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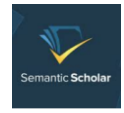


TABLE OF CONTENTS

SIEF, Vol. 9, No. 1, June 2021

EDITORIAL

Eradicate Social Poverty through Developing Educational Technology

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> *"We need technology in every classroom and in every student and teacher's hand, because it is the pen and paper of our time, and it is the lens through which we experience much of our world."*
>
> *–David Warlick*

POVERTY is a complex social problem. According to Rowntree (1902) and Reynolds (1971), poverty is a multi-faceted, dynamic, and complex aggregate, which is related to economic, social, cultural and other factors. In the historical process of humankind's continuous struggle with poverty, eliminating various factors that form poverty, especially the ability factors that restrict individual development, including education, health, etc., so as to finally solves the problem of poverty is the ultimate goal of anti-poverty. Among them, education, as a fundamental measure to improve the feasible ability of individuals, is considered to be a key factor in eliminating poverty and promoting social development and progress (Tilak, 2002).

From the perspective of balanced development, each country has a special period of unbalanced educational development among different ethnics, groups, and regions. In order to solve these imbalances, various countries have made effective attempts and achieved great results. Practical experience showed that in underdeveloped countries and regions, more attention was paid to how education could help people get rid of poverty (Schwartzman, 2004; Zhang, 2020; Zhu, 2020), while in developed countries or regions, researchers paid more attention how to help achieve educational equity through

inclusive education and promote the balance of development between regions and groups (Gaggioli & Sannipoli, 2021; Hirsch, 2007).

Among the various elements of educational development, information technology is exerting an unimaginable power. Both developed and developing countries and regions are beginning to attach importance to the education information and integrate educational technology into national development strategies (Li et al., 2021; Machekhina, 2017). This move is aimed at expanding the coverage of high-quality educational resources and the balanced development of education by adopting practical measures and approaches such as the sharing and co-construction of high-quality resources, mutual training of regional teachers, and personalized resource distribution through the coupling effect of information technology and education, so as to achieve eventual fairness in education quality (Cheng & Haiyan, 2016).

The three articles published in this issue of SIEF include "*Research on the Targeted Poverty Alleviation Model of China's Online Education Based on "Three Classrooms-Taking the Shishi Xiangyun Online School in Chengdu, China as an Example*" (Tian et al., 2021), "*Using Information Technology to Promote Education The improvement of education quality in resource-poor areas-Taking Qianxinan Prefecture, Guizhou Province, China as a sample* (Huang, 2021) and "*Investigating the Impact of Literacy-infused Science Intervention on Economically Challenged Students' Science Achievement: A Case Study from a Rural District in Texas*" (Irby, 2021), come from areas with superior educational resources and weak areas in developing countries, and rural areas in developed countries where high-quality educational resources are relatively scarce. The authors of the three articles explained how technology can be used in educational development from different perspectives.

We can see from these three articles that the rapid development of information technology provides new ideas and methods for solving the problem of unbalanced education development. It allows developed countries and regions to realize the widespread dissemination of high-quality educational resources through technology, and provides support for the use of information products and information technology in poor areas. Underdeveloped countries and regions use educational technology to share high-quality resources with developed countries and regions, and effectively improve the level of teachers and teaching quality, so that students receive good education. Technology rooted in education provides a practical and effective path for narrowing the gap between urban and rural education development and ultimately achieving targeted poverty alleviation through education.

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COMMENTARY

How Should Education in Rural Areas be Reformed?

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"Change is the end result of all true learning."

–Leo Buscaglia

RURAL areas are the product of the development of productivity to a certain stage. Generally, rural areas are geographical areas located outside of cities and towns. The Health Resources and Services Administration of the U.S. Department of Health and Human Services defines the term "rural" as "...not including all population, housing, and territory in urban areas. Anything that is not in a city is regarded as a rural area" (HRSA, 2021). From the perspective of production methods, rural areas refer to "a place where people mainly engaged in agricultural production live together" (The Dictionary Editing Office of the Institute of Languages, Chinese Academy of Social Sciences, 2005). When productivity has not yet reached a high level of development, there are still essential differences between urban and rural areas. Affected by economic transformation and geographical location, rural economic growth has been restricted. According to United Nations statistics, in 2018, the rural population accounted for more than half of the global population, and the rural poor accounted for 79% of the worldwide poverty population; the poverty rate in rural areas was more than three times that of urban areas. Of the 2 billion people in the world who do not have basic health services, 70% live in rural areas; the ratio of energy access in rural areas is about 75%, while that in urban areas is 96% (United Nations General Assembly, 2018).

Studies have pointed out that there has been an education crisis that

affects the country's development, and the rural population is the biggest victim of this crisis. The main reason is that cities have a significant advantage in allocating scarce educational resources; simultaneously, school education in rural areas is highly inconsistent with people's learning needs. Therefore, with the concentration of rural poverty, the gap between urban and rural education investment and teaching quality is broad and persistent. The drop-out rate, adult illiteracy, and gender differences in education in remote and rural areas are significant.

The former Director-General of UNESCO Koichiro Matsuura once pointed out that people living in remote and rural areas suffer from diseases, malnutrition, and low life expectancy to varying degrees, and education is the key to overcoming these injustices (Matsuura, 2004).

"Education for All" is a concept proposed by UNESCO at the World Education for All Conference in 1990 for the world. Its ultimate goal is to meet the basic learning needs of all children, youth, and adults. That is to "provide the people with knowledge, technology, values, and outlook on life so that they can live with self-esteem, continue to learn to improve their lives, and contribute to the country and mankind." The implementation of education for all has a profound impact on the development of rural primary and secondary education and improved the overall quality of the rural population. Literacy is the basis for improving the rural population's quality. The in-depth development of universal compulsory education is the key to transforming future agricultural laborers from physical to intellectual.

Extensive education for all has dramatically improved the rural population's quality, and the literacy rate is the most fundamental parameter for evaluating the population's education level. According to the data provided by UNESCO, in 1976, the literacy rate of the population aged 15 and over in the world was 66.91%. In 1990 this figure increased to 74.31%. Thirty years later, the literacy rate of the global population has increased to 86.47% (The World Bank, 2020). At the same time, the number of primary education for young people was growing. According to the "The Millennium Development Goals Report 2015" issued by the United Nations in 2015, the net enrollment rate of primary schools in developing regions reached 91% in 2015, increasing from 83% in 2000. The number of out-of-school primary school-age children in the world has nearly halved, and in 2015 there were approximately 57 million. Between 1990 and 2015, the global literacy rate of young people aged 15-24 rose from 83% to 91% (United Nations, 2015). These data show that compared with developing countries, developed countries have already universalized compulsory elementary education and over-universal secondary education but still attach great importance to literacy and universal education in rural areas and continue to deepen these tasks.

It is true that under the promotion of education for all, rural education in various countries of the world has developed to a certain extent, but compared with developed regions or urban areas, the quality of rural education is still worrying. In Japan, in the early stage, the quality of rural education was a long-standing and essential problem in education in rural areas, especially

in remote areas. In 1963, the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT) national academic survey showed that the test scores of elementary and middle schools in remote areas were lower than the national average. Taking the fifth grade of elementary school and the second grade of middle school as examples, the average score of the social subjects of the fifth grade of the elementary school in remote areas is 49.2 points, which is nearly 10 points lower than the national average score of 58.8 points. The average score in mathematics of the second grade of middle schools in remote areas is 31.3 points, which is 10 points lower than the national average score of 41.3 points (pp207) (Jiao, 1999).

In addition to the low overall quality of education, it is limited by the backwardness of curriculum content and teaching methods, insufficient funding, aging facilities, and shortage of teachers (Chen, 2004; Jiao, 1999; Xiao, 2004), teaching conditions. Furthermore scientific innovation literacy of students in remote and rural areas is even more lacking. Even after the Second World War, developed countries represented by the United States carried out several large-scale education reforms throughout the country, all centering on science education, but the effects of the reforms were not satisfactory. For example, in 2009, the results of the Scientific Achievement Assessment (PISA) of 15-year-old students from 65 countries and regions showed that the average score of American students' scientific literacy was only 487 points, which was lower than the average of 496 issues in the World Organization for Economic Cooperation and Development (OCED) countries. Moreover, the scores were far lower than students' average scores from countries and regions such as Singapore, Shanghai, and Hong Kong (562, 600, and 555 points, respectively) (OECD, 2010).

Countries actively promote rural education reforms to solve various problems in education in remote and rural areas. For example, in the United States, to improve the quality of rural education and step up efforts to improve student performance through examinations, another important focus is on rural courses. They were constructing the connection between the classroom and the development of the community through the local curriculum so that students can use the knowledge learned in the classroom to solve the practical problems of the rural community. This enriches the educational resources of students in rural areas and provides a suitable path for the improvement of students' scientific literacy.

Faced with the shortage of high-quality teachers in rural schools, both the United States and Japan have increased teachers' salaries to attract teachers or high-quality teachers to work in rural areas. According to Japan's "Remote Area Education Promotion Law," which was enacted in 1954 and amended many times after that, the Perfectures of Japan must issue additional special allowances to the faculty and staff of schools in remote areas. For example, the monthly allowance must be more than 25% of the sum of the monthly salary and maintenance law. In addition to using market measures such as raising teachers' salaries and salaries, Japan has also adopted administrative intervention measures, such as regular mobility policies. The ordi-

nary mobility policy stipulates that those who have served in a school for more than ten consecutive years and new teachers for more than six consecutive years solve overstaffing. Therefore, it is necessary to implement mobile teachers between schools and schools within the district, city, sub-district, and village. If the structure of the teaching team (professional, age, qualification, male to female ratio, etc.) is unreasonable, the adjustment of mobile teachers will be realized" (Li & Guo, 2006).

It can be seen that increasing teacher training and reforming rural education curricula have become fundamental approaches to rural education reforms in various countries. In this issue, Irby et al. (2021) set their sights on elementary school science teaching. They believed that science is an experimental subject, and its abstractness has caused many rural students to be unable to rely on existing teacher guidance and teaching materials to complete their understanding. This is related to the low level of teachers in rural areas in the United States and related to the characteristics of scientific disciplines. Based on this, the authors proposed the literacy-infused scientific intervention project. The project included teacher training and curriculum and teaching materials reform. It is believed that "integrating the teaching components of literacy and language into a subject area will produce higher achievements in the subject." Thus, the study has enriched the research content of rural education. Furthermore, it proposed strategies to improve rural elementary school students' scientific learning from scientific disciplines and further provided a new idea for rural education reform.

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COMMENTARY

A Useful Exploration to Improve the Quality of Rural School Education

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> *"My vision for the country is to urbanise rural areas. What is available in the cities must be available in the villages."*
>
> *–Jaggi Vasudev*

THE British educational sociologist B. Bernstein (2003) believed that in human social communication, the language signs used by people can be divided into exquisite signs and restrictive signs. Exquisite symbols include the arrangement of complex grammatical sentences and general semantics; while restricted symbols consist of simple, low-selective and restricted grammars and words, relying on the semantics of a specific context. Children born in middle-class families are familiar with and mastered exquisite symbols in their interactions with their parents, which is the basis for them to easily obtain excellent academic studies. Children born in poor families are familiar with restrictive symbols in their interactions with their parents. The language symbols used in the school education environment are mostly exquisite symbols, or standard academic language. If children from poor families cannot master the exquisite symbols, it will affect their understanding of the learning content, prone to learning difficulties, and lead to poor academic achievement.

In the process of school science education, due to its subject characteristics, teachers need to use scientific academic language to teach, and students need to use scientific academic language to understand the content of scientific knowledge, otherwise it will affect students' scientific academic achievements. To this end, teachers need to understand students' language

usage habits, consciously create a learning environment, and train students to understand the core concepts of science through learning and mastering scientific academic language, so as to describe the observed scientific phenomena. These are relatively easy for teachers in urban schools to do because their family background or living environment provides them with convenient conditions. But for teachers in rural schools, due to their family background or living environment, and long-term dealings with children from poor rural families and their parents, they are accustomed to using restricted symbols (popular language) to communicate with children. Obviously, this kind of teaching language habit of teachers is not conducive to the teaching of science courses, and the result is bound to affect the scientific academic achievements of rural school students. Therefore, if we want to improve the scientific academic achievement of rural school students, we must start with training rural school teachers and at the same time reform the curriculum of rural school science education.

