and the depth is moderate, and the students will not lose their way.

In the specific implementation process, different schools have integrated and enriched online resources according to their own conditions. For example, the Zhenjiang Experimental School in Jiangsu Province digitized the textbook guidance materials to form a digital guidance draft, which provided more targeted teaching materials (Xia, 2020); The No. 2 Daxie Elementary School in Ningbo, Zhejiang Province organized each teacher to design a guidance program (task list) based on the learning objects and the students' learning situation, which made the knowledge organized and systematic (Xie & Yang, 2020); The Second Experimental Middle School of Henan Province independently developed online curriculum resources during the pandemic. The 164 online courses not only enriched online learning resources, but also allowed the 12th grade students to further adapt to online learning (Zhou, 2020).

The Organization and Implementation of Online Teaching

Teachers, students and parents are the main participants in education. Under the impact of the pandemic, normal classroom teaching could not be carried out, and it shifted from offline to online. The change of learning methods, the assistance and cooperation

of parents are important guarantees for online teaching. Therefore, how to organize and implement online teaching has become a topic

Online Teaching Methods

The form of teaching organization is a link between teachers and students, and it is a way to organize teaching activities according to certain teaching ideas, purposes, content, and subjective and objective of teaching conditions. The emergence of online teaching in the pandemic relies on the strength of teachers, demonstrating their practical ability and real level.

Implementation Overview of Online Teaching

At the beginning of this large-scale online teaching development, the teaching and research of Education department of the Zhejiang Province organized all provincial teaching and research departments to carry out a survey on the online learning of middle and ordinary high school students in the province. The results showed that 96.0% of the students who have participated or are participating in online teaching activities organized by the school, while only 4.0% have not participated. This showed that online teaching has become the main method of education and teaching for the middle and high school during the pandemic in Zhejiang Province (The Education Department of Zhejiang Province, 2020).

Later, a survey report issued by the Academy of Educational Sciences of Hunan Province involving 31 provinces, cites, autonomous regions and Hong Kong, Macao and Taiwan regions also responded. In this report, 79.34% of the research objects had already conducted online teaching, urban area is 83.41% and urban area is 77.42%. It was concluded that online teaching had become very norm in China during the pandemic. About 80% of schools in Hunan Province, whether it is urban or rural, had launched online teaching, and teachers had tried every method to teach students. Teaching methods was also diverse. The data showed that 36.48% of the schools were mainly relied on "learning public teaching resources", 31.56% were "teacher recording or using existing resources", 11.6% were "teacher live teaching" (Academy of Educational Sciences of Hunan Province, 2020).

Classification of Online Teaching Organizations

Some scholars believed that the organizational form of online teaching should follow the idea of "flexible teaching". Each element in teaching does not stick to the inherent model, and makes corresponding adjustments according to the actual situation, to be able to learn easily, devotedly and effectively (Ma & Du, 2002). Some scholars summarized the online teaching mode of this period. For example, Zhiting Zhu and Hongchao Peng (2020) had proposed three application modes – Direct teaching, Self-learning, and Flip learning; Jianli Jiao and Xiaoqing Zhou (2020) had summarized several typical solutions – Online courses, Online live broadcast teaching, Student self-learning, and Television air classroom, etc ; Dongdong Wang et al. (2020) proposed four common

online teaching and service models based on platform selection: "TV teaching video", "Live classroom", "Resource class communication" and "Self-selected resources + Online Q & A".

Selection Strategies of Online Teaching Organization

Regarding the selection of teaching organization methods, some scholars pointed out: "Schools should allow teachers to flexibly choose suitable teaching organization forms for different learning contents according to the teaching resources and local network facility (Huang, 2020) . For example, the First Middle School in Changyuan City, Henan Province, through a guided learning program, launched online teaching activities, combined with students 'independent learning methods, created a six-step teaching method (Cai & Wang, 2020); The Experimental Elementary School of Xiamen did not blindly follow the advanced educational products at the beginning of online teaching, but required all teachers and students to use QQ groups as an platform to ensure that them can be smoothly involved in a short time. After a stable period, the school encouraged everyone to try other systems such as the National Education Digital Resource Network to ensure that online education activities can be carried out more efficiently and stably (Liu, 2020).

The combination of reality, innovation, and development of distinctive teaching organizations guaranteed the quality of online teaching.

Online Learning Methods

Learning methods refer to all learning methods and forms adopted by learners in various learning situations with different motivational orientations, mental processing levels and learning effects. It includes not only the learning methods and strategies that focus on the individual level of students, but also the learning methods of teachers and students (Pang, 2010). Affected by the pandemic, classroom teaching could not be carried out under normal circumstances, the learning environment had changed, and the learning methods had also been changed. Therefore, how to divide learning methods, which learning methods are mainly adopted by students, and how to let students to choose different learning methods according to their learning characteristics had become a topic.

Some scholars believed that different learning methods are suitable for different scenarios and students, and the tools they rely on are also different. Based on this, the online learning methods during the pandemic are divided. For example, Huang (2020) believed that the choice of learning methods should considered the characteristics of the learner, the level of cognitive processing, learning participation and etc.

Based on this, relevant education departments represented by Beijing city had advocated teachers screened learning resources and guided learning content according to the learning characteristics of their students. Teachers should strengthen offline guidance to students, and especially use this opportunity to guide students to try offline self-learning (Shi, 2020).

Parents Cooperating with Online Teaching

Family and school co-education is to cultivate students through family education and school education, to promote the overall development and healthy growth of students. During the postpone school period, the family has become the only place for students to learn, and parents have become an important partner in student learning. Communication and cooperation between school and family is an important measure to promote "School is Out, but Class is On" (Cheng, 2020). Therefore, parents' knowledge of online teaching and how to strengthen cooperation had become one of the research topics.

Parents' Knowledge of Online Teaching

The Department of Education of Heilongjiang Province conducted a questionnaire survey on the satisfaction with online teaching of parents across the province. According to the report, up to 39.84% were very satisfied, 19.71 % were less satisfied, 38.01% were relatively satisfied, and only 2.44% of were not satisfied (**Figure 2**). 92.33% of parents felt that "schools and teachers actively contacted them and communicated the cautions and arrangements for online learning." They were very satisfied with it (Heilongjiang Provincial Department of Education, 2020).

In Wang's (2020) report, we can see that parents have another attitude towards online education: on the one hand, 49.2% of parents were expecting the school to take remedies for online teaching, but on the other hand, some parents worries for various reasons, such as the choice of online courses 64.1%, unfamiliar network operation 52.4%, insufficient network and equipment conditions 14.7%, affected vision 59.9%, concertation 57.3%, online temptation 49.2%, unanswered questions 43.9%, and poor learning effectiveness 40.9% have all become concerns for parents.

Measures for Home and School Cooperation

In order to better manage home learning, the school organized room-teacher to establish a class communication management platform. Through multiple channels such as class QQ group, WeChat group or school platform, school official WeChat, etc., the school had established a positive, smooth and effective communication to maximize the support and cooperation of parents. And through the communication platform, the school can statistics and monitor the students' online viewing of online courses and homework submissions to better control the students' home learning (Cheng, 2020). For example, Jiangsu Zhenjiang Experimental School built a platform for online learning and a home-school co-education network platform through the province, city and school platforms. In addition, it also realized remote interaction with parents through the public communication platform QQ and WeChat group. At the same time, the school replied on the Education Bureau of the Province and Cities to develop online learning resources to deeply dig out parent resources, and enrich home learning resources. In addition, in order to better achieve home-school co-education, the school had specific requirements for teachers and parents to ensure the quality of online learning (Xia, 2020).

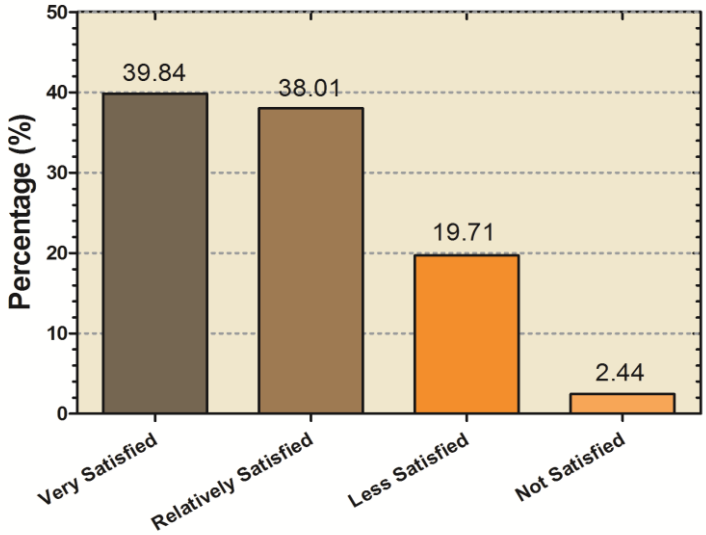

Figure 2. Satisfaction of Online Learning.

The Achievements and Deficiencies of Online Teaching Implementation

With the pandemic situation getting better in China, education will gradually return to normal. As of April 20, 26 provinces in China have started back to school (Wang & Wang, 2020), and the implementation of "School is close, but Class is On" will also come to an end. How effective it is and what are the deficiencies have become concerns.

The Effectiveness of Online Teaching

Launching online teaching nationwide is the first attempt in Chinese education history. Compared with traditional teaching methods, can online teaching bring new enlightenment to students in a home learning environment? Which teaching method can improve teaching efficiency? Can online teaching better promote individualized teaching and the balance of quality education? The effectiveness of online teaching has attracted the researchers' attention.

For example, Yao used evidence-based research method to study 1,024 samples from No. 8 Guiyang Middle School and another school with the same educational conditions and students. They analyzed the impact of two online teaching methods, recording and broadcasting, and live broadcasting, on student performance, and concluded

that more get involved by teachers is an effective way to improve teaching efficiency. (Yao et al, 2020)

Hui et al. (2020) also conducted research on the effect of technology on online teaching, and concluded that the accurate support of big data reduces the student's academic burden, guarantees the normal development of teaching, and improves teaching efficiency.

Although the research on this part is not sufficient at present, as the normal teaching gradually recovered, the research on the effectiveness of online teaching will also be continuously supplemented and enriched.

The Problems Existing in Online Teaching

Since the implementation of "School is Out, but Class is On" in China, large-scale online teaching had replaced the normal classroom teaching, and various regions had also taken actions to respond to this change, ensuring the continuity of learning. However, some scholars had seen that in the specific implementation process, the implementation of large-scale online education had been affected by infrastructure construction, unadoptable teaching methods, and unequal information literacy of the participants.

The Infrastructure in A Few Areas is Weak that Affects the Implementation Effect

Compared with developed regions, underdeveloped regions still have some problems in terms of home learning terminals and the coverage, availability and stability of network conditions. Some scholars said that it is the first time in China's basic education that large-scale online teaching replaced normal school teaching. The infrastructure preparation for large-scale online education is insufficient, and large-scale concurrent accesses greatly exceeds the platform's regular service capabilities, online teaching Platforms (such as Cloud classrooms, Rain classrooms, and Dangding Dong) were usually overwhelmed (Zhang et al, 2020), and problems such as stuck and frequent offline seriously affected the learning experience (Li, 2020). In the later period, the power of the national social enterprise had greatly improved the network operation ability, and online teaching support environment had been improved.

The Lack of Scientific Property and Applicability of Some Teaching Plan Affected the Teaching Effect

Teaching plan should be designed and implemented according to the actual situation of the school to ensure the pertinence and scientific property of teaching. However, in terms of specific implementation, some schools had a relatively simple practice model, especially in the early days of online teaching. They used the same teaching method as offline teaching, or the same time schedule as the original, without comprehensive consideration, evaluation and design of the teaching content of different levels and different disciplines.