The article entitled *Investigating the Impact of Literacy-infused Science Intervention on Economically Challenged Students' Science Achievement: A Case Study from a Rural District in Texas* published in this issue of the journal is about the impact of educational interventions on the scientific and academic achievements of students from economically challenged rural families (Irby et al., 2021). The purpose of this study was to explore a new way to improve the teaching ability of rural school science teachers and the scientific academic achievement of rural school students. The research interventions included: training and guidance for teachers, implementing science courses that include scientific and language goals, and developing students' scientific academic vocabulary and concepts through listening, speaking, reading, and writing. This experimental study proved that providing students with opportunities to practice language skills and organically combining language teaching with science subject teaching will help rural students achieve higher academic achievements. This study also showed that the abstract and normative characteristics of science subjects make it difficult for students in rural schools to learn and understand the content of science subjects. To reduce the difficulties for students in learning science courses, it is necessary to improve the teaching ability of teachers in rural schools, especially the teaching ability of science teachers. Therefore, to implement such a teaching strategy in rural schools, it is necessary to strengthen the training and guidance of teachers, as well as provide support for various resources.

This study has proved B. Bernstein's theory of language signs in practice, that is, to improve the academic achievement of rural school students, it is necessary to help students from economically challenged rural families' master exquisite signs. To achieve this goal, teachers in rural schools must be trained to organically embed the task of language teaching in subject teaching. Undoubtedly, this study has enriched the research content of rural education and provided a new idea for improving the quality of rural education.

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ORIGINAL ARTICLE

Investigating the Impact of A Literacy-infused Science Intervention On Economically Challenged Students' Science Achievement: A Case Study from A Rural District in Texas

Beverly J. Irby, Fuhui Tong, Rafael Lara-Alecio, Shifang Tang, Cindy Guerrero, Zhuoying Wang, and Fubiao Zhen

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***Abstract**: In this empirical study we examined the effect of a literacy-infused science intervention on fifth grade economically challenged students' science achievement in the curriculum-based and standardized assessments. A total of 27 treatment students and 20 comparison students from two intermediate schools in a rural district in South Texas in the United States participated in the present study. The intervention consisted of ongoing, structured, bi-weekly virtual professional development (VPD) with virtual mentoring and coaching (VMC) at the teacher level and literacy-infused science lessons with inquiry-based learning delivered at the student level. Results revealed a significant and positive intervention effect in favor of treatment students as reflected in higher normal curve equivalent scores in the standardized science assessment and higher scores in curriculum-based assessment. We conclude that the literacy-infused science intervention, inclusive of evidence-based curriculum, VPD, and VMC, is particularly beneficial for promoting science learning for the students in rural areas with educational and economical challenges due to geographic isolation.*

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***Keywords**: Literacy-Infused Science Intervention, Economically-Challenged Students, Rural Schools, Virtual Professional Development, Virtual Mentoring and Coaching*

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Introduction

OVER the past decades, the population of economically challenged (EC) students has been growing steadily in the United States. According to United States Department of Agriculture (USDA), Food and Nutrition Service (2021), the percentage of students who participated in free or reduced lunch programs (FRLP) were 30.3 million children in 2016; 29.9 million in 2017; 29.7 million in 2018; 29.5 million in 2019, and 22.4 million in 2020 (2020 was impacted by COVID-19). Students who participate in FRLP, those in our study are considered to be EC students, are those with participation based on their families' incomes of 130% and 185% of the Federal poverty level; schools are not allows to charge more than 40 cents for a reduced price lunch (USDA, 2017).

EC students have been reported to academically underperform when compared to their monolingual, middle, and upper-class peers (McFarland et al., 2019). According to the Texas Education Agency (2019), there were 60.6% EC students enrolled in public schools in 2018-2019 (2018-2019 data are the latest data for Texas, since 2019-2020 reporting is incomplete due to COVID-19). In fifth-grade in 2019, 39% of EC students passed the state standardized science and 43% in the reading assessment, respectively, at the level of meets grade level or above, compared to 49% of all students in science and 54% in reading. Such gaps in science and reading remained similar in the eighth grade (Texas Education Agency (TEA), 2019).

The EC students face the challenge to acquire the language of science to be able to understand science concepts, phenomena, and inquiries that are offered in the reform - based science instruction (Stage et al., 2013). To address the challenge, researchers have recommended the infusion of language and literacy into science instruction to support science learning (i.e., Llosa et al., 2016; Maerten-Rivera et al., 2016; Tong et al., 2014a; Tong et al., 2014b). Researchers have determined effective strategies integrating science and literacy to encourage teachers' use of scientific classroom discourse (e.g., Lewis et al., 2015), improve teachers' quality of instruction (e.g., Maeng et al., 2018), and increase teachers' understanding, confidence, and delivery of science-literacy integration instruction (e.g., Maeng et al., 2020; Santau, et al., 2010; Tong et al., 2019). Such integrated instruction has demonstrated positive evidence of enhancing students' learning in science (i.e., Llosa et al., 2016; Maerten-Rivera et al., 2016) or in both science and literacy (Lara-Alecio et al., 2012; Tong et al., 2014a, 2014b).

However, academic language is frequently information-dense, abstract, and technical (Huerta et al., 2016; Lara-Alecio et al., 2018), and teachers may lack the knowledge or capacity integrating robust language-based activities in the science classroom (Lee, 2005; Rubini et al., 2018). Science teachers are required to understand and learn how to construct a learning environment for students to acquire science-specific vocabulary for meaning-making, further to learning science core ideas, concepts and practices (Buxton & Caswell, 2020; Greenleaf et al., 2011; Irby et al., 2018; 2020).

To improve their instructional practices, teachers, particularly those from rural areas (Tang et al., 2021a), need to be provided the following educational resources related to science and literacy infusion (a) research-based curriculum (Arias et al., 2016; Cervetti et al., 2015); (b) structured ongoing virtual professional development ([VPD; Irby et al., 2015]; Costello et al., 2014; Mackey, 2009; Tang, 2018); and (c) virtual mentoring and coaching (VMC; Irby, 2015), as part of VPD, which provides teachers real-time pedagogical support to transfer their understanding of the science and literacy infused curriculum and knowledge gained from VPD and VMC to classroom instruction (Irby et al., 2020). Effective professional development and mentoring and coaching also help teachers better understand critical components of literacy and science infusion and implement the intervention with high fidelity (Tang et al., 2020). Researchers suggested that professional development and mentoring and coaching need to be provided with substantial frequency and length to be effective on teachers' instruction and further transfer on students' outcome (Maerten-Rivera et al., 2016; Tong et al., 2014b). In particular, VPD and VMC, in the virtual format, provide the same quality of support and resources and allow more flexibility for teachers with different time schedules and locations than do traditional face-to-face professional development and mentoring and coaching (Irby et al., 2020; Tong et al., 2015).

Rural school districts, including the current study context, are reported to have limited state and federal funding to address various school needs (Showalter et al., 2017; Wang et al., 2019; Williams, 2010). These districts normally have significantly low instructional expenditure (Tang et al., 2021b), and high percent of EC students (Strange et al., 2012), student mobility (Paik & Phillips, 2002; Reynolds et al., 2009), and teacher turnover (Lowe, 2006). Students in rural districts demonstrate relatively low academic achievement in reading (Cantrell et al., 2018; Tang et al., 2021a) and science (Holland et al., 2011; Wang et al., 2019) as compared to students in districts serving middle- and upper-class population. Due to geographic isolation and limited educational resources, rural teachers have not been provided with adequate professional development opportunities (Vernon-Feagans et al., 2010) to be trained to integrate literacy and science instruction for supporting their students' science learning (Tang et al., 2021a; Wang et al. 2019). Lara-Alecio et al. (2021) confirmed that when provided with the same VPD, rural teachers demonstrated similar gains in content knowledge and pedagogy as their peers in urban and suburban school districts. Given the feasibility and accessibility of virtual delivery, VPD and VMC seem to be possible solutions for rural teachers to access the quality pedagogical support for providing literacy-infused science instruction to their students.

Purpose, Context, and Research Questions

The purpose of the current study was to investigate the impact of a literacy-infused science intervention on fifth-grade students' science achievement in a rural school district in the state of Texas in the United States. The rural district in our case study served more than 60% of students on free and reduced lunch, and 30% of students failed State

of Texas Assessments of Academic Readiness (STAAR, state high-stakes test) in fourth grade reading. Treatment teachers received VPD and VMC support based on a 25-week literacy-infused science (LIS) curriculum intervention delivered daily to their students. We compared students' science achievement between the treatment and control conditions. The following research questions guided our study:

(1) Is there a statistically significant difference in students' science achievement (as measured by state standardized assessment) between treatment and control conditions, controlling for their initial performance at the beginning of 5th grade?
(2) Is there a statistically significant difference in students' science achievement (as measured by curriculum-based assessment) between treatment and control students, controlling for their initial performance at the beginning of 5th grade?

Method

Research Design

This study is derived from a larger randomized, longitudinal literacy-infused science project funded by the U.S. Department of Education (LISTO, #U411B16001). The larger project was designed to increase 5th grade science teachers' instructional capacity and their students' science and English literacy in rural and non-rural schools across Texas for EC students, inclusive of former and current English learners. The current study focused on one rural school district located in the boundaries of South Texas and the Texas Coastal Bend region. We selected this district because of a large student population (68.4%) eligible for free or reduced lunch (TEA, 2018). Further, this district included schools in both conditions whereas other rural districts in the larger project only had one school. In addition, 92.4% of the students in this district were Hispanic (TEA, 2018). Two middle schools (grades 5 and 6) in the districts were randomly assigned to treatment and control conditions in the 2017-2018 school year when the intervention started.

Participants

In this study, we included all consented teachers and students in both treatment and control campuses. There were three control teachers and two treatment teachers with an average of 13.6 years of teaching science. All teachers held a bachelor's degree as well as Texas Certification in Grade 4-8 Generalist or EC-6 Generalist and are certified to teach science subject. Each participating teacher taught one section of science on their respective campus. As was mentioned earlier, two intermediate schools were randomly assigned to treatment and comparison conditions to avoid contamination of the intervention between treatment and control classrooms. At the student level, there were 50 students (30 in treatment; 20 in control) who took pre-test in science before intervention and reported their performance in the state high-stakes reading test in fourth grade. At

the end of the year-long intervention, 47 students (27 in treatment; 20 in control) took post-test, which was the analytical sample in this study. It is worth noting that only 70% of control students and 63% of treatment students passed fourth grade state high-stakes reading test.

Literacy-infused Science Intervention-Teacher Training

Literacy-infused science intervention in the larger research project included three major components: virtual professional development (VPD), virtual mentoring and coaching (VMC), and literacy-infused science (LIS) curriculum. Treatment teachers participated in bi-weekly synchronous VPD sessions throughout the year-long intervention. The sessions were delivered through high-definition video conferencing, in which VPD coaches worked with treatment teachers on previewing upcoming lessons, building capacity for LIS teaching, implementing instructional strategies, and reflecting on student learning. Treatment teachers also viewed modeling videos related to upcoming science inquiry activities. VPD sessions were recorded and shared with treatment teachers to revisit and review as needed. In addition, treatment teachers participated in VMC that was conducted via an online platform for coaches to virtually observe and provide real-time feedback on treatment teachers' delivery of LIS curriculum.

Literacy-infused Science Intervention-Curriculum

The literacy-infused science (LIS) used in the current study was derived from a previous intervention that demonstrated effectiveness in improving EC students' science achievement (Tong et al., 2014b). The LIS curriculum is standards-aligned and follows the 5E hands-on science model (Bybee et al., 2006). It is a 25-week LIS curriculum for approximately 80 minutes daily. Instructional components and strategies were embedded to support students' academic science vocabulary and concepts via listening, speaking, reading, and writing in science. It also includes technology integration for students to access online educational tools and science-related software or applications via tablets. In this section, we present examples of the LIS curriculum. First, each lesson plan unit includes language objectives that specify how literacy (listening, speaking, reading, and writing) will be developed or supported during the teaching of the science concept. The example in **Figure 1** represents daily objectives related to earth's changing surface in one week.

Treatment teachers were also provided resources to support LIS implementation. For example, the images in **Figure 2** display slides from a corresponding PowerPoint presentation to guided students to describe and compare the landform models they created using clay.

The literacy infusion can also be reflected on the vocabulary slide in **Figure 3**, which includes a variety of embedded strategies including (a) breaking down the word into syllables, (b) providing a student friendly definition, (c) providing a real-life image representing the target word, (d) a sentence including the use of the target word, and (e)

Daily Objectives		
	Science Objectives	**Language Objectives**
Day 1	The students will build models of naturally occurring landforms such as mountains, rivers, and canyons.	The students will name and describe landforms based on evidence found in images and 3D models.
Day 2	The students will explore how changes to the Earth's surface caused by wind and water affect humans.	The students will use scientific terms to describe how wind and water change the surface of the Earth.
Day 3	The students will use models to explore the rate water and wind can change the Earth's surface.	The students will read on grade-level text related to natural hazards like landslides, avalanches, and floods.
Day 4	The students will investigate factors that increase or decrease the damage caused by landslides.	The students will write to reflect on the damage cause by water- and wind-based natural hazards.
Day 5	The students will apply their knowledge to reduce the negative effects of earth's changing surface through flooding.	The students will use scientific terminology and evidence to evaluate and critique their peers proposed solutions to the flooding river challenge.