According to the questionnaire survey of the Education Research Office of the Department of Education of Zhejiang Province, there are 7 online learning methods (Live broadcast, Recording, Resource pack, Live broadcast + Recording, Live broadcast + Resource pack, Recording + Resource pack, Live broadcasting + Recording + Resource package), Pure Live broadcast got the highest proportion, reaching 51.8%, but in a survey of student satisfaction, the Resource package (the teacher does not teach, just provides learning resources for students to learn by themselves) was the learning method with the highest student satisfaction. In addition, the questionnaire also counted the way students submit their homework, the number of daily courses, and the time of each course. From the survey, problems such as long class hours and study time, electronic homework, and online punch-in were still highlighted (The Research Office of the Department of Education of Zhejiang Province, 2020). In this regard, the report recommend that schools arrange and adjust online learning from the perspective of improving the physical and mental health of students, and design teaching programs that meet the actual situation. In addition, Wang also emphasized that during the implementation of online teaching, encourage "One school One Teaching Plan", "One class One teaching plan", "One teacher One Teaching Plan" (Wang et al, 2020).

Inadequate Literacy of Some Subjects

The lack of information literacy was another practical problem faced by this large-scale online teaching implementation. Some scholars said that many teachers, students and parents were unable to follow the online teaching. In the absence of relevant guidance from the school, the participants showed inordinate "out of control" and "anxiety" during the implementation process (Jiao et al, 2020). More scholars have analyzed from the survey report that there may be problems in the information literacy of the subjects.

Teachers' Online Teaching Abilities are Different

According to the relevant research report of the Institute of Curriculum and Teaching of East China Normal University, most teachers have self-study experience with online platforms (45.22% are frequently used and 37.69% are occasionally used). And most teachers are not stranger to online education (40.29% knew very well and 45.50% knew better). However, for large-scale teaching using online platforms, 41.26% of teachers still found it difficult, even 21.80% considered very difficult (Yang & & Zhang, 2020). In the relevant survey report of Beijing Normal University (Wang, et al, 2020), this situation had also been verified, and 42% of teachers were anxious about carrying out large-scale online education. The main reason does not know how to interact with students online, how to organize teaching activities, and how to deal with equipment operations. Teachers also generally are lack of online teaching experience and cannot quickly adapt to and exert the advantages of network technology.

The Lack of Online Self-Learning Ability of Students and Difficult to Guarantee the Participation of Learning

In the questionnaire survey of 9,824 parents of elementary students in 9 counties in Sichuan Province by Pu et al (2020), parent thought that children were not concentrate (44.48%) and irregular learning time (44.06%) are the main problems of online education. The results showed that 38.54% of the students had insufficient confidence in adapting online learning quickly; 37.1% believed that they had poor initiative in online learning, and 45.79% considered that need the supervision of teachers and parents to complete the task of online learning. As a result, students' independent learning ability had become an important factor that affects the final results of online learning.

Insufficient Parents' Ability to Assist Children in Online Learning

Parental assistance is of great significance to online learning. According to a survey of elementary and middle school teachers, students, parents, and educational institutions in seven major regions including East, Central, and South China conducted by the Zhongguancun Internet Education Innovation and the Collaborative Innovation Center established by the Ministry of Education and the Balanced Development of Informatization and Basic Education in China, during the pandemic, 23.4% and 29.6% of the parents indicated that they have been or often accompanied their children for online learning, and 38.1% just occasionally, but 7.9% were not (Wang & Fu, 2020).

According to the survey results of Jiang et al. (2020), 52.4% of parents reported that they were not familiar with the operation of online learning, and there were no active and effective solutions to the problems that may occur in online learning.

Based on this, Xie suggested that in addition to strengthening technical guidance and design theory guidance for teachers' online teaching, schools should also pay attention to relevant guidance for students and parents. This can train students to learn and manage independently, and establish a good home-school collaboration mechanism. Under the premise of respecting different school periods, different grades, different students' cognition laws and home learning laws, according to the unevenness of parents' education, experience, and ability, so as to ensure the implementation of online teaching (Xie et al. 2020).

Perspective

In this large-scale online teaching activity, the transformation of educational space forced the participants of various educations to quickly adjust and adapt to changes. This is not only a new problem that schools, families and students have ever encountered, but also an important challenge facing China's basic education.

It can be seen from the currently published studies that the content of online education research during the pandemic mainly focused on the following aspects.

(i) The rich education platform and resources are the strong support for this online teaching. Based on this study, we can see that under the state of suspension of classes across China, the Chinese government has combined various forces to provide a diverse teaching platform and rich teaching resources for online teaching, which has better supported the distance learn-

ing of students across the country. This ensures the continuity and scientific property of education and teaching in an extraordinary environment, thereby promoting the healthy development of students' physical and mental health at home.

(ii) Teaching guidance and home-school cooperation are the guarantee of online teaching. At the same time, we also noticed that how to make education technology and teaching more deeply integrated to better serve education and teaching, and then ensure the continuity of education in the abnormal environment has become the main problem of teaching. Therefore, changes in the teaching environment have changed both teaching methods and learning methods. Appropriate guidance from teachers and autonomous learning of students has become a new model under the implementation of online teaching. At the same time, parental assistance and joint participation ensure online teaching.

(iii) Exerting effectiveness is fundamental to online teaching. After a period of implementation, we found that online teaching at this stage has achieved some results. The integration of educational technology and teaching makes the teaching more personalized, and the teacher's online guidance makes online teaching more adaptable to students' learning needs. Although there is not much research on this aspect at present, we believe that with the continuous resumption of classes across the country, online teaching will enter the stage of convergence with classroom teaching, and research on its effectiveness will be supplemented and enriched.

However, it should be pointed out that there are also limitations in the implementation of large-scale online teaching in the outbreak, such as: the infrastructure in a few areas is relatively weak; the teaching methods or contents are not suitable; and the level of informatization of some education participants was inferior.

Existing research has certain limitations in terms of both research methods and research content.

(i) Insufficient evidence-based research in education. From the perspective of research methods, the existing research is more qualitative research, and the evidence-based research in education is slightly insufficient. It can be seen from the literature that educational surveys and educational experimental research account for less than 25%, which makes the research evidence insufficient.

(ii) Too much bias towards educational technology. From the literature, most of them were biased to educational technology, but less substantial discussion of the implementation and operation of online education during the pandemic.

These questions are also forcing us to keep thinking: how do we design top-level education for similar public health emergencies? How can schools respond quickly and comprehensively? How to formulate an adaptation plan based on actual needs?

How to provide more professional guidance to teachers, students and families? These will become important issues for education after the epidemic.

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ORIGINAL ARTICLE

Whether the School Self-Developed e-Learning Platform is More Conducive to Learning during the COVID-19 Pandemic?

Daxiang Dai,[1] Xuyue Xia[2]

1. Tangquan Middle School, Nanjing 210000, Jiangsu, China
2. Nantong University, Nantong 226000, Jiangsu, China

***Abstract**. The school self-developed e-learning platform can provide students with real and non-real-time learning resources based on its personalized learning properties like self-owned teaching conditions and levels. Meanwhile, it is beneficial to students' independent study and academic performance. During the COVID-19 pandemic, schools in China adopted e-learning platforms to conduct online teaching, whereas the efficacy of these online teaching platforms was not definitely known. It is necessary to review their effectiveness, especially for those developed by schools themselves. A total of 417 of 7th and 8th graders from two middle schools in Nanjing, Jiangsu Province were enrolled with 208 in the experimental group and 209 as the comparisons. The primary outcome of the study was students' academic performance. The results demonstrated that: (i) the online platform-based self-learning was conducive to students' grades; (ii) school self-developed e-learning platform was more effective in improving student achievement than other non-school self-developed ones.*

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***About the Author:** Daxiang Dai, Advanced Teacher, Tangquan Middle School, Nanjing 210000, Jiangsu, China. Email: 447604856@qq.com;*

***Correspondence to**: Xuyue Xia, Master's Candidate, School of Educational Science, Nantong University, Nantong 226000, Jiangsu, China. Email: 616636896@qq.com.*

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WITH the rapid development of communication and information technology, China has been giving more expectations to education informatization, and set up higher requirements for the construction of educational resources (Chen, 2019). In 2012, The Ministry of Education of China (2016) clearly stipulated in the "Ten-Year Development Plan for Educational Informatization (2011-2020)", i.e., Build an educational cloud resource platform, bring hundreds of companies and 10,000 teachers and students together to develop excellent resources. In the same year, China held the first National Education Informatization TV and Telephone Working Conference, which clearly defined the purpose as "Three connections and two platforms" (Three connections mean schools connected with broadband network, classes connected with high-quality resource, and people can communicate in network learning space; The two platforms refer to the connection between public service platforms for educational resources and public service platforms for educational management and future development of Chinese education informatization (Liu, 2012). In June 2016, the "The 13th Five-Year Plan for Education Informatization" issued by the Ministry of Education clarified the focus of education informatization, which was to achieve the coordinated development of public service platforms and strengthen the ability of information service in teaching and management: Innovation of the construction and application model of "Day Day Up" platform, for serving classroom learning to supporting network-based extensive learning, improving the application level of education informatization, and deepening the integrated development of information technology and education (The Ministry of Education of China, 2016). On April 13, 2018, the Education Informatization 2.0 Act issued by the Ministry of Education proposed three transformation: (i) from dedicated resources to large resources; (ii) from improving students' application ability to information technology to technological literacy improvement; (iii) from application integration development to innovation integration development. By 2022, China proposed to reach the development goals of "three comprehensiveness, two height, one largeness". The "one largeness" herein refers exactly to the establishment of a large platform of "Internet + education" (The Ministry of Education of China, 2016). Under this background, students' learning cloud platforms have been springing up in China.

Tangquan Middle School in Nanjing, Jiangsu of China has been exploring an independent learning model for students based on the Internet environment. After years of practical accumulation, a unique network teaching platform model has been formed and achieved remarkable results. During this COVID-19 pandemic, our school actively responded to the call of "School is Out, But Class is On", and all students have adopted our self-developed network platform for self-study. To further discuss the effectiveness of the school's network platform, we proposed to obtain scientific evidence through a rigorously designed experimental study to evaluate its use.

The Origin of the Experiment

The education and learning cloud platform is the development of cloud computing in the field of education (Lv et al., 2017). It is the basic structure of future education

informatization, and develops along with technology. It includes all hardware computing resources. After virtualized these resources, they can provide a good platform for educational institutions, educators and students (Zhang & Wu, 2010). The school self-developed learning platform refers to a platform developed by three parts of schools, teachers, and parents together with a full consideration of both school and student conditions, so as to provide an equal and free learning environment (Lin, 2016).

Under the normal teaching conditions, no significant change occurred in many cases, i.e., e-learning platforms were only used as assistant means of teaching and supplementary means of learning, although the government advocated helping students learn through the Internet and issued a series of related policy documents (as mentioned in the introduction) to change the learning method and enhance the learning efficacy (Ni et al., 2010). Therefore, it was difficult to see whether e-learning platforms were conducive to learning.

At the end of 2019, COVID-19 pandemic broke out. Due to its impact, teachers could not teach normally. Therefore, The Ministry of Education of China issued the document regarding "School is Out, but Class is On" in January 2020, which clearly stated that providing a variety of high-quality online teaching resources through coordinating and integrating national, local and school-related teaching resources that are available for selection (The Ministry of Education of China, 2020). In response to the call of the Ministry of Education, local government in Jiangsu had issued relevant countermeasures and built an "Internet + Education" model (Jiangsu Provincial People's Government, 2020), and in Zhejiang, the government issued "Guidelines for the comprehensive implementation of online teaching in elementary and middle schools during the postponed period of spring semester" (The Department of Education of Zhejiang Province, 2020), etc. It was proposed that all elementary and middle schools should implement online teaching by following the requirement of "School is Out, but Class is On", and encourage students to use the online learning platform during the pandemic. In order to better understand the use of the online platform, the Teaching and Research Office of Zhejiang Province organized a survey of middle and high school students that had a total of 558,982 participants. The survey showed that 96.0% of the students were involved in the online teaching activities organized by the school, and about 88.6% of them considered that they really wanted to participate in online courses and receive teacher's guidance (Teaching and Research Office of the Department of Education of Zhejiang Province, 2020). In addition, the Education Bureau of Zengcheng District of Guangzhou Province also conducted a survey on the online teaching for 155 schools. The study included 125,047 students, and 60% of them expressed experienced a good learning of the platform (Southern Metropolis Daily, 2020).