Figure 1. Week 10 Days One to Five Daily Science and Language Objectives.

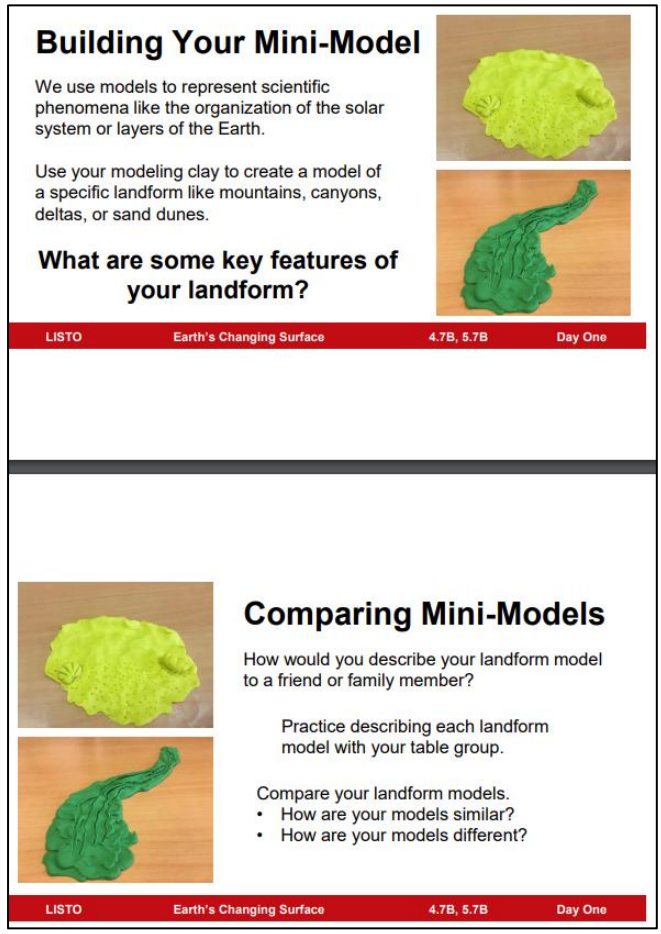

Figure 2. Week 10 Days One Hands-on Activity: Building Your Mini-Model.

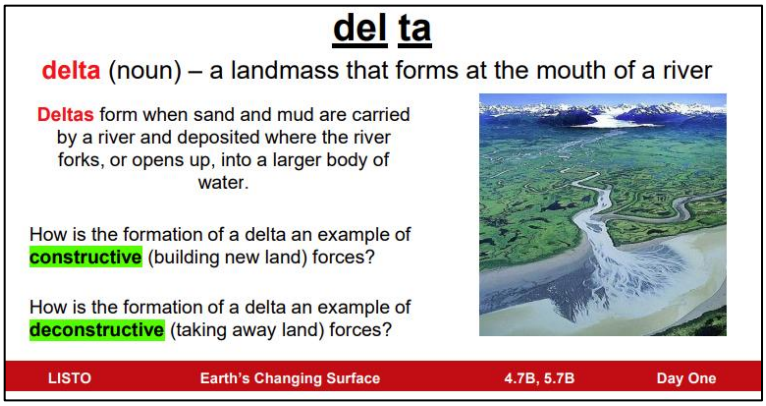

Figure 3. Week 10 Days One Science Vocabulary.

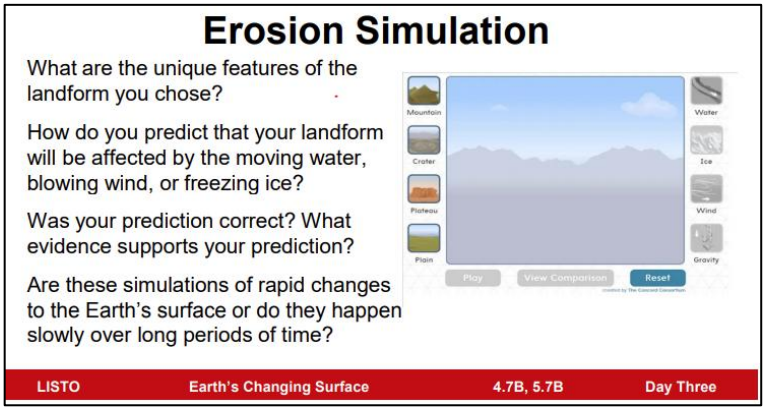

Figure 4. Week 10 Day Three Online Simulation.

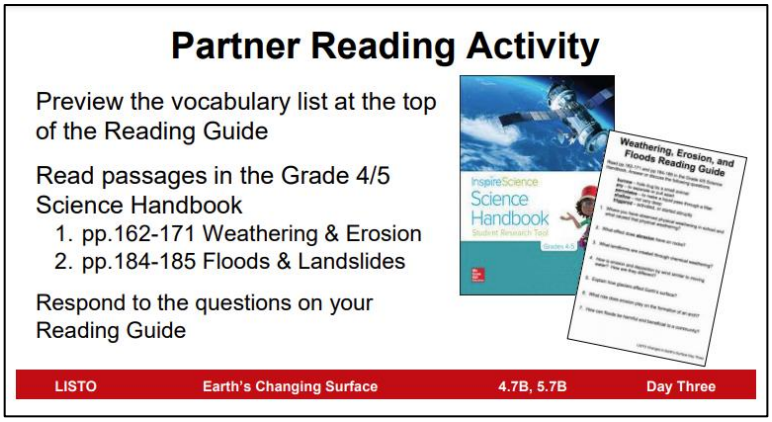

Figure 5. Week 10 Day Three Partner Reading Activity.

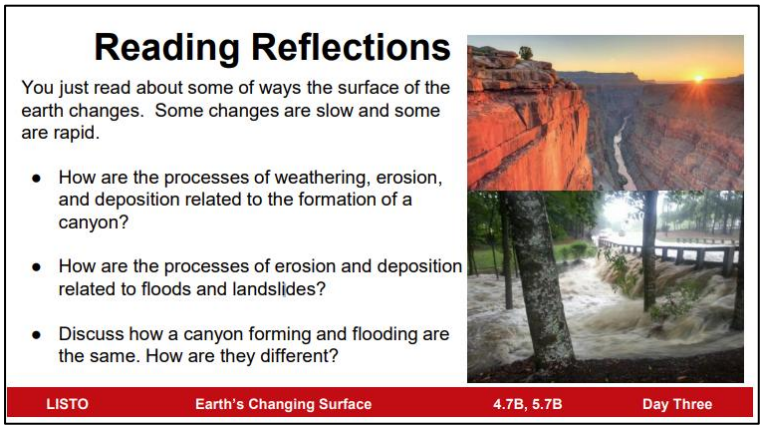

Figure 6. Week 10 Day Three Reading Reflection.

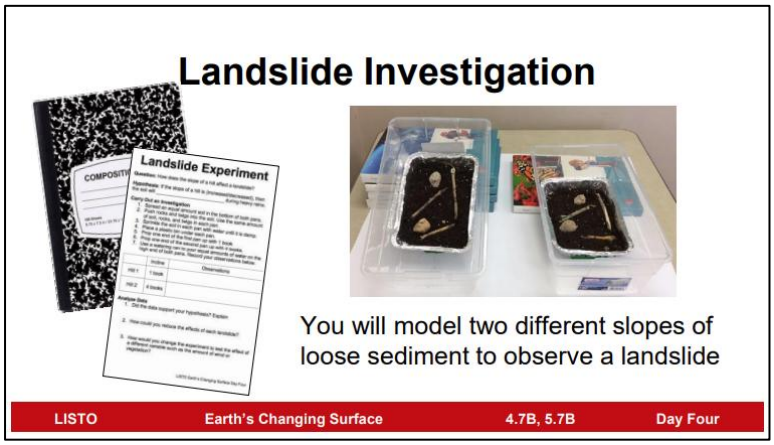

Figure 7. Week 10 Day Three Reading Reflection.

questions for students to discuss and respond to that provide opportunities for students to practice using academic vocabulary.

Figure 4 provides students with focus questions as they work through an online simulation related to erosion.

Figure 5 guides students through a partner reading activity. Students are strategically partnered based on their reading level. After previewing vocabulary that will be encountered in the text, partners take turns reading the assigned text (e.g., partner A reads the first paragraph, partner B reads second paragraph), support each other during reading by helping to decode challenging words, and calling attention to expository text structures (e.g., images, graphics, captions, headings, subheadings, bold words). After

reading, partners read the comprehension questions on the reading guide to discuss and record their responses (see **Figure 6**).

Figure 7 is displayed while small groups of students work through a hands-on, collaborative activity to investigate two landslide slopes. Students refer to the activity guide for instructions and to record their observations.

Instruments

In the fifth grade intervention, students were pre-and post-tested using a standardized assessment and a curriculum-based researcher developed assessment. The Iowa Test of Basic Skills [ITBS] (Dunbar et al., 2015) is a norm-referenced, group-administered test measuring knowledge and skills in academic areas, including reading, math, science, social studies, and etc. For the purpose of the larger project, we administered the science subtest (ITBS Level 11 Form E) to measure students' knowledge of scientific principles and information, and the methods and processes of scientific inquiry. According to the test manual, reliability is reported at 0.848 in form of Kuder-Richardson Formula 20 (K-R 20). There are 37 items in the ITBS Level 11 Form E. The Big Ideas in Science Assessment (BISA) is a researcher-developed standards-aligned science assessment, which is developed following big ideas in science based on standards (see Lara-Alecio et al., 2018 for the details of development and validation of BISA). There are 30 items in the BISA test. To examine the impact of literacy-infused science intervention on students' science achievement, students' fourth grade English reading proficiency measured by the State of Texas Assessments of Academic Readiness (STAAR) reading assessment were collected. Grade 4 STAAR reading examined whether students demonstrate an ability to understand and analyze written, literary, and informational texts across reading genres (TEA, 2017).

Data Collection and Analysis

To address the first research question, we examine the differences in the post-test of ITBS between treatment and control students, controlling for their performance in ITBS pre-test and fourth grade English reading proficiency. Normal curve equivalent (NCE) scores generated from ITBS were used for analysis. To address the second research question, we compared the differences in the post-test of the BISA between treatment and control students, controlling for their performance in the BISA pre-test and four grade STAAR reading scores. Analysis of covariance (ANCOVA) was conducted with the pre-test and fourth grade STAAR reading as covariates and post-test as the outcome variable to monitor students' science learning and compare between treatment and control conditions.

Students took the fourth-grade STAAR reading assessment at the end of fourth grade, and school districts transferred their scale scores to us at the end of fifth grade. The BISA and the ITBS assessments were given at the beginning and end of grade 5. The number of items answered correctly in BISA, ITBS NCE scores, and STAA read-

ing scaled scores were used in data analysis. A total of 47 students (27 in treatment; 20 in control) completed the intervention and had both pre-and post-test scores.

Results

Descriptive statistics of pre- and post-tests from both treatment and control conditions are listed in **Table 1**. There was no statistically significant difference between treatment and control students regarding their pre-intervention science achievement as measured by ITBS (p = 0.465, Cohen's d = -0.218) and BISA (p = 0.074, Cohen's d = 0.074). According to the What Works Clearing House (WWC, 2017), an effect size with an absolute value greater between 0.05 to 0.25 indicated baseline equivalence was achieved, but pre-test scores need to be included as the covariate in the outcome analysis. In the following section, we present our findings by research questions.

RQ1. Is there a statistically significant difference in students' science achievement (as measured by state standardized assessment) between treatment and control conditions, controlling for their initial performance at the beginning of 5th grade?

An ANOVA was performed to determine the effect of the literacy-infused science intervention on students' science achievement measured by nationally normed test, ITBS, after controlling for students' pre-intervention performance. The results (see **Table 2**) indicated that there was a statistically significant difference in post-intervention ITBS NCE scores between intervention and control students after adjustment for pre-intervention performance in science measured by ITBS and in reading measured by Grade 4 STAAR Reading test, $F(1, 43) = 19.24$, $p < 0.001$, partial $\eta^2 = 0.309$, suggesting a statistically large effect size (Cohen, 1969; Richardson, 2011).