In term of the online learning, other countries have already implemented earlier than China. Caleb Phillips in Boston, USA first suggested a private correspondence course through email, although the first electronic distance education could be tracked back to 1920s that was performed through radio. The emergence of the Internet had caused a transformation of the distant education (Clark, 2020). The Clinton Administration of the USA announced in 1996 that it would broadly establish education on the

Internet, they set the goal as before 2000, every classroom and every library should be connected to the Internet (Zhang & Wang, 2008). Since then, studies started to observe the effectiveness of e-learning. Erik et al. (2008) found that as long as teachers had a better understanding of students, they could adapt online courses to the needs of students and maximize their success in online learning. Klaus (2003) believed that e-learning platform was an integrated educational technology with e-learning. Through it, learners can participate in the construction of learning and can make progress in exploration and discussion in order to achieve a multi-angle and comprehensive understanding of knowledge (Garrison & Terry, 1998).

In China, Lin (2019) pointed out that the online learning platform has the following benefits: (i) it provides a technical foundation for cooperative learning. (ii) it makes teaching more targeted on the contents. (iii) it reduces the peer pressure and improve student participation. Further, Lu (2020) believed that the combination of online learning platforms and classroom teaching had greatly stimulated students' learning initiative, effectively improved their ability to use words, and gradually realized the student-centered transformation of classroom teaching. Wan (2016) believed that the e-learning platform developed by the school itself had a positive effect on Biology class. For example, in terms of the learning situation, it had reliable and accurate data; in terms of homework, it can be more targeted, reduce unified test papers, and carry out targeted personalized guidance; in terms of increasing interest, some students were more willing to complete homework on the Internet, they felt very cool.

Therefore, the online learning platforms have become the main tool for many schools to implement the reform of autonomous learning for students. Meanwhile, the school self-developed e-learning platforms achieved teacher-oriented teaching and student-oriented learning. In comparison, the public e-learning platforms lack of personalized property that only rely on the so-called standardized resources and tools.

In previous studies, factors like teacher guidance and the help of educational institutions were not ruled out. At the same time, no practical evidence shown whether the school self-developed learning platform was more conducive to learning. So this study observed the online learning platform developed by Tangquan Middle School in Nanjing, Jiangsu Province as the primary intervention variable, and discusses the following questions: (i) Can the use of modern educational technology promote learning? (ii) Is the school self-developed online learning platform more conducive to learning over the public-developed ones?

Methods

Purpose

As mentioned earlier, the use of e-learning platforms for teaching is a widespread phenomenon in elementary and middle school in China currently and is considered as an effective means to achieve student-centered learning. However, due to the difference in learning conditions in different schools in various regions, not all schools can use the same platform, i.e., some use public platforms, but some use independently developed

by schools themselves. Under this background, the main purpose of this study was to investigate whether the e-learning platform developed by schools is conducive to student learning.

Subjects

We selected 7th and 8th graders[1] from two schools in Nanjing, Jiangsu Province as the subjects. Two hundred fifteen students from Tangquan Middle School were set as the experimental group and another 210 from another middle school were set as the control. In the experimental group, the school used its own educational cloud platform for teaching, while in the control group they used the public service platform of Jiangsu Education Resource as online teaching.

In order to better control the influence of students' preconditions and pre-test differences on the results; we first controlled variables such as the students' family background etc. After obtaining the pre-test results, we matched the data for the experimental and the control, and matched the participant sample according to the students' total scores of Chinese, mathematics, and English. After deleting the samples with missing testing, finally obtained 7th grade with the experimental group 98 samples and the control group 100 samples, 8th grade with the experimental group 110 samples and the control group 109 samples.

The two schools participating in the study were all public schools with good reputation. There are no significant differences between them in terms of teachers, students, and school hardware conditions.

Primary Outcome

The experimental test tool was a unified standardized test prepared by the Teacher Development Center of Pukou District, Nanjing. The staff who prepared the testing is rich in teaching experience, so it can guarantee the testing had good reliability and validity. The pre- and post-test of the three courses of Chinese, Mathematics and English were unified. These scores were the primary outcomes for evaluating the effectiveness of the self-developed online platform versus the public ones.

Intervention

In China, learning platforms are roughly divided into three categories. The first category is developed by the Ministry of Education or other local governments; the second category is developed by different companies; and the third category is developed by schools. Although the national and local governments and companies had put a lot of effort into the development and construction of the platforms, the first and second types are difficult to realize personalized learning for each student.

The intelligent cloud network learning platform developed by the school was the primary intervention of this study. It mainly included five parts: smart teaching, smart learning, smart growth, smart management, and smart training. These were different from the content of the online platform used in the control group. The obvious

difference was that the core content provided by the smart teaching platform by Tangquan Middle School was the teaching resources developed by the school; the most important thing was the preparation of personalized teaching plans according to factors such as students' learning status and cognitive level. The control group used the Public Service Platform of Jiangsu Educational Resources, and the teaching was conducted as live broadcasting following the exam outline, it did not have any school self-developed resources.

During the COVID-19 pandemic period, Tangquan Middle School in Nanjing established a special working task. The school leaders and all teachers were carefully planned and arranged. Before the lesson, the room-teacher published the schedule on the teaching platform, other teacher issued the resource list and learning requirements, which guided students to preview and upload the preview results in time. After the class, the teacher reviewed and graded the homework, and did Q & A with individual counseling on the platform in time (Dai & Lin, 2020).

Procedure

This experiment was planned from the end of January 2020, officially started at the beginning of February and ended at the end of April 2020. At the planning stage, the two schools first identified the participating students, and through matching and comparison, to ensure that the basic situation were the same and no significant difference between them; Second, coordinated the teaching content and progress, and trained the teachers for both groups to ensure that the use of the online learning platform met the study requirements; At last, prepared the materials and determined the specific flow of the study.

From the beginning of February to the end of April 2020, it was the experimental implementation phase, which lasted 13 weeks. During this stage, the two schools taught according to the platforms they chose. Before and after the experiment, pre- and post-tests were taken. For the experimental group, the teachers can accurately take good control of the learning situation, and put different requirements for different students according to their learning ability to carry out personalized teaching.

Results

A total of 208 samples from the experimental group and 209 from the control group were valid for analysis. Prior to the study, in order to ensure the consistency of the learning level of the students in the two groups, a unified test was taken. The analysis of the test results is shown in **Table 1**.

Before the study, all participating students from both schools used classroom to learn. For the three courses analyzed, independent sample *t* test was performed using SPSS20.0. The *t* value of the Mathematics was the smallest, 0.591 versus 0.314, and the *t* value of the Chinese was the largest, 0.806 versus 1.013. There was no significant difference in the three courses between the two grades indicating both groups were comparable.

After weeks learning, statistically significant differences were observed in all three courses for the scorings ($p < 0.05$). In this analysis, the test effect was expressed as a standardized mean difference (Cohen's d) as: 0.2-0.5 means small difference, 05-0.8 indicates medium difference, > 0.8 means big difference. From this data, Chinese and English of the 7th graders had a moderate effect size ($0.5 \leq d < 0.8$), and Mathematics showed small effect amount ($0.2 \leq d < 0.5$). For all three courses, the 8th graders showed small effect size ($0.2 \leq d < 0.5$). From the point of difference between the pre- and post-test scores of both groups, the difference of the post-test effect is much larger than that of the pre-test, indicating that the difference between the two groups is significantly increased (**Table 2**).

Discussion

Can Modern Educational Technology Promote Learning?

The integration of modern educational technology and education has always been a topic of great concern. Sivin-Kachala Jay (1994) observed the impact of modern educational technology on students' learning methods and academic performance pointed out that modern educational technology had a great influence on students' learning methods and achievements. The correct and reasonable use of educational technology in teaching can better stimulate students' interest; it can broaden their horizons, increase their knowledge, and cultivate their innovative ability. Zhao (2015) mentioned that the use of modern educational technology can improve the quality and effectiveness of information input, strengthen the authenticity of communication and feedback, and create more opportunities for researchers, a good opportunity to study the language learning process.

From these, it is easy to see that the combination of modern educational technology and education can effectively promote students' academic performance. At the same time, China has always maintained a supportive attitude towards the application of modern educational technology. In order to advocate it, the government had successively issued "The Ten-Year Development Plan for Educational Informatization (2011-2020)", "The 13th Five-Year Plan for Educational Informatization" and "The Educational Informatization 2.0 Act" and a series of policies (The Ministry of Education of China, 2012, 2016, 2018). Under the guidance of these series of documents, China had achieved the construction of education informatization 1.0, that is, the construction of "Three connections and two platforms". It was precisely because the national education informatization had achieved certain results that when the state issued the "School is Out, but Class is On" through the online e-learning platform" (The Ministry of Education of China, 2020).

Through our data, we believed that Internet education technology has been becoming a common way of changing school education, and it will change students' learning behavior and promote the innovation of education methods. This to large extent guarantee the performance of "School is Out, but Class is On" during the COVID-19 pandemic.

Table 1. Pre-Test Scores.

Grade	Course	Group	Mean	SD	*t*	*p*	*Cohen's d*
7th	Chinese	Exp. (n=89)	75.051	5.844	0.806	0.421	0.115
		Ctrl. (n=100)	74.145	9.499			
	Mathematics	Exp. (n=89)	75.286	10.404	0.591	0.555	0.084
		Ctrl. (n=100)	74.190	15.179			
	English	Exp. (n=89)	74.296	10.831	0.783	0.435	0.111
		Ctrl. (n=100)	73.095	10.761			
	Total	Exp. (n=89)	224.633	17.856	1.067	0.287	0.152
		Ctrl. (n=100)	221.430	23.890			
8th	Chinese	Exp. (n=89)	75.186	8.104	1.013	0.312	0.137
		Ctrl. (n=100)	73.862	11.032			
	Mathematics	Exp. (n=89)	78.236	18.963	0.314	0.753	0.042
		Ctrl. (n=100)	77.505	15.261			
	English	Exp. (n=89)	77.359	10.195	0.880	0.380	0.119
		Ctrl. (n=100)	75.922	13.720			
	Total	Exp. (n=89)	230.782	29.340	0.899	0.370	0.122
		Ctrl. (n=100)	227.289	28.138			

Note: Exp.: Experimental Group; Ctrl.: Control Group.

Table 2. Post-Test Scores.

Grade	Course	Group	Mean	SD	*t*	*p*	*Cohen's d*
7th	Chinese	Exp. (n=89)	71.184	8.791	4.577	0.000	0.651
		Ctrl. (n=100)	63.360	14.511			
	Mathematics	Exp. (n=89)	70.398	13.014	3.416	0.001	0.486
		Ctrl. (n=100)	63.180	16.480			
	English	Exp. (n=89)	70.898	13.823	3.543	0.000	0.504
		Ctrl. (n=100)	62.655	18.524			
	Total	Exp. (n=89)	212.480	24.517	5.493	0.000	0.781
		Ctrl. (n=100)	189.195	34.231			
8th	Chinese	Exp. (n=89)	71.991	9.243	3.499	0.001	0.473
		Ctrl. (n=100)	61.766	29.208			
	Mathematics	Exp. (n=89)	74.473	27.489	2.159	0.032	0.292
		Ctrl. (n=100)	66.583	26.575			
	English	Exp. (n=89)	73.536	13.297	2.437	0.016	0.329
		Ctrl. (n=100)	65.041	34.026			
	Total	Exp. (n=89)	220.000	30.262	3.602	0.000	0.487
		Ctrl. (n=100)	193.390	71.276			

Note: Exp.: Experimental Group; Ctrl.: Control Group.

Is the School Self-Developed Online Learning Platform More Conducive to Learning?