RQ 2. Is there a statistically significant difference in students' science achievement (as measured by curriculum-based assessment) between treatment and control students, controlling for their initial performance at the beginning of 5th grade?

An ANOVA was performed to determine the effect of the literacy-infused science intervention on students' science achievement as measured by researcher-developed curriculum-based instrument of BISA, after controlling for students' pre-intervention performance. The results (see **Table 3**) indicated that there was a statistically significant difference in post-intervention BISA scores between treatment and control students after adjustment of students' pre-intervention performance in science as measured by BISA and in reading as measured by Grade 4 STAAR, $F(1, 43) = 6.188$, $p = 0.017$, partial $\eta^2 = 0.126$, suggesting a statistically medium to large impact (Cohen, 1969; Richardson, 2011).

Discussion and Conclusion

In this study, we investigated the impact of a literacy-infused science intervention on fifth-grade students' science achievement in a rural school district in the state of Texas in the United States. Our study included bi-weekly VPD over 25 weeks with mentoring and coaching of the LIS curriculum delivered by science teachers. Our results indicated

Table1. Description of Pre and Post and Baseline Equivalence.

		Pre-test/Baseline Equivalence				Post-test	
Condition		N	Mean	S.D.	Cohen's d	Mean	S.D.
ITBS_NCE	Treatment	27	35.6	18.72	-0.218	43.41	16.77
	Control	20	40.35	20.28		26.70	24.36
BISA	Treatment	27	11.9	5.75	0.074	17.07	4.11
	Control	20	11.85	5.1		15.05	6.07

Table 2. ANCOVA Results of Comparing Treatment and Control Students' Science Improvement Measure by ITBS NCE Scores Controlling for Students' Initial Performance in Reading and Science.

Source	SS	df	MS	F	p-value	Partial Eta Squared
Intercept	2,631.76	1	2,631.76	10.57	0.002	0.197
Condition	4,789.74	1	4,789.74	19.24	< 0.001	0.309
ITBS_Pre_NCE	73.04	1	73.04	0.29	0.591	0.007
G4 STAAR Reading	3,985.35	1	3,985.35	16.01	< 0.001	0.271
Error	10,702.99	43	248.91			
Total	83,724.00	47				

Note: SS, sum of squares; MS, mean squares; df, degree of freedom.

Table 3. ANCOVA Results of Comparing Treatment and Control Students' Science Improvement Measure by BISA Controlling for Students' Performance in Reading and Science before Intervention.

Source	SS	df	MS	F	*p*-value	Partial Eta Squared
Intercept	11.231	1	11.231	0.843	0.364	0.019
Condition	82.416	1	82.416	6.188	0.017	0.126
G4 STAAR Reading	88.620	1	88.620	6.654	0.013	0.134
BISA_Pre	121.511	1	121.511	9.124	0.004	0.175
Error	572.692	43	13.318			
Total	13,540.000	47				

Note: SS, sum of squares; MS, mean squares; df, degree of freedom.

a positive effect of the literacy-infused science intervention on fifth grade students' science achievement on a standardized test as well as a researcher-developed test, with medium to large effect sizes. This is consistent with previous studies that integrating instructional components of literacy and language into a subject area would yield higher

achievement in that subject (Llosa et al., 2016; Lara-Alecio et al., 2018; Maerten-Rivera et al., 2016).

A further examination of students' performance on ITBS indicated that after one year of literacy-infused science intervention, treatment students on average make more than one year's gain (8 points increase in NCE) in contrast with a loss of 13 points in NCE scores among control students. Given the relatively low passing rate of fourth grade STAAR reading test (both conditions having one-third of students who failed the test), treatment students' progress in science learning suggested that extra literacy support, as embedded in LIS curriculum played a critical role in supporting low-achieving students' science learning. Further, by the end of 5th grade, the average performance of these students was still below the national average (50 points on NCE). We argue that one year of LIS intervention was effective for EC students, and anticipate a continued upward trajectory with a longer duration of such intervention or early intervention that spans longitudinally which has been reported to have strong impact on students' science achievement (Tong et al., 2014a).

The findings are consistent with the previous studies with grade 5 EC students (i.e., Tong et al., 2014a; 2014b) and were also supported by theorists (e.g., Halldén, 1999) and researchers (Kieffer et al., 2009; Lee & Stephens, 2020) who advocated and highlighted the benefit of language/literacy support for diverse learners. In rural school districts with a high percent of EC students and students who underperform in reading/literacy (Showalter et al., 2017; Wang et al., 2019), our literacy-infused science intervention is promising and beneficial as we found that it scaffolds students' science learning with extra science-related literacy support, which addressed the needs of these ED students in rural schools. In science classrooms, students are expected to apply literacy skills to conceptualize ideas, make connections, and exchange their scientific thoughts with their peers (Wright et al., 2016). The literacy-infused science instruction (Lara-Alecio, et al, 2016), as was described in our study, provided opportunities for students to practice their language skills and at the same time in a content area, strengthen the foundation for establishing background knowledge and vocabulary, and increase their academic achievement. This finding is also supported by findings from August et al. (2009). Our findings are particularly important for rural school teachers and students.

We also emphasize that the VPD that supported teachers' learning about language-and-literacy infused instruction is helpful for teachers to understand the critical role of literacy in students' science learning, particularly for teachers in rural districts with limited instructional and PD resources (Vernon-Feagans et al., 2010). Furthermore, even experienced science teachers may face challenges in implementing inquiry-based practices. Strategies, such as modeling teaching and peer collaboration, as were included in our VPD, supported teacher learning, shaped teachers' pedagogical practices, and further created more structure opportunities for students' science learning. Arais et al. (2016) also support this conclusion. In our intervention, VPD coaches worked with treatment teachers to preview lessons and reflect on student learning, and provide real-

time feedback on treatment teachers' delivery of LIS instruction, which ensured teachers' fidelity of implementing the LIS curriculum.

Implication for Literacy-infused Science Intervention of EC students in Rural schools

Due to isolated geographic characteristics and relatively small enrollment, rural schools have limited access to educational resources and state and federal funding, which limits rural teachers' professional growth (Showalter et al., 2017; Tang et al., 2021a; Wang et al., 2019). While science teachers hold the most important role in supporting students' science knowledge and literacy learning, they need an environment or a platform that supports their professional development, provides equitable access to instructional resources, and promotes students' science learning as a natural consequence. VPD and VMC seem to be such environments that teachers, especially rural teachers, can receive in an equitable manner, as high a quality of professional development and mentoring and/or coaching as do their peers in more privileged districts.

Beyond VPD and VMC, the literacy-infused science curriculum that incorporates 5E model and integrated with literacy support for developing students' listening, speaking, reading, and writing in science context, is particularly resourceful for science teachers who work with EC students. Access to these resources may contribute to reducing the achievement gap between rural and non-rural students (Tang et al., 2021a). As Lara-Alecio et al. (2021) pointed out, VPD and VMC enhanced teachers' content knowledge and instructional capacity, regardless of teachers' locations. Our study confirmed the benefit of VPD, VMC, and LIS curriculum which enhance science teachers' instructional capacity and professional growth, and promote students' science achievement in rural schools. It also stands to reason that such benefit to teachers and students in the teaching and learning of science may extend to other school settings that serve a large population of EC and under-privileged population.

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ORIGINAL ARTICLE

Text Comprehension and Study Method Acquisition for Students with Specific Learning Disorder: Development and First Application of the SUST Program

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Abstract*: In this paper we describe an educational program for the development of the study method for students with specific learning disorders (SLD) and a first Italian application on a small sample of fifth grade students. This experience was aimed at collecting useful data precisely to review and improve the above-mentioned program. A particularly relevant problem was identified looking at the anthropological dimension of the capability learning and the need for students to acquire the learning to learn ability. Specifically, it is about the low levels of text comprehension in Italian schools and its consequences on the study activities. Within the inclusive perspective and taking into account the effective didactic strategies in the evidence-based education (EBE) perspective, the project created and tested a teaching kit (SUST) for the fifth classes of the primary school, at-tended by students with SLD. This experimental framework was conducted following the Design Based Research methodology. It also focused on the training of teachers within the intervention classes. The positive results of SUST application open a constructive scenario for the definition of intervention programs aimed at improving text comprehension and study skills of students with SLD. This program should be tested in a wider context of schools.*

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Introduction

IN this paper we describe the program *Strategies for Understanding and Studying the Text* (SUST) developed to promote the study method for students with specific learning disorders (SLD)[1] and we illustrate its first application on a small sample of fifth grade students of primary school in Italy.

The *capability approach*[2] has been an imperative and innovative reference for the development of SUST in an inclusive way.

The promotion of the study method for students with special learning disorders-SLD is essential to enable them to learn in a *lifelong learning*[3] perspective. In this sense, it is closely linked to the *capability approach* as relevant to reflect on educational practices, in a generative and inclusive perspective.

As is well known, the *capability approach* has developed in the areas of political philosophy and economic perspectives of *welfare*. It is an innovative approach to assess the well-being of people and social justice. This assessment takes into account the individual's substantial freedom to act on the basis of values and opportunities.

The *capability approach* outlines a complex vision of human development. It considers as the center of its reasoning the economic and anthropological dimensions.

This last dimension identifies individual well-being as a process that aims to affirm and enhance the individual potential, in logic of equality of opportunity and social justice.

According to Sen, the role of *capabilities* correlates directly with the well-being and freedom of man and indirectly with social change and economic production. This approach encourages society to stimulate and promote the internal individual capabilities[4] of each person through education, support and family and social care within an ethical framework based on the right to equality, equal opportunities and education.

The perspective we intend to follow here frames the *capability approach* as an overall vision that provides an interpretative-methodological key useful to offer concrete answers to the many aspects emerging around the issue of inclusive schools.

In particular, it reflects on the ability of the *capability approach* to respond to the heterogeneity of students, without attributing difficulties exclusively to the characteristics of the individual, but in relation to the actual freedom of choice, life, relationships and study that are really offered.

In this context, placing and defining the right to study in the light of the logic of capabilities means avoiding labeling and "building" schools in which contextual, environmental and personal factors interact to determine a positive functioning of the student with SLD.

In fact, students with SLD are entitled to the fundamental freedoms that allow them to be learners on a basis of equality. Equality is civic, but which is also completed as equality of education.

From this perspective, Sen's ethical-normative approach correlates with the impulse to achieve an inclusive environment by producing changes that enhance opopportunities for freedom and well-being.

Therefore, school policies for inclusion are called to expand and to enhance the development of students' *capabilities* by translating resources into a real and *substantial* freedom.

In this sense, in a heterogeneous class attended by students with SLD, it is necessary to have a greater quantity and quality of effective environmental factors to promote the functioning of these students, that is, what each of them is able to achieve (Sen, 1999). Otherwise, the learning disadvantage can be conceived as a real limitation of *capabilities*[5].

The right to study is not always reaffirmed, especially for students with SLD for whom "knowing how to study" represents the vital drive to flourish themselves, their own abilities, as free and responsible beings.

In the promotion of the study method, also Sen's reflection about agency comes into play. Sen defines it as a process aimed at producing a change in the person, based on the values he nurtures and the goals he sets himself (Sen, 2001).

Agency is one of the aspects that characterize the study method, as it translates into the person's ability to be active in own learning.

In fact, "capacitating does not lie (so much) in the resources to be mobilized, but in the mobilization of these resources" (Boterf, 1995).

If the principles outlined above are valid for a just society, the same is true for the school that recognizes the individual learning potential of each student with SLD.

Consequently, in the inclusive school, teachers have to support the agency of students with SLD and to guide the development of a study methodology, establishing a virtuous circle in the teaching/learning process.

Materials and methods

Effective Teaching Strategies for Understanding and Studying the Text

Before developing SUST program, the research team identified the most effective teaching strategies to reduce and/or compensate the specific difficulties of the students with SLD.

The strategies identified are set out below.

Graphic organizers are visual aids that allow the reader to get an idea of the con-tent of the text. They show the conceptual cruxes or rather the main and secondary information, and the causal relationships between the events narrated or described, as well as the relationships between them. They have an effect size (ES)[6] of 0.26 (Okkinga et al., 2018).

Graphic organizers are particularly useful to organize concepts to be learned through informational-expository texts relating to disciplines of primary and secondary schools (Novak, 2001).

Graphic organizers include: concept and mind maps, colored highlighting of parts of the text, underlining, use of symbols, etc. (Hattie, 2009). In particular, concept maps have been shown to be very effective devices with an ES of 0.55 (Hattie, 2009).

The *summarizing organizers* make it possible to produce a text similar to the source text so that it can be studied or analyzed by eliminating information considered secondary and superfluous. The aim is to make a synthesis of the most important contents (Benvenuto, 1987).

The ability to summaries is a strategic process of elaboration. It requires a specific articulation of the didactic proposal: first, the teacher shows how to identify the most important information through the modelling and, subsequently, how to summaries it. In a third phase, the student tries to perform the two previous actions autonomously, supported by the teacher's feedback.

During this phase, the student is called upon to: eliminate secondary information through precise activities, such as: identification of the most important information and of the key concept(s); highlighting of key words; synthesis. Thus, like graphic organizers, the summarizing organizers stimulate metacognition and self-regulation, and optimize the quality of the student achievements relative to understanding, organizing and remembering the studied material (Bonaiuti, 2014).

Indeed, the use of these organizers has positive effects with regard to summary writing skills and content memorization (NICHD, 2000).

The summarizing organizers are often employed in combination with other teaching strategies, as in the case of the reciprocal teaching (Rosenshine & Meister, 1994).

Reciprocal teaching is a multiple strategy (Davis, 2013) that actively engages the teacher and the student in a co-construction of meaning of the text.

Developed for students at risk of educational failure and also considered effective for those with learning disabilities (Mitchell, 2014), *reciprocal teaching* consists of four individual strategies (Palincsar & Brown, 1984):

- Making predictions about the content of the text, before reading it (*predicting*);
- Clarifying unfamiliar words, new concepts, and idiomatic expressions (*clarifying*);
- Asking questions by recalling explicit and implicit information (*questioning*);
- Summarizing by identifying, paraphrasing and integrating the information (*summarizing*).

Actions related to the strategies are initially presented by the teacher through modelling and thinking aloud and, subsequently, are conducted independently by the student.

Hattie (2009) summarized an ES value of 0.74. More recently, Lee and Tsai (2017) evaluated the effectiveness of the strategy for students with specific poor comprehension[7] who achieve better learning outcomes than students who received regular instruction (ES = 0.86).

These strategies were grouped in the SUST teaching kit and applied on a repertoire of texts to be offered in fifth-grade primary classes attended by students with SLD.

SUST: A Program for Understanding and Studying a Text

SUST is designed as an educational resource to support teaching intervention in fifth-grade primary schools. It consists of two workbooks for student - one for the application of reciprocal teaching, the other for graphic and summarizing organizers.

Following the approach pioneered in Italy by SApIE[8] (Calvani & Chiappetta, 2019), the workbooks collect both the repertoire of texts and the activities useful to apply the teaching strategies.

The workbooks guide the students by providing them with the necessary indications for their completion, such as: the explanation of the activity to be carried out on the text, the exemplification of the assignments, the questions they must ask themselves for the use of *reciprocal teaching*, the strategies they must activate for the use of graphic and summarizing organizers, the spaces for writing the answers, as well as the incentives to feed-back between the students themselves. Each student has a personal copy of the workbooks.

The texts in SUST are narrative and expository. The narrative texts are related to various literary prose genres and, although they tend to present events that are generally close to reality, they are not limited to the documentation of a true or likely reality.

The expository typology of texts has an argumentative function, or rather it is based on the intention to provide competencies or to propose and discuss thesis.

The texts were chosen and adapted for students with SLD on the basis of precise lexical, syntactic and graphic criteria (Traversetti & Rizzo, 2020).

The Section of SUST Dedicated to Reciprocal Teaching

The section of the teaching kit for *reciprocal teaching* consists of a repertoire of 20 texts (8 narrative and 12 informative-explanatory), and the description of the relevant teaching activities.

In particular, the 8 narrative texts refer to the subject of Italian language, while the 12 explanatory texts refer to the following subject: History (2 texts), Geography (3), Science (3), Civic Education (2), and Technology (2).

The teaching activities for each text are summarized in a visual form. The time needed is indicated. In particular, the activities concern individual work, pair work and class discussion. The individual work concerns the development of the steps related to the strategies of: making predictions, catching unknown words and searching for their meaning, asking questions about the content, producing summaries.

Following the example of SApIE's Reading Comprehension-Reciprocal Teaching program (Calvani & Chiappetta, 2019; Rizzo et al., 2020), there is also a fifth phase to develop inferential understanding of the text. Each phase is declined on the basis of one or more standard questions for each text (**Table 1**).

Table 1. Phases of Reciprocal Teaching and Related Guide to Questions.
Predicting
"What do you think the text will be about?"
Clarifying
"Are there words you do not know the meaning of?"
Questioning
"What do you think is the most important information?". If you cannot answer, ask yourself: "Who? What? When? Where? How?"
Summarizing
"How could you say, in a few words, the point of the story?"
Understanding what the text does not say
What is the moral of the story? "What can you learn from this story?" "What did you understand that the text does not say?"

Specifically, the activities foresee that, on the first three texts of each type, the students observe the cognitive modelling of the teacher. For the subsequent texts, the modelling is gradually reduced, taking into account the progress of the skills gradually acquired by the students and monitoring the process of using the strategy themselves.

Once the teacher's modelling is over, the students carry out work in pairs, within a maximum time limit of 15 minutes in which one of the two students, or both, alternately write the summary in the workbook. During this work, the teacher uses feedback (ES = 0.73; Hattie, 2009) to confirm the correctness of the answers, showing if there is a need to improve them. For students with SLD, this corrective feedback is characterized in terms of indications of useful guidelines for completing or integrating the task, through alternative ways of working that reduces the cognitive load (Sweller, 1988). Following the pair work, the class discussion involves listening to the summaries produced by the various pairs, intervening when a different solution is proposed, in order to negotiate the best summary to write in the workbook.

The Section of SUST Dedicated to Graphic and Summarizing Organizers

The section of the teaching kit for the application of the strategies of graphic and summarizing organizers consists of a workbook with 21 explanatory texts: History (n.6); Geography (n.6); Science (n.5); Technology (n.2); Civic Education (n.2).

With regard to graphic organizers, the section includes the following activities: highlighting parts of the text in color and drawing up concept maps. With regard to summarizing, the section includes the following activities: identification of key words, elaboration of notes in the margins of the text and production of paraphrases. The graphic organizers are applied to a total of 11 texts, and the summarizing organizers to 10 texts.

The activities proposed for these texts are both individual and in pairs.

A First Application of SUST in Italian Schools

The SUST program was applied on a small sample of Italian schools as a pilot study, in order to revise the program and improve materials and application methods.

To this end, the *Design Based Research* (DBS) method (Dede, 2005) was used to arrive at an 'artifact', also of an organizational nature (Simon, 1969).

A non-probabilistic sample (Cohen et al., 2007), was made up of three fifth classes of Italian primary schools, three of which were intervention classes and two parallel classes with control functions, for a total of 115 students and 10 teachers (6 subject-teachers and 4 support-teachers).

The students were distributed as follows: 24 students with SLD and 51 other students in the intervention classes; 12 students with SLD and 28 other students in the parallel classes.

Teacher Training

The project also provided training to enable teachers to use SUST. The training referred to the most appropriate ways of assessment of learning, as well as to the relevant compensatory and dispensatory measures to be taken for students with SLD[9]. The training took into account the models considered to be able to contribute effectively to the acquisition of adequate teaching expertise: *visible learning* (Hattie, 2017), which is characterized by interventions on teachers mind frame and *video modelling*.

Survey Instruments

As is well known, in the field of inclusive education, data collection responds to the need to understand an educational phenomenon characterized by a high degree of complexity. Therefore, a *mixed-method approach* (Trinchero, 2002) was preferred. The requests of control class teachers who were not willing to devote much time to the administration of tests were also taken into account. For this rea-son, the tests were divided into common tests (for all classes) and in-depth tests (only for the intervention classes). The "common" tests are the MT Tests (Cornoldi et al., 2017) and the Metacognitive *Questionnaire/QMeta* (La Marca et al., 2019). The 'in-depth' tests are described in **Table 2**.

Here, we present the results of a common test, the QMeta Metacognitive Questionnaire, and of an in-depth test, the Structured Interview with Teachers[10]. With particular reference to the intervention classes, the two instruments highlight the views of both students and teachers about the importance of teaching and learning specific study strategies with high inclusion potential. They also bring out the critical points of the research project.

Results

Table 2. The Use of Metacognitive Strategies According to the Students within the Intervention Classes.

Timing	Description	Reasons for the Choice
In & Out	Narrative and informative-expository text study evaluation form	At the beginning of the year, the form was proposed before the start of the training session in order to support the teachers of the intervention classes in analyzing the level of comprehension of the study text of their students. Its use enabled teachers both to understand the need for targeted action for students' acquisition of study strategies and to motivate themselves for specific training. At the end of the school year, it seemed appropriate to re-propose the same form so that teachers could monitor the progress of their students, with reference to the initial ones, following the educational pathway undertaken.
In & Out	Evidence of summary	This test was chosen in order to understand the impact of learning about text comprehension on the ability to synthesize. It was Initially proposed to all classes but later it was carried out only by the teachers of the intervention classes. The other teachers considered their time commitment too heavy and so their tests were not available
In Progress	Scheduled questions	During the didactic intervention, the programmed questions were considered a test strictly related to the didactic path proposed in the intervention classes. They were therefore considered necessary in order to check whether they could really be used, both as compensatory tools for students with SLD and as a means of assessment for all the other students, within the framework of the action schemes and the teaching and assessment strategies proposed to the teachers of the intervention classes during the training. Special criteria were also provided for assessing questions.
In Progress	Unstructured face-to-face interviews with teachers	Unstructured interviews were made available and carried out at the request of teachers of intervention classes only, in order to clarify any doubts about the application of the proposed strategies. These interviews were recorded and transcribed.
Out	Checklist for observing the study of a student with SLD	At the end of the school year, the proposal to observe and describe in detail the study methods of students with SLD was considered important in order to collect useful data to characterize the situation in all its complexity (What compensatory tools did they use in their studies? What dispensatory measures have they adopted? What study strategies did they prefer?). Like the summary test, this one was also proposed to all classes, but its administration was accepted and carried out only by the teachers of the intervention classes.
Out	Structured interview with teachers	To detect the specific point of view of the teachers of the intervention classes, activating a reflexive action also attentive to the emotional aspects of the students with SLD, was necessary to define the real contexts in which the didactic kit was applied with the relative strategies from a qualitative point of view. It was also considered that this allowed the ecological context of the research to be enhanced, opening up to the knowledge of unexpected data, according to the principle of serendipity (Lucisano & Salerni, 2002).

The Qmeta Metacognitive Questionnaire

The QMeta questionnaire was used in order to detect the metacognitive strategies that the students employ in understanding the text. In the questionnaire, the students expressed the extent to which the statements[11] corresponded to their person-al way of reading, understanding and studying a text, using a rating scale from 0 to 2.

The QMeta provides the opportunity to obtain partial and comprehensive scores. The partial scores are related to critical aspects that should be investigated for a

targeted teaching activity. Comprehensive scores are an index that allows an easy evaluation of the metacognitive aspects implemented by the students while reading. They offer a single figure that allows comparisons to be made between students with and without SLD certification, within the same class group.

The total time within which each test had to be completed was not established be-fore, but all the classes completed it within ten minutes. Students with SLD did not need additional time, as they were able to read the items with the help of the teacher.

For the students with SLD as well as for the other students, two repeated-measures analysis of variance (ANOVA) models were conducted on the two types of classes involved.

Responses to the QMeta metacognitive questionnaire, whose aggregate data are reported here, showed that, at the end of the year, students with and without SLD in the intervention classes report using more metacognitive strategies for comprehension and text study than at the beginning of the year.

The analysis of the data for the students with SLD in the intervention classes shows that the teaching action contributed positively ($F = 122.645$; $p < 0.001$; ES = 0.192) to the students' employing metacognitive strategies, such as: anticipation, identification of the most important information, summarizing and discussing with others. As shown by the post-test, the answers reveal a significant improvement both with respect to their initial performance ($M = 3.083$ *vs.* 12.833; $p < 0.001$) and with respect to the performance of the students of the control classes at the end of the school year ($M = 12.833$ *vs.* $M = 6.500$; $p < 0.001$) (**Table 3** and **Figure 1**).

The analysis of the data shows that for the students without certification of SLD in the intervention classes the didactic action contributed positively to the use of metacognitive strategies ($F = 336.310$; $p < 0.001$; ES = 0.212). At the post-test, the answers show a significant improvement both with respect to their initial performance ($M = 4.820$ *vs.* 12.920; $p < 0.001$), and with respect to the answers of the students of the control classes at the end of the school year ($M = 12.920$ *vs.* $M = 6.139$; $p < 0.001$) (**Table 4** and **Figure 2**).