Most domestic researches in China tend to study the adaptability of e-learning platforms, the construction and application strategies (Chen, 2019; Zhu, 2020), and rarely study the conducive effect on students' learning. Ye (2019) proposed a hybrid teaching based on cloud platforms. It was no longer centered on teachers and teaching materials. Teachers no longer had a single evaluation of learning, so they can understand students comprehensively and provide targeted guidance to promote the positive development of their learning. Liu (2020) showed that the emergence of a new learning approach such as an online platform had enhanced the diversity and flexibility of learning and improved the traditional classroom teaching, and constructed an independent learning environment for students. Outside of China, studies on whether online learning platforms conducive to students' learning were also carried out. Wang et al. (2002) studied the impact of learning effectiveness of giving advice to learners in the online learning environment, and concluded that giving learners guidance and advice at the right time could help improve the quality of learning. Zhou et al (2020) believed that students' self-directed learning were conducive to the improvement of their academic performance. Yao et al. (2020) found that the effect of live teaching was better than the recorded teaching. Professor John Palfrey of Harvard Law School (2003) commented on the blog as one of the e-learning platforms: "Blog makes communication between teachers and students more convenient and effective, and achieves unprecedented effect in teaching and learning." Robinson (2008) studied the effectiveness of network platforms for learning at a technical level, and proposed that asynchronous communication technology could let learners have more time to learn critically and reflectively, which was more conducive to promoting the development of their higher-level thinking skills in the use, analysis, summarization and evaluation of knowledge. Therefore, it is easy to see that compared with the traditional classroom teaching mode, in which the teacher is the main body of the teaching activity and the student are in a passive state of receiving knowledge that ignores their characteristics of active cognition and the individual differences and needs (Ye, 2019), whereas e-learning platform is conducive to learning by providing students with more specific, suitable learning choices, and especially the school self-developed online learning platform is more conducive to learning than the public-developed ones.

The Value and Deficiency of the Experiment

In previous studies, the effectiveness of the online learning platform was established in normal teaching activities, and this study was conducted under the background of the COVID-19 pandemic, so it excluded the factors for teacher guidance and counseling in educational institutions, and its results have positive significance for the upcoming usage of online teaching platforms for future teaching.

However, we need to point out the limitations of this study. First, this study was that the sample size was not that big. Second, because the students study at home,

the related variable could not be completely controlled. So in future studies, further improvement in the accuracy of the study design is necessary.

Conclusion

This study showed that (i) under the environment of "School is Out, but Class is On", it is feasible for students to learn independently, and (ii) the school self-developed e-learning platform based on its personalized learning resources can significantly improve students' academic performance. Based on these, we suggest that schools and teachers should use online teaching platforms selectively. With the development of online teaching platforms, there are many online teaching platforms available on the market, so schools and teachers should choose them carefully.

In sum, the e-learning platform should be based on the school's learning situation and fully considered the differences in student learning have more significant impact on students' performance. Therefore, when schools and teachers do the online teaching, they should consider the actual situation of the school and choose the optimal one that is suitable most to students.

Note:

1. *The 7th and 8th graders are the last two years of the middle school.*

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ORIGINAL ARTICLE

Research on the Integration of STEM Education into the Rural Elementary School Science Curriculum: An Example from Rural Elementary Schools in Western China

Xiuping Qiao,[1] Xinyi Zhou[2]

1. *Jiujiang Elementary School, Shuangliu District, Chengdu 610200, Sichuan, China*
2. *Network and Information Center of Chengdu Normal University, Chengdu 610200, Sichuan, China*

Abstract*. Due to the limitation of social economic conditions, the teaching effect of science in rural elementary schools remains unsatisfactory and poorly studied. This research integrates STEM education into rural elementary school science courses to explore whether STEM courses are effective in improving students' knowledge and ability, asking: Are STEM courses better than traditional science courses in improving students' knowledge and abilities? An experimental study of STEM curriculum teaching was conducted in science education at Jiujiang elementary School in Shuangliu County, Chengdu, China. The experimental group receiving STEM classes had increased total score, basic knowledge, and ability expansion compared to the control group receiving traditional classes. This showed that the integration of STEM education into rural elementary school science courses is feasible and effective.*

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About the Author: *Xiuping Qiao, Principal of Jiujiang Elementary School, Shuangliu District, Chengdu 610200, Sichuan, China. Email: 496569839@qq.com;*

Correspondence to*: Xinyi Zhou, Professor, Network and Information Center of Chengdu Normal University, Chengdu 610200, Sichuan, China. Email: neemo@126.com.*

Introduction

STEM, short for Science, Technology, Engineering, and Mathematics, emphasizes the intersection and integration of multiple disciplines. Since the introduction of STEM education in the United States in 1986, both developed countries, such as those in Europe and the United States, and developing countries have increasingly paid attention to STEM education. In China, a national strategy exists to vigorously develop STEM education through national policy intervention (Yu & Hu, 2015). Because STEM education has made outstanding contributions to socioeconomic and technological development in terms of key capabilities and innovative thinking, STEM education research has also become a hot topic that is experiencing rapid development (Li et al., 2019). The research includes four categories: STEM conceptualization, educational equity, student academic achievement, and teaching practice. The focus of research is gradually shifting from value-oriented to curriculum practice (Du, 2018).

With the rapid development of STEM education on a global scale, China "has also entered the vigorous development stage of STEM education, and has made significant progress in educational practice, theoretical research and educational policy" (Chinese Academy of Educational Sciences, 2017). In practical research of STEM courses, higher education is the main research object and followed by elementary and middle school education There are also comparative studies on China-American STEM education. However, less research has been done on STEM education courses in areas with rural economic conditions in China. Rural areas in China account for 94.7% of the country's land area, but this vast land area is economically behind and weaker in basic education than urban areas (Zhang, 2015). In recent years, China has implemented education poverty alleviation policies and education investment in rural areas has been strengthened (Yu, 2006). However, due to various factors, such as economics, humanities, family and geography, the teaching of science courses in rural elementary schools is limited, and improvement of students' knowledge and ability in science remains subpar. This paper studies the teaching practice of STEM in the science curriculum of rural elementary schools in China to address the current lack of research on STEM education in rural areas with poor economic conditions and designs a reference STEM curriculum for rural elementary school students in China.

Methods

Practical Exploration and Research of STEM Courses

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***Conflict of Interests**: None.*

Jiujiang Elementary School in Shuangliu District, Chengdu is a typical Chinese rural elementary school. In recent years, with the continued advancement of balanced development in education, the educational ecology of this school has greatly improved. However, a questionnaire combined with interviews and observations investigating the current status of the school's science curriculum revealed the following. (i) Due to excessively traditional teaching methods, students' learning initiative and creativity are low. (ii) Students' knowledge is narrow, and their hands-on ability is weak. (iii) Due to inadequate family instruction about the concepts of natural phenomenon, students are easily affected and confused to them. (iv) Although students have a strong interest in science classes, their scientific literacy is low. Here, we focus on the characteristics of elementary school students in rural China, and explore whether, in the science curriculum, STEM teaching has more advantages in training students' knowledge and ability than traditional teaching.

This experimental study addresses the following two questions regarding the integration of STEM education into the elementary science curriculum:

(i) Are STEM courses effective in improving students' knowledge and ability?
(ii) Are STEM courses better than traditional class teaching at improving students' knowledge and ability?

Experimental Design

The research involved five steps, as outlined below.

(i) From fifth grade students of Jiujiang elementary school in Shuangliu District, 200 students of comparable learning level were divided into a control and experimental groups of 100 each.
(ii) Teaching on "buoyant force" for eight class hours was designed for both traditional and STEM courses.
(iii) Students in the control group experienced the traditional science teaching method, while students in the experimental group experienced the STEM teaching method.
(iv) Questionnaire surveys were given to all students before and after the course study. These tested the students' knowledge and ability. Statistics and analysis on survey responses were done and conclusions drawn.
(v) Through discussion and analysis of survey responses, the content of the courses was modified to improve the teaching design based on the trial teaching, and the final teaching courses formed.

Teaching Design of STEM Unit Courses on "Buoyant force"

In this study, the "Buoyant force" unit in the fifth-grade science class was selected as the theme for STEM curriculum design. This course has a total of 8 class hours (**Table 1**).

Compilation of Questionnaire

Table 1. STEM Course Content.

CH	Theme	Content & Process	Sci.	Tech.	Engi.	Math.
1st	Preliminary understanding of buoyancy	1. Teamwork: Put the foam block in the water, discuss why the foam will float on the water, and complete the guided learning sheet; 2. Introduce buoyancy and visually understand the concept of buoyancy through video; 3. Student cooperation: divide the foam block to guide students to explore the influence of the same object on the heave and weight (and complete the record form); 4. The group conducts communication summary and report (the impact of object volume, etc. on sinking and floating).	The floating objects made of the same material in the water are independent of their weight and volume.	Cut objects as required		Use the concept of fractions when cutting
2nd	What factors are involved in floating?	1. Teachers lead students to think by guiding students to observe the floating experiment of putting different shapes of play dough into the water; 2. Brainstorming: The teacher allows students to boldly guess the factors affecting the floating, and sort the object's according to their own guesses; 3. In-depth exploration: Predict the floating of different materials in the water and conduct experimental verification in groups to complete the guided learning sheet; 4. The group conducts exchanges and summarizes and reports (factors affecting floating).	Explore the factors that affect floating			Number and sort as required
3rd	The floating of play dough in the water	1. Teachers guide students to observe and think by demonstrating the floating of a piece of play dough in water; 2. Student's operation: shape the play dough freely, predict and verify the their floating; 3. Brainstorming: Based on the results of the experiment, students guess the reasons that affect floating; 4. The teacher introduces the concept of "drained water", through experiments to verify the hypothesis and complete the guided learning sheet.	The volume of water drained by an object in the water is called the amount of water discharged	Pinch the play dough into different shapes	Different shapes will affect the floating of play dough	Read the amount of water drained from the measuring cup
4th	Build a small boat	1. The teacher introduces the history of the development of the ship through a short film, and let students guess why the ship can float on the water; 2. Students make hands-on production: Everyone uses the same amount of play dough to make boats in different shapes, and observe the their floating in the water;	Why can a boat float on the water?	Make different shapes of boating by play dough	How to make a floating boat? How to make the boat carry more weight?	Measure and record the maximum weight that carried objects

		3. The group's exploration and research: Thinking about how to make improvements to make the boat carry more weight; 4. Students improve the boat and conduct a boat show.				
5th	Buoyant force	1. Experiment introduction: Let students experience the concept of buoyancy by themselves; 2. Discussion by the group: Whether the volume of the object in the water affects the buoyancy, make an exploration research table; 3. Cooperative learning: learn to use dynamometer to measure buoyancy force correctly and verify the record form; 4. Summarize the factors that affect the buoyant force.	Understand the concept of buoyant force	Use spring dynamometer to test buoyant force	The Principle of testing buoyant force by spring dynamometer	Reading of spring dynamometer
6th	Will sink objects be affected by the buoyant force of water?	1. Teachers guide students on the method of learning experiment verification; 2. Teamwork: Complete the experiment and fill in the record form; 3. In-depth exploration and research: The amount of buoyant force experienced by different stones; 4. Analyze and summarize the stress on the stones and foam by drawing: whether the sinking object is affected by buoyant force.	Learn how to verify the experiment		Control the volume of objects immersed in the water	Calculate the magnitude of buoyant force by reading the value of the dynamometer
7th	The floating of potatoes in the liquid	1. Teachers demonstrate the floating of potatoes in different liquids through experiments, and introduce the effects of different liquids on the floating of objects; 2. Guess and verify "what is the liquid in the experiment"; 3. Teamwork: Set up a control group to verify the effect of different liquids on the floating of objects; 4. Analyze the rules and draw conclusions.	Different effects of different liquids on the buoyant force of objects	Evaporate the liquid with an alcohol lamp and observe		Measure the amount of water and dissolve it with different amounts of table salt
8th	Explore the causes of sinking and floating of potato	1. Under the guidance of teachers, students make guesses about the reasons that affect the floating of potatoes, design and make exploration and research records; 2. Teamwork: Verify the reason, complete exploration and research record form; 3. Analyze the rules and draw conclusions.	The same object will experience different buoyant force in different liquids	Use the balance correctly to weigh the weight	The principle of balance to scale weight	Reading the value of the weight of the balance scale

Note: CH: Class hour; Sci: Science; Tech: Technology; Engi: Engineer, Math: Mathematics.

The questionnaire used in this experiment includes two parts: basic knowledge (questions 1-10) and ability expansion (questions 11-14). Questions 1-10 are 4 points each, questions 11-12 are 10 points each, and questions 13-14 are 20 points each for a total of 100 points. An example basic knowledge question is: (multiple choices) When the object buoyant force (_) gravity in the water, it sinks. A) Less than; B) Greater than; C) Equal. An example capacity expansion question is: What would our life be like if we lost the buoyant force of water? Try to write a reasonable scenario, the more reasonable the better. Scenario One: __; Scenario Two: __; Scenario Three: __; Scenario Four: __. The content of the questionnaire was discussed with teachers several times, and the questionnaire gradually refined.

Cronbach's α coefficient was used to test the reliability of the questionnaire. The basic knowledge and ability expansion of the entire questionnaire had a Cronbach's $\alpha > 0.8$, indicating that the questionnaire has high reliability. After analysis by teachers in science, the questions designed by this questionnaire were found to meet the purpose and requirements of the measurement. The basic knowledge questions and ability expansion of the questionnaire are significantly correlated with the content of each question, indicating that the questionnaire is highly effective.

Participants and Steps

In Jiujiang Elementary School, Shuangliu District, Chengdu, 200 fifth-grade students were selected, including 108 boys (the control: 57, the experimental: 51) and 92 girls (the control: 43, the experimental: 49). To reduce non-experimental variance in the experiment, the knowledge background and learning ability of the teachers and students participating were made roughly the same for the control and experimental groups.

(i) Before the experiment, students in the control and experimental groups completed a questionnaire survey to collect pre-treatment data.
(ii) The students in the experimental group studied STEM courses, while students in the control group studied traditional courses.
(iii) After the experiment, students in the control group and the experimental groups again completed the questionnaire survey to collect post-treatment data.

Statistical Analysis

All data processing and analysis were done using SPSS v20.0. Assuming that both pre- and post-experiment questionnaire data of the control group meets the normal distribution, we continued to use the independent sample t-test to compare the control group before and after learning, including testing on the student's total score, basic knowledge, and ability expansion.

Results

Pre-experiment Data Analysis

Before the experiment, there are no significant differences in knowledge (effect = -0.037), ability expansion (effect size = -0.065) or total score (effect size = 0.063, P > 0.05) between the experimental group and the control group (**Table 2**).

Comparison between Pre- and Post-experiment Data of the Control Group

Students in the control group differed significantly in the total score, basic knowledge and ability expansion before and after learning ($P < 0.01$; **Table 3**). The average score of the control group after learning was better than before learning. The effect size was moderate in both pre- and post-experiment tests. This shows that traditional courses can improve students' knowledge level and ability.

Comparison between Pre- and Post-experiment Data of the Experimental Group

Students in the experimental group differed significantly in total score, basic knowledge and ability expansion before and after learning ($P < 0.01$; **Table 4**). The average score of the experimental group after learning was greater than before learning and the effect size was large in both pre- and post-experiment. This shows that STEM courses can improve students' knowledge level and ability.

Post-experiment Data Analysis

An independent sample t-test compared the experimental and control groups after learning, including testing on the student's total score, basic knowledge, and ability expansion (**Table 5).**

After separate learning, students in the two groups differed significantly in total score, basic knowledge and ability expansion ($P < 0.01$; **Table 5**). Overall performance ability expansion had a moderate effect size, and the basic knowledge effect size was large. Thus, the STEM teaching course has advantages over the traditional course when integrated into the science curriculum.

Discussion

The experimental data reveals that the teaching practice of STEM used in this study was effective in improving the science curriculum knowledge and ability of elementary school students in rural China and had advantages over the traditional science curriculum. The core features of STEM are that it is interdisciplinary, interesting, experiential, situational, collaborative, artistic, empirical, and technologically enhanced. The STEM education curriculum is designed to engage students in learning based on activities, projects, and problem solving that provide a hands-on classroom experience (Wang, 2016). In response to the characteristics of rural elementary school students in China, the teaching design of the STEM science curriculum is as follows. (i) Multidisciplinary

Table 2: Independent Sample *t* Test of the Pre-Experiment Data.

	Control Group	Experimental Group	*t*	*P*	*Cohen's d*
Overall Score	46.67±22.01	48.03±20.91	-0.448	0.449	-0.063
Basic Knowledge	17.79±7.52	18.06±7.03	-0.262	0.220	-0.037
Ability Development	28.90±17.36	29.96±15.42	-0.457	0.087	-0.065

Note: Data are presented as mean ± SD, $p < 0.05$ means statistically significant.

Table 3: Level Analysis of the Control Group Before and After Learning.

	Pre-experiment	Post-experiment	*t*	*P*	*Cohen's d*
Overall Score	46.67±22.01	61.26±28.09	-4.088	.000**	-0.578
Basic Knowledge	17.79±7.52	23.14±8.27	-4.787	.000**	-0.037
Ability Development	28.90±17.36	38.12±21.98	-3.292	.000**	-0.466

Note: Data are presented as mean ± SD, **p <0.01

Table 4: Level Analysis of the Experimental Group Before and After Learning.

	Pre-experiment	Post-experiment	*t*	*P*	*Cohen's d*
Overall Score	48.03±20.91	71.19±19.14	-8.170	.000**	-1.155
Basic Knowledge	18.06±7.03	29.96±5.83	-12.438	.000**	-1.759
Ability Development	29.96±15.42	45.75±14.58	-7.441	.000**	-1.052

Note: Data are presented as mean ± SD, **p <0.01

Table 5. Independent Sample *t* Test of the Post-Experiment Data.

	Control Group	Experimental Group	*t*	*P*	*Cohen's d*
Overall Score	61.26±28.09	71.19±19.14	-2.921	.000**	-0.413
Basic Knowledge	23.14±8.49	29.96±5.83	-6.622	.000**	-0.937
Ability Development	38.12±21.98	45.75±14.58	-2.893	.000**	-0.409

Note: Data are presented as mean ± SD, **p < 0.01.

knowledge should be integrated into real situations that are interesting and closely related to life. Students use brains, hands, and cooperation to improve class participation, develop innovative thinking, and improve problem-solving skills (Sun, 2018). (ii) By providing rich perceptual knowledge, students are stimulated to create "confusion," find new explanations, form new concepts, and this promotes students to change from original concepts to scientific concepts (Lin, 2014). (iii) Through the experience of STEM science courses, students' internal motivation is stimulated, scientific knowledge is accurately understood, advanced thinking is developed, and their ability to solve problems is improved (Chen, 2019).

STEM education has become a hot topic of common concern in current international education research and reform, providing innovative ideas for the new round of basic education science curriculum reform in China. The elementary school stage is a critical period for children's knowledge and ability expansion. At this stage, students have not yet fully formed their own ways of thinking and problem-solving, and thus this is the best period to cultivate innovative ability (Long & Zhao, 2015). An increasing number of empirical studies suggest that children's scientific interests are formed before the age of 14 years (Tai et al., 2006). Rural areas in China can combine their own characteristics with the existing practices of related cities in China and advanced foreign experience (Zhu & Lei, 2018) to actively promote the exploration of STEM education, carry out STEM education actions, and improve the ecology of STEM education construction. This requires gathering all social forces, including schools, libraries, science centers and museums, extracurricular tutoring institutions, enterprises, higher education institutions, communities, and families, etc. (Chen et al., 2019).

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ARTICLE

Is the Standardization of Compulsory Education School Helpful to Improve Students' Performance? An Empirical Analysis Based on Monitoring Data in Province A

Yanli Liu,[1] Jijun Yao,[1] Shike Zhou[2]

1. Nanjing Normal University, Nanjing 210024, China
2. Jiangsu Teaching and Research Office of Primary and Secondary Schools, Nanjing 210024, China

Abstract*. The standardization of compulsory education schools is an essential measure to promote education balance and improve education quality. However, when the implementation effect of this policy was evaluated, the improvement of input factors such as facilities and equipments, teaching faculty and funding were only focused on, but with less attention was paid to the impact of the standardization on students' academic performance. This kind of imbalance makes it difficult to fully grasp the real effects of standardization and its potential problems, which may lead to deviations in the direction of standardization construction. Therefore, this study used the monitoring data in province A that includes the standardized construction of compulsory education schools and academic quality of students to analyze the correlation between standardization construction and student performance through Ordinary Least Square (OLS). Further, a Regression Discontinuity Design (RDD) was used to analyze whether standardization construction is the cause of differences in student performance. The results showed that there was no significant correlation between standardization construction and elementary school students' performance, and negative correlation with middle school students' performance; no substential causal relationship exists between standardization construction and student performance. This is majorly due to the emphasis on the conditions of school-running was set too much, and then the student performance was neglected. Therefore, future evaluation should be gradually changed while deepening the standardization construction with more attention paid to the connotative development and efforts made to the improvement of the education quality.*

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***About the Author:** Yanli Liu, School of Education Science, Nanjing Normal University, Nanjing, China, E-mail: 1609604712@qq.com.*

Shike Zhou, School of Education Science, Nanjing Normal University, Nanjing, China, E-mail: jyszsk@163.com;

***Correspondence to**: Jijun Yao, School of Education Science, Nanjing Normal University, Nanjing, China, E-mail: yaojijun_njnu@163.com.*

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Introduction

IN 2010, China issued the "Outline of the National Middle- and Long-term Education Reform and Development Plan (2010-2020)", which proposed that "advancing the standardization of compulsory education schools and balancing the allocation of resources such as teachers, equipment, books, school buildings, etc." "Establish the national basic quality standards and monitoring system for compulsory education" (July 29, 2010) strive to continuously improve the standardization of compulsory education, promote education equity, improve education quality, and promote balanced development of compulsory education. In this context, local governments have successively issued relevant policy documents to vigorously promote the standardization of compulsory education schools. Take province A as an example, in 2015, the government of the province A released the "Standards for Provincial A Compulsory Education Schools (Trial)" (Provincial Government of A, 2015). Subsequently, the Education Department of Province A (2016) also developed the "Monitoring Indicators for the Standardization of Provincial A Schools for Compulsory Education (Trial)", through which the schools do self-assessment and self-test first, and then county-level and city-level review, and finally provincial review that formed the monitoring data of school standardization construction of province A.

The formulation and implementation of these measures have being greatly promoted the standardization construction of compulsory education schools ("standardization construction" for short). "The Compulsory Education School Standardization Construction Monitoring Report of Province A in 2017" showed that the standardization construction compliance rate has gotten significant improvment and the effect was remarkable. Up to 2017, "71.26% of schools in province A have basically reached the provincial standard", and the rate of compliance has increased by 15.3% compared with 2016; The average compliance rate of compulsory education schools in 13 districts and cities is 73.34% on average, 16% higher than that in 2016; in addition, the achievement of indicators had also been at a high level. In 2017, "the first-level indicators reached over 60%, three first-level indicators were close to 100%", "60% of the second-level indicators reached 80%", and "46 third-level monitoring points was above 80%" (Education Evaluation Institute of Province A, 2018). From the data above, we can see that the standardization construction of Province A has reached a high level.

Based on the experience of countries around the world, the construction of education standardization is an essential step to promote a balanced development of education and improve education quality. These achievements made by Province A in standardization construction were undoubtedly of great significance. However, in terms of specific indicators and construction content, most provinces, including A, currently focus on condition improvement in the process of standardization. Although this can improve school security, promote education equity, and provide a better learning environment, but as far as the ultimate goal of education policy implementation is concerned, it is obvious that it should be the development of students, rather than "input factors". When taking only the input such as facilities, equipment, teachers, and funds

as the first evaluation criteria, it will make us depend too much on the conditions for running schools, but not on students' development. However, it is hard to obtain the answer directly from the results of such evaluations.

Since 1980, the United States has promoted a gigantic "education standardization movement". During that process, the transformation of educational evaluation criteria had become the major reform point. Starting with Rose V. Council for A Better Education in Kentucky in 1989, a series of education lawsuits were passed and the standards for American education investment and accountability had gradually realized a change from "fair" to "adequate". The so-called "adequate education" was definitely different from the "fair" one, of which did not simply stop at judging whether the educational opportunities and resources were being equally allocated (This is exactly the starting and end points of most Chinese domestic education policy evaluations), but from the perspective of the extent to which the education provided by the education system for the educated has realized the development of the educated to assess the effectiveness of various educational measures. This is a typical result-oriented educational evaluation and resource allocation. However, the "adequate education" largely refers to students' academic performance that judges whether an education policy is effective, through looking at the improvement of students' performance (Yao, 2018; Li & Tao, 2015)

The reason for result-oriented education policy evaluation as an essential one is majorly due to "it is not enough to only focus on the fairness of resource allocation, it is necessary to combine the fair resource allocation to the quality of education, so as to achieve a balanced high-quality development" (Li & Zeng, 2002). Regarding China's education practice, studies on the result-oriented evaluation is yet adequate. Taking compulsory education school standardization construction as an example, the existing studies mainly focus on the discussion of standards, necessity and feasibility, construction principles, strategies, methodologies, and issues. But it remains unclear whether standardization promotes student performance. Today, China has basically realized "letting each child learn", but the urgent problem is how to realize "making each child learn better". So, the lack of evaluation research and practical exploration of output dimension is obviously not conducive to the completion of this core task.