The Structured Interview with the Teachers

Following the administration of the exit tests, the Structured Interview addressed to the teachers of the intervention classes showed that the project was considered *an excellent opportunity for professional growth*. This was particularly due to the fact that the teaching strategies present in the SUST made it possible *to increase the students' knowledge and skills in an evident and parallel way. This facilitated the inclusion of those with difficulties, resulting in a general level of competence in understanding and studying linguistic, historical-geographical and scientific texts.*

In particular, the teacher of the class which obtained the best result for students with SLD stressed that the activity in the *reciprocal teaching* section of the kit *helped them to overcome their difficulties* and proved to be a powerful tool for inclusion. Students with SLDs are in fact "progressively improved in the process of text comprehend-

Table 3. Answers of Students with SLD (QMeta Questionnaire).

Time	Class	Mean	SD	N
Post	Intervention	12,833	2,334	24
	Parallel	6,500	2,236	12
Pre	Intervention	3,083	1,530	24
	Parallel	4,250	1,712	12

Table 4. Students without Certification of SLD (QMeta Questionnaire).

Time	Class	Mean	SD	N
Post	Intervention	12,920	1,872	50
	Parallel	6,139	2,244	36
Pre	Intervention	4,820	1,320	50
	Parallel	5,111	2,376	36

sion, in particular in asking questions, hypotheses, arriving at syntheses and managing time" (Traversetti & Rizzo, 2019).

Moreover, it emerged that "some of them, who in collective discussions related to the reading of a text initially failed to make relevant interventions, were more confident in intervening" (Traversetti & Rizzo, 2019).

With regard to the activities related to graphic and summarizing organizers, the teachers of 2 out of 3 classes considered it appropriate to revise the Personalized Learning Plans (PDPs), monitoring them in *itinere* (in progress) and redesigning them in order to take into account the use of SUST strategies.

With regard to the critical points that emerged, the teachers of 2 out of 3 intervention classes revealed that the most complex phase was that of producing the summary in 20 words, especially for students with SLD. These students, in fact, were more focused on the game of finding and counting the 20 words within which to write the summary rather than on summarizing the content.

The teaching strategy which has proven to be the most effective in solving this particular problem is slowing down and spending a lot of time reading and care-fully analyzing the various summaries.

Discussion

Despite the small sample size, we can be assured that the project had positive results in relation to the development of text comprehension by students with SLD and other students. Following the intervention, in fact, students with difficulties achieved better

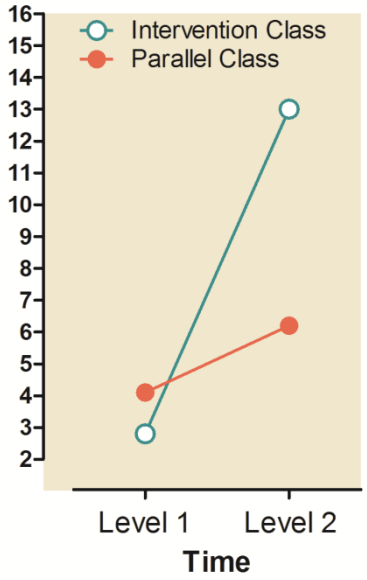

Figure 1. Use of Metacognitive Strategies According to Students with SLD into the Involved Classes, at the Beginning and End of the School Year.

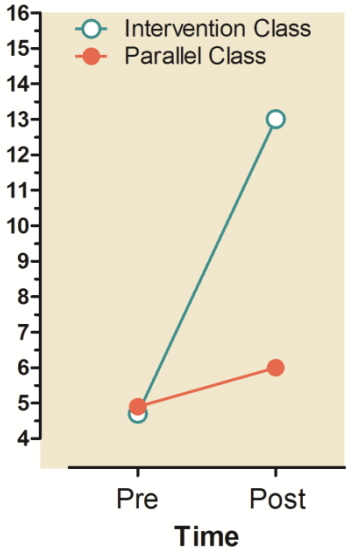

Figure 2. The Use of Metacognitive Strategies According to Students without SLD Certification into the Involved Classes, at the Beginning and End of the School Year.

learning outcomes than students who received the usual instruction (Chall & Jacobs, 2003; Lee & Tsai, 2017).

The common activities always proposed to both students with SLD and their peers showed a clear improvement in their ability to employ metacognitive strategies. At the end of the project, in fact, these students stated that they used the new metacognitive strategies more frequently and more consciously than at the beginning of the year and also than students in the other three classes.

This leads us to believe that the teaching activities carried out in the intervention classes had a strong inclusive value, improving the learning and participation of all the students, with and without SLD. In fact, all students showed great interest and enjoyment in using the different new strategies. The students considered these activities out of the ordinary.

The level of inclusiveness of the intervention classes was enhanced by the redesign of the Personalized Learning Plans (PDPs) for students with SLD and the class programming. Following the training, the effective teaching strategies of the SUST were included to promote text comprehension for the study of different subject.

Despite some difficulties, therefore, it seems possible to state that the methodological approach of the training has made it possible to lay the foundations for effectively combining research with teaching, according to a sustainable and useful intervention model to be replicated in other situations.

The research outlines possible applications in broader scenarios. Considering the usefulness of the proposal, the project should be continued in order to improve the development of the SUST and extend it to a repertoire of different types of texts: not only narrative and explanatory, but also regulatory and argumentative.

In the development of the overall intervention, it will also be necessary to take into account the need to apply the teaching strategies over a longer period of time, probably from November to May, as well as suggested by teachers.

Notes

1. *For further details, see: Borkowski, Muthukrishna, 2011; Chiappetta Cajola, Traversetti, 2016, 2018.*
2. *For further information, see: Nussbaum, Sen, 1993; Sen, 1982, 1992, 2000, 2009; Nussbaum, 2011.*
3. *To deepen, see: Delors, 1997; Council of the European Union, 2018.*
4. *Capabilities can be divided into: internal capabilities (intellectual, emotional, personal, perception and movement) and combined capabilities (the result of interaction with the living environment). Capabilities are thus the sum of internal capabilities and the social, political and economic conditions in which people's functioning can be determined.*

5. *Sen illustrates a similar concept by comparing the choice of a wealthy person to abstain from food with the contingent situation of a person suffering from hunger (Sen, 1999). The former possesses the essential capabilities to choose to fast, the latter is deprived of these capabilities and is substantial-ly disadvantaged.*

6. *It is a standardised indicator representing a measure of the strength of an investigated phenomenon. If the number is less than zero, the result is negative, if it is higher, it indicates a positive result. A value between 0 and 0.10 has a small effect, up to 0.30 has a medium effect and above 0.50 has a large effect. "The threshold above which the consequential effect of a given intervention visibly shows its effects is from ES=0.40" (Bonaiuti, 2014, pp15).*

7. *Those who have difficulties in the specific domain of text comprehension at the transition between the third and fourth grade of primary school (Chall & Jacobs, 2003).*

8. *SApIE is the association that in Italy promotes the dissemination of evidence-informed learning strategies, www.sapie.it.*

9. *The "Guidelines for the right to study of students and students with specific learning disorders" (MIUR, 2011) provide operational indications to teachers and guide them to the use of appropriate compensatory and dispensatory measures. Compensatory and dispensatory measures include: use of voice synthesis, calculator, diagrams and maps, forms, etc.; reading by others; additional time during tests.*

10. *For other results see: Traversetti, Rizzo, 2020 and Rizzo, Traversetti, in press.*

11. *The statements are as follows: "It happens to me that at a certain point I get lost and don't know what is being talked about"; "It happens to me that I imagine what will happen in the text after reading the title"; "I stop to look for the most important things in what I am reading"; "I try to guess the meaning of unknown words or phrases"; "It happens to me that I linger in the middle of the story to imagine how it will end"; "I underline the text to select the most important things"; "I think back in a few words what I have read, how far I have got"; "I re-read to make sure I have understood what I am reading"; "In my mind I summarize what I am reading"; "I look for other people to discuss with be-cause this allows me to better understand what I am reading" (La Marca, Di Martino, Gülbay, 2019).*

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ORIGINAL ARTICLE

The Influence of Parent-Child Relationship on the Academic Pressure of Elementary Students: A Moderated Mediation Model

—Based on the Survey and Analysis of 38,069 Elementary Students

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***Abstract**: Taking the elementary students of grade 5 in Jiangsu Province as the object, the research is carried out on the family and peer factors that affect the academic pressure of elementary students. The results show that parent-child relationships and peer relationships are critical protective factors for elementary students' academic pressure. The parent-child relationship negatively predicts the academic pressure and affects its academic pressure through the peer relationship, while self-esteem regulates the relationship between the peer relationship and the academic pressure. The study results suggest that constructing a good parent-child relationship and peer relationship while improving children's self-esteem positively impacts elementary students to cope with academic pressure.*

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***Keywords**: Elementary Students, Academic Pressure, Parent-Child Relationship, Peer Relationship, Self-Esteem*

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Question

ACADEMIC pressure is the various stimuli from the environment that students endure in the learning process and the resulting physical, psychological, and socially behavioral reflections. It has been widely concerned by scholars in education and psychology for a long time. Based on many previous studies, it is generally believed that academic pressure includes both subjective and objective aspects: one is the accurate load of learning, and the other is the physical discomfort and psychological pressure caused by the students facing their tasks (Long et al., 2013), and the latter is our preferred factor in this study. Too high academic pressure will negatively affect academic performance, volition control (Pan et al., 2016), and sleep quality (Dou et al., 2019); and easily cause negative emotions such as anxiety and depression in students (Liu & Tao, 2005). Severe academic pressure can also lead to academic burnout (Zhu & Wang, 2009) and even negative behavioral tendencies such as self-harm and suicide (Zhang et al., 2016; Ang & Huan, 2006). It can be seen that excessive academic pressure has negative effects on children's physical and mental health. In the past few years, more attention has been paid to the academic pressure of middle school students and college students (Li et al., 2019; Lin et al., 2020). In recent years, with the increasingly fierce competition, the notion of "not letting children lose at the starting line" has taken root in people's hearts. Children begin to bear the multiple expectations of parents, teachers, and society from the elementary level. Even if repeated requests are made to reduce the burden on students, the phenomenon of excessive academic pressure on elementary students still exists. Studies have found that contemporary elementary students most often experience negative life events with academic performance as the mainstay (Yu & Chen, 2001), and their academic pressure level is generally on the rise (Wu, 2019) and has exceeded the appropriate level (Huang & Wang, 2020). What is more worthy of vigilance is that academic pressure, which has been increasing in recent years, has become a significant risk factor that causes elementary students' destructive emotions, problematic behaviors, and even suicidal behaviors (Chen et al., 2010; Zheng et al., 2001; Li, 2020). Therefore, reducing the burden must start with reducing the pressure, or reducing the pressure is the essence of reducing the burden. From developmental psychology, elementary school is the beginning of an individual's formal entry into school for systematic learning and a crucial period for personal physical and mental growth and personality development. Therefore, an in-depth discussion on the influencing factors and mechanisms of elementary students' academic pressure is of great value. This will provide theoretical and data support for elementary students' physical and mental health development and elementary education and better guide practical work.

The parent-child relationship refers to the relationship between parents and children. It is the earliest interpersonal relationship established by children, involving two dimensions of intimacy and conflict (Li et al., 2015). Attachment theory (Fisher, 1974) believes that a good parent-child relationship plays a fundamental role in individual adaptation and development; conversely, a poor parent-child relationship may expose it to more risks. Studies have shown that a good parent-child relationship is an

essential factor in promoting children's healthy development, and parents are protective factors for children to alleviate behavioral adaptation problems (Xie, 2020; Wang et al., 2018). On the contrary, a bad parent-child relationship can lead to difficulties in adapting to teenagers and negatively affect their development (Zou et al., 2010). Studies have shown that the parent-child relationship is one of the important factors affecting students' academic pressure. Parents' severe punishment of their children, overprotection, and refusal to deny are strong predictors of academic pressure (Luo, 2019; Wang et al., 2012). A good parent-child relationship has a significant preventive and interventional effect on the academic pressure of students (Mulyadi et al., 2016). However, the longitudinal study of scholars such as Kim found that the closer the parent-child relationship, the greater the academic pressure of the child (Kim & Lee, 2013). According to the pressure buffer model proposed by Sheldon et al., an excellent social support network can provide people with stable and active support, and sufficient social support resources can strengthen the individual's ability to cope with pressure, thereby preventing individuals from perceiving high levels of pressure (Cohen & Wills, 1985). The primary source of social support for elementary school children is the family, and good family support can buffer pressure (Wei et al., 2018).