Ideally, for output-oriented education policy evaluation, a comprehensive assessment of the impact of a policy on student performance, abilities, and attitudes should be made. However, most of these indicators are difficult to measure, so most of the output-oriented education policy evaluations use student performance as a proxy for output. In view of this, we, in the following content, will try to analyze the policy effects of standardization construction based on student performance. Through this type of analysis, we tried to answer whether standardization construction has improved the learning output situation represented by academic performance? Furthermore, we analyzed the differences in standardization construction and whether they met the standards, and explore whether it was the cause of academic differences between schools. Therefore, we first used the Ordinary Least Square (OLS) to study the correlation between the degrees of standardization construction, whether or not the standardization construction

meets the standards and the academic performance. Secondly, Regression Discontinuity Design (RDD) was used to infer causality between both these variables. Finally, the research conclusions were analyzed, discussed and related suggestions were put forward.

Research Design

Research Framework

Based on the available data, we took students in grades 3 and 8 in the compulsory education stage of province A as the research objects, used the academic performance of the students as the dependent variable, and standardize construction work as the independent variable. So we examined the impact of standardization construction on student development from the output side.

Based on this, we first studied the correlation between standardization construction and student performance. Specially, we used the standardized construction evaluation data of province A to describe the implementation effect of the policy by using the two variables: one is the standardized construction scores of each school (continuous variables) and whether the standardized construction had reached the standard (categorical variables). On this basis, OLS was used to analyze the relationship between the degree of standardization construction, the achievement of the standard, and student performance.

We need to point out that general regression analysis can help us figure out the relationship between independent and dependent variables, but it is difficult to do the causal inference. As mentioned earlier, we wanted to understand not only the relationship between standardization construction and student performance, but also whether this policy was responsible for differences in performance between schools. To this end, we used RDD to analyze whether there was a causal relationship between standardization construction and student performance.

RDD was first proposed by Thistlethwaite and Campbell (1960) in 1960 and it is a method for estimating processing effects in non-experimental environments. Using this method, they analyzed the impact of scholarships on students' future academic success. Students' scholarships depend on observable test scores. However, between the students who just met the award criteria and the students who almost reached the award criteria, in addition to whether they received scholarships (differentiated by the score standard), other characteristics are in line with the principle of randomness, so they are comparable. If the student's test score was greater than or equal to the cutoff value, then a scholarship was awarded to enter the experimental group; otherwise, the student was assigned into the control group. If there was a difference in the academic performance of the two groups, we could conclude that this difference is caused by the scholarship policy. Initially, this evaluation strategy did not receive much attention. However, since this method has advantages that other methods do not have in terms of causal inference, after the 1990s, more and more studies began to use this method to estimate policy effects in various backgrounds, making it gradually become an important method of causal inference in social science research (Lee & Lemieux, 2010). In the field of education,

some representative research results have also appeared. For example, Lee (2018) took Tennessee as an example and used Fuzzy Regression Discontinuity to study whether a grade-based bursary policy would affect students' bachelor's degree within six years. Li and Konstantopoulos (2016) used 2011 TIMSS data from 14 European countries, and used Instrumental Variable method and Regression Discontinuity Design to study the impact of class size on the mathematics performance of fourth grade students. Wei (2012) studied whether the "No One Child Left behind Act" improved the performance of students with disabilities based on RDD. But so far, the research on the use of RDD by Chinese scholars is relatively rare (Chen et al., 2014; Chu & Meng, 2017; Liu et al., 2016; Wang & Sun, 2015). In particular, within our scope, no researcher has used this method to carry out causal relationships between the standardization of compulsory education schools and student performance.

According to the "Monitoring Report on the Standardization Construction of Compulsory Education Schools in Province A in 2017", the schools with more than 80% of the monitoring points that have reached the standard are defined as "basically meeting the standardization construction standards" ("achieve the standard" for short) and the schools with less than 80% are defined as "not meeting the standardization construction standard"("below the standard" for short). This formed a quasi-experimental data structure at the policy level and provided the conditions for causal inference using RDD. We set the schools with "achieve the standard" as the treatment group, other schools as the control, and set the policy rate of reaching standard 80% as the threshold. In this way, we can observe whether there is a "cutoff" in the performance of schools near this critical value, so as to determine whether the standardized construction of the compulsory school as an exogenous shock variable has become the cause of the difference in student performance.

Model Set-up and Variable Description

Based on the above idea, we first used the OLS to explore the relationship between the degrees of standardization construction, whether or not the standardization construction meets the standards and student performance. The specific model is set as follows:

$$\mathrm{xxmean_i} = \lambda_0 + \lambda_1 \mathrm{xzhachrate_i} + \lambda_i \mathrm{W_i} + \mu_i \qquad (1)$$

$$\mathrm{xxmean_i} = \gamma_0 + \gamma_1 \mathrm{T_i} + \gamma_i \mathrm{W_i} + \mathrm{u_i} \qquad (2)$$

Among them, $xxmean_i$ represents the average score of the test results of students in i school; $xzhachrate_i$ represents the degree of standardized construction of i school; T_i is a categorical variable, which indicates whether the standardized construction of i school has reached the standard, $T_i = 1$ represents reached the standard, $T_i = 0$ represents not reached; W_i is the control variable, it includes socio-economic variables such as the area to which the i school belongs, the per capita GDP of the city where the school located, the education demands of the city where the school located, and urban-rural categories; μ_i is the residual.

On this basis, we set the basic standards (that is, the rate exceeds or equal to 80%) defined in the standardization construction assessment of Province A as cutoff, and use Sharp Regression Discontinuity to infer causality. The specific study design is: according to whether each school's degree of standardization construction exceeds 80%, the following formula can be obtained:

$$T_i = \begin{cases} 1 \text{ if } xzhachrate_i \geq 80\% \\ 0 \text{ if } xzhachrate_i < 80\% \end{cases} \quad (3)$$

Where T_i is treatment variable, *xzhachrate*$_i$ is assignment variable. If the degree of standardization construction $xzhachrate_i \geq 80\%$ of i school, then T_i is equal to 1; otherwise, T_i is 0. Whether the school enters the treatment group or the control group depends entirely on whether the degree of standardization construction *xzhachrate*$_i$ exceeds 80%. According to this, the school are randomly grouped in the smallest neighborhood [80% - ε, 80% + ε] near the cutoff to obtain quasi-experimental design , So, the local average treatment effect (LATE) near *xzhachrate* = 80% can be estimated:

$$\begin{aligned} LATE &= E(y_{1i} - y_{0i} | xzhachrate = 80\%) \\ &= E(y_{1i} | xzhachrate = 80\%) - E(y_{0i} | xzhachrate = 80\%) \\ &= \lim_{xzhachrate \downarrow 80\%} E(y_{1i} | xzhachrate) \\ &\quad - \lim_{xzhachrate \uparrow 80\%} E(y_{0i} | xzhachrate) \end{aligned} \quad (4)$$

Set the Regression Discontinuity model as follows:

$$xxmean_i = \alpha + \beta_1 (xzhachrate_i - x_0) + \beta_2 T_i + \beta_3 T_i \cdot (xzhachrate_i - x_0) + \beta_i Z_i + \varepsilon_i$$
$$(-h \leq xzhachrate_{i-} x_0 \leq h) \quad (5)$$

Among them: *xxmean*$_i$ represents the average score of the test results of students in i school; *xzhachrate*$_i$ indicates the degree of standardized construction of i school; x_0 indicates the cutoff value, which is 80%; *xzhachrate*$_i$-x_0 is central treatment for the degree of standardization construction; T_i indicates whether the standardized construction of i school has reached the standard with 80% as the cutoff, 1 means that achieve standard, and 0 means that not up to standard; Z_i is the control variable, which includes the area where i school belongs, the per capita GDP of the city in which the school is located, education needs, and urban-rural categories; The interaction term $\beta_3 T_i$ *(xzhachratei-*x_0*)* is to allow regressions on both sides of the cutoff to have different slopes.

Data Source and Variable Description

The data used in this study mainly came from the monitoring data of standardization construction of compulsory education schools in Province A, the test data of academic

quality of compulsory education students, and the statistical yearbooks of various cities in Province A.

Among them, the monitoring indicators of standardization construction of province A in 2017 were composed of 8 first level indicators (school setting, campus construction, educational equipment, teacher team, education and teaching, school management, quality evaluation, and funding guarantee), 40 second level indicators and 69 monitoring points. The elementary schools (including teaching center), middle schools and nine-year schools with compulsory education in 13 cities and 116 counties (cities and districts) in Province A were estimated.

The academic quality monitoring of compulsory education students in Province A was an independent test of the academic quality of fourth and ninth grade students in Province A. The test content was the academic level of Chinese and mathematics of the third grade students, and the academic level of Chinese, mathematics, English and science of the eighth grade students. In 2016, the Province A adopted a two-stage stratified sampling method and sampled 1,771 elementary schools. Among them, the number of students sampled was 141,516 in Chinese, and 141,460 in math. In middle school, Chinese and Mathematics had 992 schools were sampled, and 82,358 and 82,319 students were chosen respectively; English and Science had 883 schools were sampled, 78,246 and 78,685 students were chosen, respectively.

The statistical yearbook data of 13 cities in Province A were from the websites of statistical bureau of each city. It was for obtaining the annual data of economic development and education demand of each district and city.

On this basis, we conducted data processing according to the research design. Given the research focus was on the relationship between standardized construction and students' academic performance, so we matched the school standardized construction data and student academic performance data. In the end, the data of 1,619 elementary schools and 880 middle schools were used.

Among them, the academic performance of elementary school was measured by the average of Chinese and math performance of each school; the academic performance of middle school was measured by the average of Chinese, math, English and science performance of each school. The calculation of the degree of the school's standardized construction was divided by the number of compliance monitoring points divided by the actual number of monitoring points. To make the estimation more accurate, control variables were added. Under the decentralized and county-based education management system in China, the development of local education was related to the local socio-economic level, so the per capita GDP index of the city where the school was located represented the level of local economic development. In addition, the demand for education was also one of the factors affecting the standardization of schools. Therefore, we divided the number of students in school in each prefecture-level city in the *Statistical Yearbook of Province A* by the number of permanent residents (calculated separately for elementary and middle schools) to represent the educational needs of the city where the school is located. In addition, urban-rural disparities and regional differences (central, southern, and northern province A) might also affect student perfor-

mance, so the urban-rural categories and regions to which schools belong were used as control variables in the model.

The specific variable settings are shown in **Table 1**. There was a large difference in the test results of elementary and middle schools in different schools. The minimum test score for elementary school was only 342 points, and the highest score is 663 points. The degree of the standardization construction of elementary schools was between 58.1%-100.0%, and the average rate was 82.4%. The level of middle school standardization was between 58.1%-98.4%, and the average rate was 84.8%. In addition, there were large differences in the level of economic development and education demand of different regions.

Results

Correlation analysis based on OLS

First, the relationship between school standardization and student performance was analyzed by OLS. Through the White test, we found that there was a problem of heteroscedasticity in the regression equation. Therefore, weighted least squares regression (WLS) was used for heteroscedasticity correction.

Models (1) and (2) showed that after controlling the school's area and urban-rural category, the education demand of the city, and the per capita GDP of the region where the school is located, the degree of standardization of elementary school construction and whether it meets the standard or not was negatively related to the average student's performance, but not show statistical significance. The regression results of model (1) showed that under the control of related variables, for every 1% increase in the level of standardization, the grade of elementary school students decreased by 0.113 points, but it was not statistically significant. The regression results of model (2) showed that the difference between achieve the standard or not of standardization construction in elementary schools and the achievement of students was 1.802 points, but it was not significant.

Models (3) and (4) showed that the degree of standardization construction in the middle school and whether the standardization construction meets the standards or not was significantly negatively related to student performance. Model (3) found that the degree of standardization construction increased by 1%, and the score of middle school students reduced by 1.225 points. Model (4) showed that compared with below the standard schools, the average score of students in middle schools that reached the standard was 15.779 points lower.

In terms of controlling variables, the economic level of the city where the elementary school is located had a significant positive impact on student performance, and there was a positive but not significant impact on the educational demands and student performance in the middle school stage. The coefficient of the region to which the school belongs indicated that the performance of the Central province A was higher than those of the Northern Province A. Students in urban areas were significantly better than rural students.

Table 1. Variable Descriptive Statistics.

Variable	Variable Meaning		Mean	SD	Min	Max
xxmean	Test score	Elementary School	503.524	57.054	341.750	663.014
		Middle School	495.080	47.461	301.453	649.278
T_i	Reach the standard or not of standardization construction	Elementary School	0.676	0.468	0	1
		Middle School	0.773	0.419	0	1
xzhachrate	The degree of standardization construction (%)	Elementary School	82.442	6.898	58.060	100
		Middle School	84.800	6.922	58.060	98.390
cityGDP	Per capita GDP by city (10,000 CNY)	Based on Elementary School sample	9.932	3.227	4.831	14.556
		Based on Middle School sample	9.867	3.238	4.831	14.556
qy1	Central Province A	Elementary School	0.200	0.400	0	1
		Middle School	0.206	0.404		
qy2	Southern Province A	Elementary School	0.460	0.499	0	1
		Middle School	0.444	0.497		
cx1	City	Elementary School	0.525	0.500	0	1
		Middle School	0.557	0.497		
cx2	County town	Elementary School	0.343	0.475	0	1
		Middle School	0.362	0.481		
edudemand	Education demand of 13 cities in province A (%)	Elementary School	6.216	2.021	4.480	10.390
		Middle School	2.383	0.460	1.800	3.460

Causal Inference Based on RDD

Based on the previous design, we used the standard of 80% as cutoff to analyze whether there is a causal relationship between standardization construction and student academic performance.

Figures 1 and **2** are the RDD data of the degrees of standardization construction and students' academic performance after centralized processing. The academic performance of elementary and middle school students had a slight fluctuation at 80% of the standardization construction indicating that no significant causal relationship exists between the construction of standardization and the differences in student performance at various schools.

In order to accurately estimate the causal relationship between them, we performed further analysis. For RDD, the choice of bandwidth is critical. We chose the optimal bandwidth based on minimizing the Mean Square Error of the two regression functions at the cutoff proposed by Imbens & Kalyanaraman (2012). We used a rectangular kernel and half and twice the optimal bandwidth for causality tests.

Table 3 shows that under different bandwidth settings, there is no significant causal relationship between the standardized construction of elementary and middle schools and student performance. In order to ensure the robustness of the discontinuity regression results, we also tested the continuity of the conditional density of the group-

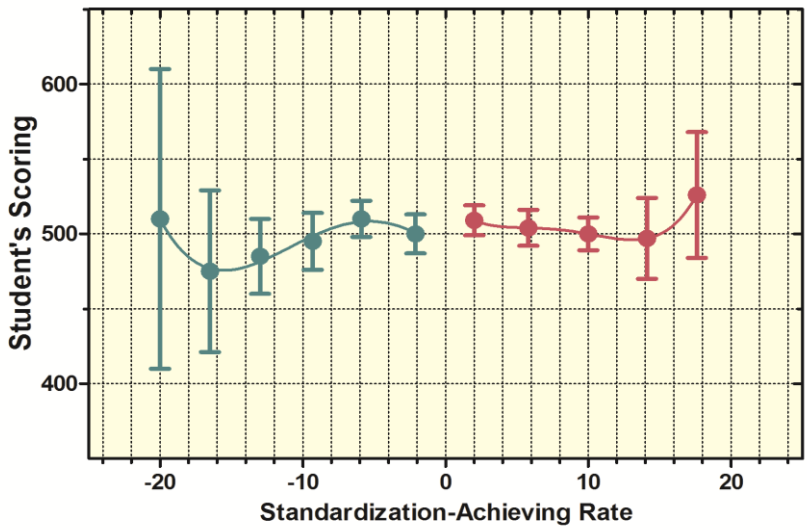

Figure 1. Regression Discontinuity (Elementary School).

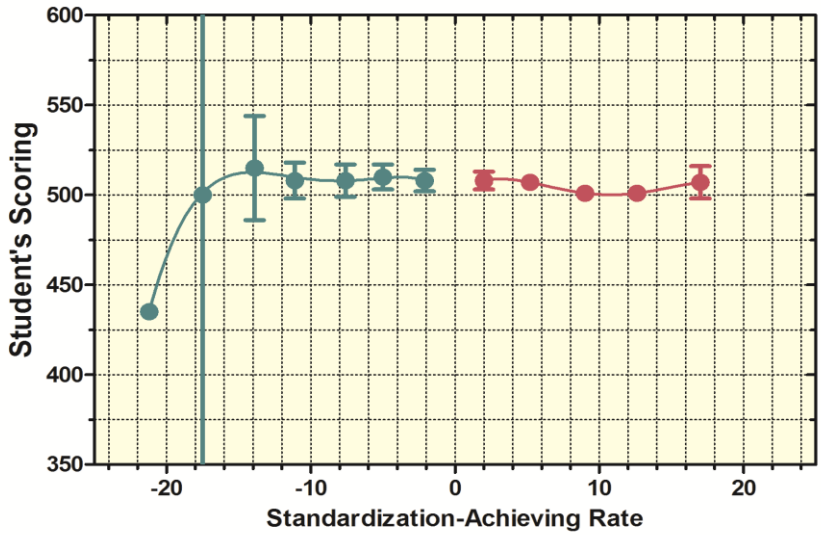

Figure 2. Regression Discontinuity (Middle School).

Table 2. OLS Regression Results of Compulsory Education School Students' Performance and the Degree of Standardization.

		Elementary School		Middle School	
		(1)	(2)	(3)	(4)
The degree of standardization construction (%)		-0.113		-1.225***	
		(-0.636)		(-5.807)	
Reach the standard or not of standardization construction			-1.802		-15.779***
			(-0.724)		(-4.374)
Per capita GDP by city (10,000 CNY)		2.928*	6.129***	0.562	1.737
		(1.792)	(3.134)	(0.291)	(0.813)
Educational demand of the city where the school is located (%)		-0.364	-0.471	8.789	8.527
		(-0.307)	(-0.383)	(1.518)	(1.432)
School Location	Central Province A	44.796***	41.883***	43.286***	41.001***
		(5.175)	(4.865)	(5.388)	(4.990)
	Southern Province A	-12.517	-34.746**	35.986**	24.875
		(-0.967)	(-2.535)	(2.464)	(1.621)
Type of School Area	City	27.568***	29.380***	17.730***	15.556***
		(6.275)	(7.562)	(2.942)	(2.728)
	County/Town	-1.204	-1.568	9.087	7.543
		(-0.270)	(-0.389)	(1.537)	(1.365)
Constant Term		467.430***	439.001***	534.434***	438.892***
		(21.346)	(26.616)	(18.670)	(19.640)
Number of Samples		1,619	1,619	880	880
F		43.667	53.652	23.708	22.813
Adj. R^2		0.156	0.186	0.153	0.148

*Note: The value of t in parentheses; ***p , **p , and *p indicate that the levels of significance of 1%, 5%, and 10%, respectively.*

Table 3. Regression Discontinuity Results of Compulsory Education School Student Performance and Reach the Standard or not of Standardization Construction.

Achieve the standard or not of standardization construction	Elementary School	±3.541		±7.083		±14.165	
		-6.146	-11.164	8.661	7.619	8.158	5.845
		(-0.551)	(-0.963)	(1.190)	(1.005)	(1.583)	(1.083)
	Middle School	±3.76		±7.53		±15.06	
		12.216	11.222	4.217	5.549	2.026	1.815
		(0.754)	(0.670)	(0.456)	(0.571)	(0.278)	(0.238)
	Add control variables or not	Y	N	Y	N	Y	N

*Note: Z value in parentheses; ***p, **p, and *p indicate that the levels of significance of 1%, 5%, and 10%, respectively.*

ing variables and control variables at the cutoff point. The results showed that there is no obvious change at the cutoff between the assignment variable and the control variable, which was in accordance to the continuity assumption.

In summary, through RDD analysis, we did not find a clear causal relationship between standardization construction and student performance, that is, the level of standardization construction is not the cause of differences in student performance.

Discussion and Reflection

Based on our analyses, from the monitoring indicators of the standardization construction of compulsory education schools, in the dimensions involved in the indicators, especially in terms of hardware security, Province A had basically completed the task of balanced development, and the standardization construction work had reached a higher level. In other words, from the input side, the effectiveness of the standard construction was satisfactory.

However, many previous studies found that the improvement of school running conditions may not necessarily lead to the improvement of education quality. For example, the Coleman Report found that investment in educational resources was not the biggest cause of differences in student performance (Coleman et al., 1966). In addition, Hanushek at Stanford University analyzed 377 related studies and found that no strong correlation exists between student performance and school resources. Simple resource policies had little effect on improving student performance (Hanushek, 1997). Similarly, studies from China also reached these conclusions. For example, Hu (2007) used the data of rural public elementary and middle schools in western China through regression analysis and found that most of the physical and financial resources invested in elementary and middle schools did not significantly improve student performance. Hou and Shen (2014) used the 2009 Shanghai PISA test data for middle school students and found that there was no significant correlation between the quality of school education resources and student performance.

As thus, these findings show further that when we do policy assessment, we cannot look at the "inputs" only, but also the "outputs". Although we do not think that output-oriented evaluation is a better performance evaluation method than input-oriented one; on the contrary, we firmly believe that in the process of standardization, improvement and balance of guarantee conditions are the top priority of this work. However, we also believe that while most of the current similar evaluations focus on input performance, the review of output performance is a necessary link to ensure that the evaluation conclusions are comprehensive, scientific and robust.

In fact, our analysis also showed that when we conducted output-oriented policy performance evaluation, we oftentimes got different results from the input-oriented evaluation. In this study, although the construction results on the input side was impressive; many problems were revealed on the output side. OLS regression results showed that no significant correlation exists between standardized construction policies and elementary school students 'performance; but there was a negative correlation with

middle school students' performance, and the average score of school that was 15.78 points lower than those who were below the standard. The RDD analysis also found that there was insufficient evidence that standardization construction is the cause of differences in student performance.

Our conclusions are obviously different from the results of input-oriented performance evaluation. We are more concerned about what exactly caused this difference. So, we further analyzed the monitoring data of standardized construction, and performed variance analysis on 62 quantifiable detection points according to achieve the standard group and below the standard group to determine whether the students' performance in each group was significantly different under different indicators.[1] The results showed a significant difference between the two groups in the number of school tracks, the area per student, sports area per student, the provision of network multimedia classrooms per student, the setting of reading rooms, electronic reading rooms, and the number of stored books in libraries, etc. Taking the "number of school tracks" as an example, the ANOVA results show that the average score of the students in the schools that meet the standards is 13.01 points lower. According to the requirements in the standardized monitoring indicators, "complete elementary school is below 6 tracks". Only schools with less than or equal to 6 classes in one grade can be included in the compliance group. However, in the course of our investigation, we found that most of the rural elementary schools in Province A meet this condition, and in urban elementary schools, especially many "quality elementary schools" are often difficult to find. Therefore, it is impossible to reach the target on this indicator. However, the quality of teaching in such schools is often much higher than the average level, which in general raises the student performance of schools that do not meet this target.

At the level of middle school, indicators such as the number of school tracks, the average building area per student, the number of books per student, the number of new books per student per year, the student-computer ratio, and the ratio of middle school teachers with undergraduate or higher education levels were significantly different between achieve and the below the standard. Taking the "student-computer ratio" as an example, those who were achieve-the-standard scored 14.31 points lower than the contrast ones. According to the requirements of the monitoring indicators, "the ratio of the number of students in the school to the number of students using computers in the network environment must reach 8:1 in middle schools." High-quality schools often have difficulty in meeting this requirement due to the large scale. The low scores of resource indicators per student are often the main reason why the "high-quality schools" with higher grades have difficulty meeting the standards.