Although there are many studies on family factors affecting children's pressure, most of them are based on parental rearing styles and family functions (Liao, 2015; Hua, 2018), and there are few studies on the internal mechanism of the parent-child relationship affecting children's academic pressure. How the parent-child relationship affects academic pressure (a moderated mechanism) and under what conditions affect academic pressure (mediation mechanism) remains further explored. Secondly, in previous studies, insufficient attention has been paid to the indirect role of other factors (such as peer relationships) between parent-child relationship and academic pressure, and research on the regulation of individual susceptibility factors/protective factors is also lacking.

According to the ecological system theory of human development, family and peers are two important micro-systems that affect children's development (Bronfenbrenner, 1992). As children enter school collective life, the influence of peers on individuals is becoming increasingly prominent. Studies have shown that the peer relationship of elementary students in grades 3-6 is superior to the parent-child relationship (Dong & Wo, 2005). Peer relationship is a kind of common activity and mutual cooperation relationship between children of the same or similar age, or mainly refers to a sort of interpersonal relationship established and developed in communication between peers or individuals with the same level of psychological development (Yang, 2008). Studies have shown that peer friendship and the frequency of peer interaction are negatively correlated with academic pressure (Li et al., 2019; Wu & Xiang, 2020), while peer infringement is positively correlated with academic pressure (Zhang et al., 2015). A good peer relationship helps reduce negative emotions such as anxiety, depression, and stress (Zhang et al., 2019). It can be seen that the peer relationship is closely related to the academic pressure of children.

The establishment of a good peer relationship may be related to a person's parent-child relationship. As the first interpersonal relationship with the longest duration in an individual's life, the parent-child relationship has an important impact on the individual's peer relationship (Ye & Pang, 1999). Many studies had paid attention to the comprehensive effects of family factors and peer factors on children (Lin et al., 2008; Liu et al., 2019). Although these studies were still controversial, these results supported the indirect effect model of the parent-child relationship and peer relationship on children's problem behaviors. This model emphasized the fundamental role of the parent-child relationship and believed that the parent-child relationship is the foundation for the establishment and development of the peer relationship, which indirectly affected the behavioral adaptation of children through the peer relationship (Tian & Tian, 2014). De Goede et al. believed that the perception of the parent-child relationship will affect children's perception of the peer relationship (De Goede, I. H., et al., 2009). A good parent-child relationship could promote individuals to establish and maintain positive, close and extensive friendships (Yu & Zhou, 2004). Unfavorable parent-child relationships caused children to lose the emotional and trust basis for interpersonal communication, lack the necessary cognitive and social skills (Zheng & Cen, 2006), and are not conducive to children's establishment and development of a good peer relationship. Many other studies had shown that peer factors are in line with the indirect effect model in the influence mechanism of parent-child on adolescents' negative emotions, subjective well-being, loneliness, depression, and risk-taking behaviors (Wang et al., 2016; Zhang et al., 2019; Tian et al., 2014); however, there is still a lack of research on the subject of academic pressure that jointly examines the roles of the two.

The individual-environment interaction model points out that individual behavior is formed and developed in the interaction between the individual and the environment (Chen et al., 2015). Therefore, the discussion on the internal mechanism of children's academic pressure should examine the environmental factors (parent-child relationship, peer relationship, etc.) and discuss the influence of individual elements. Self-esteem is often referred to as the core of mental health, a "buffer" and "filter" for destructive emotions. It is significantly negatively correlated with bad moods such as anxiety and depression that damage mental health (Zhang et al., 2015), and stress is usually one of the causes of bad moods such as anxiety and depression (Wu et al., 2009). As far as the peer relationship is concerned, self-esteem has a significant positive correlation with the peer relationship (Lai et al., 2008), and self-esteem can clearly predict the peer relationship (Liu et al., 2016). Individuals with high self-esteem have a positive attitude towards self-ability and value (Cai et al., 2011) and have better self-regulation ability (Setliff & Marmurek, 2002), and adaptability (Wu et al., 2009); and they tend to be confident and proactive in communicating with the outside world, and it is easy to get the goodwill of their peers. Compared with individuals with low self-esteem, they are more likely to have good interpersonal relationships (Baumeister et al., 2003) and obtain peer support and friendship.

In summary, as important variables in the two micro-systems of family and peer, parent-child relationship and peer relationship have an important impact on the

development and adaptation of adolescents. However, previous studies on the influence of family and peers on academic pressure only focused on one of them. There are few relevant supporting studies on the impact of the combination of the two on the academic pressure of elementary students, resulting in a large number of results "independently" and relatively fragmented (Tian & Tian, 2014). Therefore, it is necessary to deeply explore the mechanism of the two effects on learning pressure, which is also the focus of this research. In addition, previous studies have mainly focused on the buffering effect of self-esteem between stress and adaptability problems (Wu et al., 2009). In contrast, less direct attention has been paid to the regulating effect of self-esteem on stress. Therefore, under the influence of the ecosystem theory, based on the "individual-environment interaction view," this study intends to start from the parent-child relationship and peer relationship between the individual's self-esteem and the environment in which it is located, to examine both the individual and the environment impact on children's academic pressure. Based on the "stress buffer model" of self-esteem, individuals with high self-esteem have more resources to help them cope with destructive emotions and difficulties. This study proposed that self-esteem has a regulating effect on stress. In short, this study intends to construct a moderated mediation model and examine the influence of family factors (parent-child relationship), peer factor (peer relationship), and individual factor (self-esteem) on children's academic pressure. Specifically, this study will investigate the modulator (How does the parent-child relationship work?) and mediation (When does the parent-child relationship work?) mechanisms of parent-child relationships that affect children's academic pressure based on a large sample of 38,069 elementary students. And explore the mediating role of peer relationship and self-esteem's regulation of the mediation chain to provide empirical support and theoretical guidance for the prevention and intervention of children's academic pressure. In summary, we can speculate that peer relationships and self-esteem may have a mediating role between parent-child relationships and academic pressure. The model is shown in **Figure 1.**

This study puts forward the following hypotheses: (1) The parent-child relationship, as a protective factor of academic pressure, can negatively predict academic pressure. (2) The parent-child relationship may indirectly affect the academic pressure through the peer relationship, that is, the peer relationship is likely to play an intermediary role between the parent-child relationship and the academic pressure. (3) Self-esteem plays a regulatory role in the path of "peer relationship-academic pressure."

Methodology

Research Objects

Since 2006, Jiangsu Province has gradually established an academic quality monitoring system for basic education students in the province. Every two years, the academic level of elementary and middle school students is tested, and data related to students' academic performance is collected through questionnaire surveys; the scope of the study

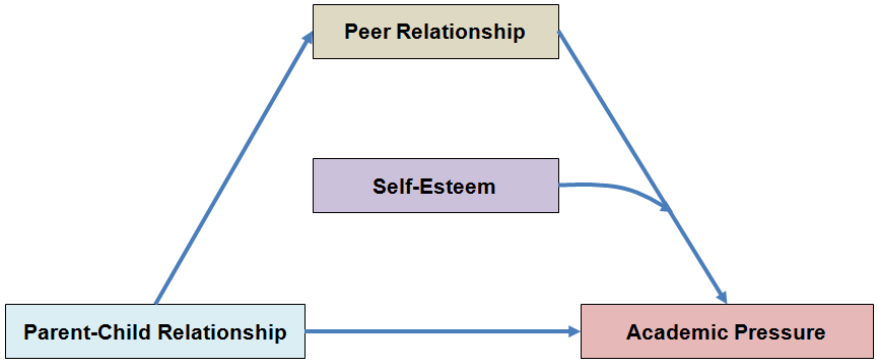

Figure 1. The hypothesis of the Moderated Mediation Model.

includes randomly selected students and teachers, and school leaders of their schools. The data used in this study comes from the 2018 basic education student academic quality monitoring data in Jiangsu Province. The test adopted a two-stage stratified sampling method to conduct random tests and surveys on elementary and middle school students. Among them, the elementary school randomly checked the fifth-grade students of 1,725 schools. After excluding samples with missing main variables and apparent errors in the answers, 38,069 samples were finally included in the analysis. The effective subjects were 19,831 males and 18,238 females; 18,911 were only one child, and 19,158 were non-only-one children.

Research Tools

Parent-Child Relationship

Use self-compiled five items, namely "I feel happy with my parents," "I will share my secrets and personal feelings with my parents," "My parents and I will argue with each other or blame each other," "When I encounter problems, my parents will help me solve it," and "I will do something happy with my parents." Each item is scored with 5 points (1 "never"→5 "always"). Item 3 is reverse scoring. The higher is the scale score, the higher is the parent-child relationship level. Use AMOS 22.0 for confirmatory factor analysis (the same below). The fitting results are obtained: x^2/df = 163.65, RMSEA = 0.065, CFI = 0.982, TLI = 0.963. The results show that the questionnaire fits well. The α coefficient of the questionnaire was 0.65.

Peer Relationship

Use self-compiled five items, namely "I am happy when I am with my classmates," "I often quarrel with my classmates," "I can find friends when I need them," "Classmates like me very much," and "It's hard to make others like me." Each item is scored with 5

points (1 "disagree" →5 "agree"). Among them, the second and third items are scored in reverse. The higher is the scale score, the higher is the peer relationship level. Using factor analysis, the question "I often quarrel with my classmates" was deleted. The remaining four questions fit well: x^2/df = 13.96, RMSEA = 0.018, CFI = 0.999, TLI=0.995. The α coefficient of the questionnaire was 0.65.

Self-Esteem

Use self-compiled five items, namely "I feel I have many advantages," "I feel that I am a loser," "I can do things well like most people," "In general, I am Satisfied," and "I often feel that I am useless." Each item is scored with 5 points (1 "Agree" →5 "Disagree"). Among them, the second item is reverse scoring. The higher is the scale score, the higher is the level of self-esteem. In this study, the questionnaire fits well: x^2/df = 120.43, RMSEA = 0.056, CFI = 0.990, TLI = 0.967. The α coefficient of the questionnaire is 0.66.

Academic Pressure

Six self-compiled items are used, namely "the amount of homework," "the difficulty of the homework," "the number of tests and examinations," "if the school announces the results and rankings, how do you feel," "I feel that during class Nervous," and "Every time I take an exam, I'm always worried that I cannot do well." Each item uses a five-point scoring. The higher the scale score, the higher the academic pressure. In this study, the questionnaire fits well: x^2/df = 201.48, RMSEA = 0.073, CFI = 0.977, TLI = 0.915. The α coefficient of the questionnaire is 0.66.

Data Analysis

Use SPSS25.0 to calculate descriptive statistics, correlation coefficients, and internal consistency reliability analysis of each variable. Use AMOS22.0 to perform confirmatory factor analysis on each variable. Use the SPSS macro program PROCESS to carry out moderated mediation analysis.

Common Method Deviation Test

Harman's single factor method was used to test the common method deviation (Zhou & Long, 2004). In the test, all items related to the four variables of the parent-child relationship, peer relationship, self-esteem, and academic pressure are used for exploratory factor analysis to extract a factor. It was found that the explanatory rate of the first-factor variable was 22.19%, which was less than 40%, indicating that there is no serious common method bias problem in this study.

Results

Descriptive Statistics and Related Analysis of Each Variable

Pearson correlation analysis is performed on the scores and gender of elementary students in the parent-child relationship, peer relationship, self-esteem, academic pressure, and whether they are the only child. The results are shown in **Table 1**. Both parent-child relationship and peer relationship are significantly negatively correlated with learning pressure, indicating that they are both protective factors for learning pressure; parent-child relationship and peer relationship are significantly positively correlated, indicating that independent variables and intermediate variables are relatively independent and suitable for doing a subsequent test of mediation effect. At the same time, the correlation between self-esteem and peer relationship, and academic pressure is significant. The peer relationship is positively correlated with self-esteem, and academic pressure is negatively correlated with self-esteem, which is suitable for subsequent moderating effect testing (Wen et al., 2005). In addition, the results showed that gender and whether an only child is significantly related to the parent-child relationship, peer relationship, self-esteem, and academic pressure. In view of the fact, the existing studies have found that the depression of only children is higher than that of non-only children (Fan, 2014), academic pressure is an important factor in the development of depression in Chinese adolescents (Hou & Chen, 2016). Therefore, this study takes the only child or not as a control variable into the model. In addition, studies have found that gender is an important individual factor affecting the development of adolescents' self-esteem (Pan, 2015). Girls are more likely to perceive higher stress than boys (Ma, 2014). Therefore, this study also included gender as a control variable in the model.