From our analyses, in many indicators, the phenomenon of "below the standard" group has better performance, which reveals exactly everyone's thirst for quality education resources. The relative shortage of quality education resources has led to a shortage of "good schools". The expansion of the scale of running a school will reduce the supply of resources per student, which will inevitably lead to lower-than-expected results at the output end. This divergence between the actual quality of running a school and the evaluation results at the input side reminds us once again that we need to reflect on the

setting of such education policy evaluation indicators, so as to use a more comprehensive perspective to define and evaluate the implementation of education policies.

Conclusions and Suggestions

We can draw the conclusions based on our analyses: from the perspective of input, the standardized construction of compulsory education schools in Province A had achieved gratifying results, but from the perspective of output, such kind of input had not significantly affected student performance. No sufficient evidence indicates that standardization construction is the cause of differences in student performance.

We need to point out that this conclusion does not mean we deny the value and significance of resource input. After all, resources are the bottom line guarantee, and our conclusion shows that the current standardization construction still has much room for improvement in terms of how to achieve balance between input and sufficient output. In particular, we suggest:

First, in the direction of standardization construction, we must achieve a transition from equal input to sufficient results. As pointed out by existing research, "Quantity and hardware standards are the appearance of standardized school construction, and quality and connotation standards are the essence of standardized school construction; therefore, the quality of school running must always be the first place for standardized evaluation" (Zhang & Zhang, 2017). Currently, the desire for higher quality education and the contradiction between the imbalance and inadequate supply of quality education resources are the main conflict in the process of educational reform and development. As mentioned earlier, since the 1980s in the United States, the principle of education supply had gradually changed from fairness to adequateness, and its core idea was to allow each child to achieve the maximum possible development under the conditions of certain resources (Xue, 2011). This is also of value to China's current standardization construction.

Second, in the focus of construction and the selection of performance evaluation indicators, to avoid "seeing things but not seeing people," we must coordinate the relationship between the unified requirements and the development of the school's characteristics. This requires that standardized construction is to increase the evaluation of output quality while ensuring the necessary facilities and equipment, teachers, curriculum resources and funding for the development of each school. In order to promote hardware investment and condition improvement to truly serve the development of students, and thus effectively improve the quality of education, strive to achieve the growth and development of each student. In this process, it is necessary to avoid setting all indicators in a balanced and stable manner. It is necessary to allow the development of school characteristics and the substitution and coordination between different evaluation dimensions. It is not necessary to be confined to the full realization of the indicators, as long as the construction of the school can better achieve the development of students, it should be regarded as completing the task of "standard construction".

Third, strengthen scientific research and set scientific and rational evaluation indicators for standardization construction. An important finding of our study is that

simply focusing on the standardization of the input side does not promote the improvement of student output. The reason for this is largely due to the fact that in the setting of standardized construction indicators, the relationship between "input" and "output" has not been thoroughly explored. Many indicators are often designed based on experience rather than scientific evidence. In the process of evidence-based reform, European and the USA require solid empirical evidence as the basis for making major policy decisions. In the "Every Child Success Act", the United States not only continues the requirements of evidence-based decision-making in the "No One Child Left Behind" act, but also makes clear the strength of various types of evidence (Slavin, 2017). From this point, China has a lot of room for improvement. In the process of future standardization, more emphases should be placed on the rationality and scientificity of the index setting, and each index should be fully demonstrated to make the evaluation play a better role in finding problems and guiding reform.

Note:

1. *Due to space limitations, we did not report the results of variance analysis of 62 indicators. For complete information, please contact Yao, the corresponding author of this article. Contact email: yaojijun_ njnu@163.com.*

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NEWSLETTER

How Trait Trustworthiness and Facial Trustworthiness Affect Children's Trust in Peers?

By Li, Q.G., Zhang, W.Y., Sun, J.Y., Ma, F.L.

FACIAL trustworthiness means that the credibility of trustee is related to facial features and trait trustworthiness means that the credibility of trustee is related to individual personality traits. Li's team surveys 297 students aged 8 to 12 to explore the prediction of trustee's trait trustworthiness and facial trustworthiness on peer trust and its age difference. The measurement process is divided into three parts. First, each participant evaluates the credibility of their classmates to obtain peer trust scores. Second, through the introduction, the test relates high credibility to the traits of being honest, reliable, and considerate, so as to obtain the number of high credibility nominations for each student, and obtain the trait credibility scores. Third, 80 primary students aged from 8 to 12 who did not participate in the test are selected to evaluate the credibility of participants from each face photo to get a face credibility score. The results show that:

- Children are inclined to trust peers with high face trustworthiness and high trait trustworthiness.
- Compared with low trait trustworthiness, when trustees have higher trait trustworthiness, face trustworthiness has a greater predictive effect on peer trust.
- Compared with low face trustworthiness, when trustees have higher face trustworthiness, trait trustworthiness has a greater predictive effect on peer trust.

The predictive effect of trait trustworthiness increases with the growth of age, whereas the predictive effect of facial trustworthiness remains the same.

Source: Psychological Development and Education, 2020; 36 (1):38-44.

NEWSLETTER

Impact of Kindergarten Environment on Teachers' Learning Engagement

By Zheng, J., Cai, Y.Q.

TEACHERS' learning engagement refers to the involvement in learning behaviors, the quality of emotional experience, and the use of cognitive strategies when teachers participate in learning activities based on daily teaching and research in kindergartens in order to improve professionalism and work efficiency. In order to explore the relationship between teachers' learning engagement, kindergarten environment and basic psychological needs, a study published in Studies in *Early Childhood Education* uses the preschool teachers' learning engagement scale, kindergarten environment scale and basic psychological needs scale to conduct a questionnaire survey on 1,037 kindergarten teachers with random selection.

The results show that:

The overall level of kindergarten teachers' learning engagement is high, but the development level of each dimension is significantly different. Among them, emotional and value engagement is the highest, cognitive strategy engagement is the second, and learning behavior engagement is the lowest. This may be because, as teachers' professionalism is valued today, teachers increasingly feel learning's promotion of professional development, and thus value learning and feel proud and satisfied because of learning gains. However, affected by the characteristics of kindergarten teachers' work, the distribution of female role in family, and individualistic cultures, teachers are unable to devote themselves to learning and are not good at cooperating learning, which are not consistent with that learning is an activity that requires perseverance, thus restrict their learning behavior engagement.

There is a significant positive correlation between learning engagement, kindergarten environment, and basic psychological needs. Kindergarten environment not only significantly positively predicted learning engagement; and it also influences teachers' learning engagement through the mediating role of basic psychological needs. The author believes that related learning, teaching and research can ensure that teachers' learning is carried out on a daily basis and in a standardized way, so that teachers' learning can be followed by rules, thereby ensuring that teachers have a certain degree of learning engagement.

Therefore, on the one hand, kindergartens should actively create a good environment for teachers by satisfying teachers' needs of autonomy, competence, and relatedness to enhance their learning engagement. On the other hand, teachers should attach importance to basic psychological needs and enhance their sense of autonomy, competence and belonging in professional learning and development.

Source: Studies in Early Childhood Education, 2020; (1):54-63.

NEWSLETTER

The Impact of Parental Strict Discipline and Children's Self-Control on Their Subjective and Objective Academic Performance

By Ding, Y., Wang, M.F.

HOW does parental harsh discipline and children's self-control affect their subjective and objective academic achievement? A study published in *Chinese Journal of Clinical Psychology* selects 443 fifth and sixth grade children from a primary school in Jinan City, Shandong Province as well as their parents as sample, completing the Parent-Child Conflict Tactics Scale, the Academic Achievement Self-Rating Scale and the Social Skills Rating System. In addition, demographic information and children's final grades of Chinese, math and English are also collected. The independent sample T test of SPSS is used to analyze the differences and the process plug-in is used to analyze the mediating effect. The analysis results are as follows:

- Boys experience higher levels of paternal harsh discipline and maternal psychological aggression than girls.
- The objective academic achievement of girls is significantly higher than boys, and there is no gender difference in subjective academic achievement.
- Self-control mediates the relationship between parental harsh discipline and the subjective/objective academic achievement rather than that between maternal harsh discipline and the subjective/objective academic achievement.

Based on the analysis results, the study concludes that paternal harsh discipline, but not maternal harsh discipline, exerts indirect effects on subjective/objective academic achievement through the mediating role of children's self-control.

Source: Chinese Journal of Clinical Psychology, 2020; 28 (1):119-125.

NEWSLETTER

What's the Core of Reducing Learning Burden Accurately Based on Different Student Portraits in the AI Age?

By Zhang, S., Zhang, P., Cao, R., Cheng, S., Fang, D.

A RECENT study published in *China Educational Technology*, randomly selects 8,973 sixth-grade students from 44 primary schools in a district of Beijing as subjects. Based on 8,713 effective subjects, this study explores the potential classification of students' learning input and subjective schoolwork load inside and outside the school. And the development characteristics of various types of students are analyzed from the perspectives of individual academic achievements, learning quality and interpersonal relationship through clustering analysis and other methods.

The research finds that:

- The situation of students is not the same, some need to reduce the learning burden, some need to increase time investment, and some need to improve the quality of learning. They are divided into four categories — "low engagement high burden" "high engagement high burden", "high engagement low burden" and "low engagement low burden", according to the state of learning investment and subjective academic burden.
- Four clusters differ significantly in academic achievements, interpersonal relationship and learning quality.
- The core of learning burden reduction lies in improving students' non-academic literacy, such as the quality of learning. When the level of engagement is different, students with good learning quality feel lower burden.

Therefore, it is concluded that:

- It is necessary to establish an accurate diagnosis system for scientific classification of students' burden in the era of artificial intelligence.
- Students of different types should adopt personalized programs to reduce their learning burden.
- Society, school and family should be fully guided, and intelligent adaptive learning system should be adopted to improve students' learning quality, which is the core path to reduce students' learning burden.

Source: China Educational Technology, 2020; (1):114-121

NEWSLETTER

Does My Friend's Academic Achievement Affect Mine?

By Zhang, Y.Y., Huang, M.W., Ren, P., Zhang, R.P.

RECENTLY, an empirical paper published in *Journal of Psychological Development and Education* uses peer nomination and self-report questionnaires to collect data of eighth-grade adolescents at the end of two semesters, and obtains 216 pairs of same-gender friends whose friendships are stable in one semester. The subject-object mutual dependence model is used to explore the influence effect of academic achievements between two friends, as well as the mediating effect of achievement goal orientation (including mastery goal orientation, approach goal orientation, and performance-avoidance goal orientation) on mutual influence between two friends and gender differences.

Research finding are as follows:

- Similarity in academic achievement between adolescent friends results from both selection effect and influence effect; In addition, two teenagers in a pair of friends can spontaneously form a study group, where they share their understanding of knowledge and attitude towards their studies, and urge each other to complete certain learning tasks together.
- Mastery goal orientation plays a mediating role in the relationship between an individual's own current and subsequent academic achievements, and the academic achievements of friend can influence the other's or his/her subsequent academic achievements through his/her or the other party's mastery goal orientation. Male students have more mediating paths than female students.
- For male students, performance-approach goal orientation plays a negative mediating role in the relationship between an individual's current academic achievement and his own subsequent academic achievement, but has a positive influence on his friends' subsequent academic achievement.
- The results support that pair-based friendship is one of the most important contexts for adolescents' academic development and highlight the key role of achievement goal orientation in the interaction between friends' academic achievements and the pattern of gender differences.

Research innovation:

This study distinguishes the different mediating effects of three kinds of achievement goal orientation on academic achievement of individual themselves and the friend, and reveals the different modes of influence on the friend's academic achievement by three categories of achievement goal. To a certain extent, it fills the gap in the current research on the internal mechanism of mutual influence on friend's academic achievements.

The shortage of research:

This study only investigates the effect of stable friends on academic achievement, and does not answer whether there is an influence between individuals with other friends or without paired friendship neither the mechanism of the influence.

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