The Influence of Parent-Child Relationship, Peer Relationship, and Self-Esteem on Academic Pressure

To test whether there is a moderating mediation model for the influence of the parent-child relationship on academic pressure, we first tested the mediating role of the peer relationship between parent-child relationship and academic pressure. Based on the above analysis, it is found that the relationship between parent-child relationship, peer relationship, and academic pressure meets the conditions for mediating effect analysis. Therefore, model 4 in the PROCESS program developed by Hayes is used to analyze the mediating effect (Bolin, 2014), and gender and whether to be alone are included in the control variables for analysis. As shown in **Table 2**, the parent-child relationship can negatively predict the academic pressure of elementary students (β = -0.28, t = -56.29, $p < 0.001$), and positively predict the peer relationship (β = 0.37, t = 78.26, $p < 0.001$). The peer relationship can negatively predict academic pressure (β = -0.20, t = -38.62, $p < 0.001$). The Bootstrap 95% interval of the direct effect of the parent-child relationship on academic pressure and the indirect effect of peer relationship does not

Table 1. Descriptive Statistics and Correlation Analysis Results of Each Variable (n=38,069).

Variable	M±SD	Min (Max)	1	2	3	4	5	6
1 Gender	1.48±0.50	1 (2)	1.00					
2 Only-one Child	1.50±0.50	1 (2)	0.03**	1.00				
3 Parent-Child Relationship	21.17±3.79	5 (25)	0.04**	-0.07**	1.00			
4 Peer Relationship	17.47±3.13	4 (20)	0.10**	-0.07**	0.38**	1.00		
5 Self-Esteem	21.13±4.13	5 (25)	0.03**	-0.08**	0.37**	0.46**	1.00	
6 Academic Pressure	16.87±3.63	6 (30)	-0.01*	0.04**	-0.28**	-0.28**	-0.32**	1.00

*Note: Gender1 = Male, Gender2 = Female; Only-One Child1 = Yes, 2 = No. *p < 0.05, **p < 0.01, two-tailed test.*

Table 2. Regression Analysis (Standardization) of the Mediating Model of Peer Relationship between Parent-Child Relationship and Academic Pressure.

	Academic Pressure		Peer Relationship		Academic Pressure	
Variable	*β*	*t*	*β*	*t*	*β*	*t*
Gender	-0.01	-0.52	0.18	18.94***	0.03	3.21**
Only-One Child	0.04	4.13***	-0.09	-9.33***	0.02	2.36*
Parent-Child Relationship	-0.28	-56.29***	0.37	78.26***	-0.20	-38.88***
Peer Relationship					-0.20	-38.62***
R^2	0.08		0.15		0.11	
F	1080.68***		2271.90***		1215.22***	

*Note: *p < 0.05, **p < 0.01, ***p < 0.001, two-tailed test. Each variable in the model adopts the standardized variable.*

Table 3. A Test of the Mediating Role of Peer Relationship in Parent-Child Relationship and Academic Pressure.

			Boot CI	Boot CI	
Effect Type	Effect Size	Boot SE	Lower Limit	Upper Limit	Relative Effect Ratio
Overall Effect	-0.278	0.005	-0.288	-0.268	100.00%
Direct Effect	-0.203	0.006	-0.214	-0.192	72.99%
Indirect Effect	-0.075	0.002	-0.080	-0.070	26.98%

Each variable in the model adopts the standardized variable.

Table 4. Moderated Mediation Model.

Regression Equation					
Outcome Variable	**Predictor Variable**	***β***	***t***	R^2	***F***
Peer Relationship	Gender	0.179	18.941***	0.152	2271.899***
	Only-One Child	-0.088	-9.335***		
	Parent-Child Relationship	0.371	78.265***		
Academic Pressure	Gender	0.024	2.497*	0.146	1084.557***
	Only-One Child	0.003	0.338		
	Parent-Child Relationship	-0.157	-29.891***		
	Peer Relationship	-0.139	-24.049***		
	Self-Esteem	-0.214	-38.178***		
	Peer Relationship × Self-Esteem	-0.036	-8.842***		

*Note: *p < 0.05, **p < 0.01, ***p < 0.001, two-tailed test. Each variable in the model adopts the standardized variable.*

contain 0 (see **Table 3**), indicating that the peer relationship plays a part of the mediating role between parent-child relationship and academic pressure.

Secondly, model 14 is used to analyze the moderated mediation model, and gender and only child are included as control variables. The results are shown in **Table 4**. After putting self-esteem into the model, peer relationship significantly negatively predicts academic pressure (β = -0.139, t = -24.049, $p < 0.001$), and the product term of peer relationship and self-esteem has a significant effect on the prediction of academic pressure (β = -0.036, t = -8.842, $p < 0.001$). This shows that self-esteem has a significant moderating effect on peer relationships and academic pressure.

According to the mediating effect analysis results with moderation, gender and whether the only-one child is the control variables and the specific path coefficients between the variables are shown in **Figure 2**.

To specifically reveal the magnitude and direction of the self-esteem adjustment effect, the self-esteem score is divided into "high self-esteem group" and "low self-esteem group" based on the mean ± 1 standard deviation (SD), and a simple slope analysis is performed (Simple slope analysis), the results show (see **Figure 3**). Under low self-esteem conditions (one SD below the average), peer relationship has a significant negative predictive effect on academic pressure (β = -0.10, t = -16.97, $p < 0.001$); under high self-esteem conditions (one SD higher than the average), the peer relationship still has a significant negative predictive effect on academic pressure (β = -0.17, t = -22.29, $p < 0.001$), but the predictive effect is greater at this time.

Discussion

This study constructed a moderated mediation model based on a larger sample of data. It focuses on the mediating role of the peer relationship between the parent-child rela-

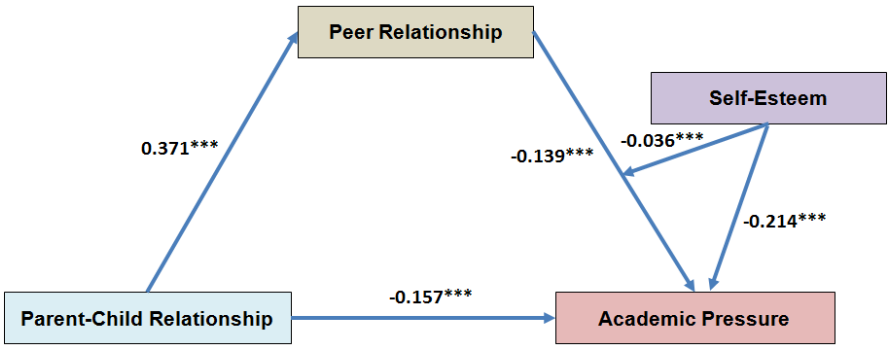

Figure 2. A Diagram of a Moderated Mediating Effect Model.

*Note: *p < 0.05, **p < 0.01, ***p < 0.001, two-tailed test.*

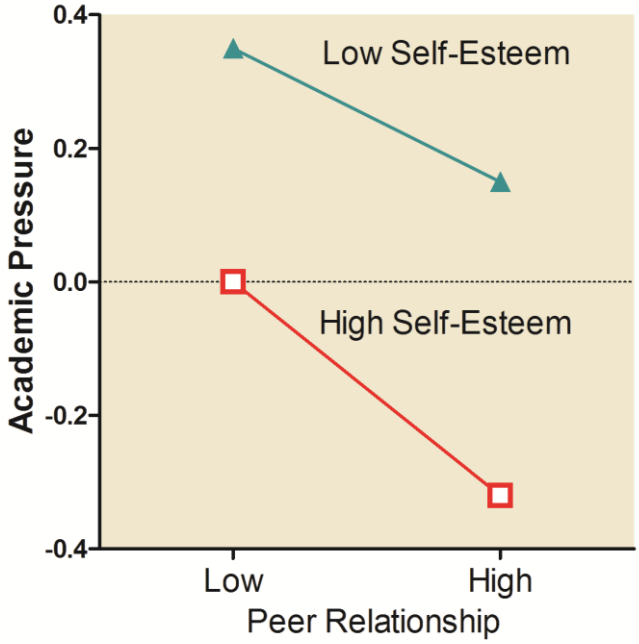

Figure 3. Diagram of the Moderating Effect of Self-Esteem on Peer Relationship and Academic Pressure.

tionship and the child's academic pressure and whether this role is regulated by self-esteem. The research results help to answer what the parent-child relationship passes (how does it work?) And under what conditions (when does it work?), these two key

issues affect academic pressure. It has specific theoretical and practical significance for future research in this field and preventive intervention of academic pressure.

The Impact of Parent-Child Relationship on Academic Pressure

The results of this study show that the parent-child relationship of elementary students negatively predicts academic pressure, that is, the better the parent-child relationship, the lower the academic pressure level, which is consistent with most previous research results (Cohen & Wills, 1985), and once again supports the attachment theory and pressure buffer model. It shows that a good parent-child relationship is a protective factor for elementary students' academic pressure, which can be interpreted as follows: a good parent-child relationship is conducive to the establishment of active parent-child attachment and promotes parent-child communication and family support (Mulyadi et al., 2016). The more proactive the parents are to communicate with their children, the more helpful it is to reduce the children's academic pressure (Xu & Zhang, 2017). A supportive parent-child relationship from the family can significantly alleviate the negative effects of stress on emotional behavior adaptation (Wang et al., 2018).

However, the aforementioned Kim et al. have reached inconsistent research conclusions. They conducted a 5-year longitudinal study on the parent-child relationship and academic pressure of Korean children. Using a horizontal analysis, they found that the parent-child relationship has a positive effect on academic pressure. Pressure has a negative effect, which is consistent with the horizontal research results in this article. However, the cross-lag analysis found that the parent-child relationship can positively predict the academic pressure of adolescents. The reason for this difference lies in the difference in the design of the two experiments. This research focuses on investigating the correlation between the two, while the study of Kim et al. aims to explore the causal relationship between the two after a long period of data collection. Secondly, the subjects of the two studies are different. The subjects of Kim et al.'s study are middle school students who are in their adolescence, who are more emotionally rich and sensitive; with the increase in academic difficulty, when they cannot meet the expectations of their parents or have a gap with their peers, it is easy to have a strong sense of self-blame and guilt, which in turn increases the sense of academic pressure (Kim & Lee, 2013). The object of this study is at the elementary school level, and the academic difficulty is relatively low. As long as the parents give some active companionship and the children receive positive support, the perception of academic pressure can be significantly reduced.

The Intermediary Role of Peer Relationship between Parent-Child Relationship and Academic Pressure

It can be seen from the contents mentioned above that peer factors' introduction helps explain the mechanism through which the parent-child relationship affects children's academic pressure. The results of this study show that the peer relationship plays an intermediary role between the parent-child relationship and the academic pressure, which supports the indirect effect model, that is, the parent-child relationship can also indirectly affect the child's academic pressure through the peer relationship. Children with a high-quality parent-child relationship are more likely to establish and develop a good peer relationship, thereby reducing their academic pressure. This can be explained from the following aspects.

First of all, according to ecosystem theory, a positive parent-child relationship will make children feel respected. Then they have optimistic understandings and expectations of themselves, others, and the surrounding environment. They are willing to associate with people other than their parents and form a more active peer relationship (Ye & Pang, 1999). On the one hand, a good peer relationship can promote the spontaneous formation of informal learning groups between peers. They share their understanding of knowledge and attitudes towards academic work and can urge each other to complete specific learning tasks together (Fawcett & Garton, 2005). On the other hand, sharing information between peers reduces the difficulty for individuals to complete academic tasks alone, and the interaction between peers also stimulates children's learning enthusiasm (Ryan & Shim, 2012), and they feel less academic pressure. Secondly, according to social learning theory, a good peer relationship is the basis for peer relationships. In the process of interacting with peers, children will acquire a series of social skills, social behaviors, attitudes, and experiences, which in turn affect children's social adaptation (Rubin et al., 2007) and better cope with academic pressure. Finally, both the social development model and the primary socialization theory point out a close connection between the background factors of individual development (such as family, peers) (Chen et al., 2015). A good parent-child relationship encourages children to develop good interpersonal relationships and social adaptability, establishing high-quality friendships. Companions help each other, share and discuss academic experiences together, thereby reducing academic pressure.

All in all, the ecological subsystems do not work independently but are interconnected. As revealed by the results of this study, the parent-child relationship and peer relationship, two supportive relationships, can jointly promote academic adaptation (Song & Wang, 2017). While the parent-child relationship relieves the academic pressure, it can also increase the protective effect of the peer relationship on the academic pressure, thereby increasing the possibility of children being affected by dual protective factors. This result has some enlightenment for the prevention and intervention of children's academic pressure. The prevention and intervention of children's academic pressure should not only start with the simple family, peers, and other factors, but should pay attention to the linking effect of these factors, and pay attention to the different environments of individuals (such as family environment and peer groups) as much as possible. Not only the far-end factors of academic pressure, but also the near-end factors have been taken care of. As far as this research is concerned, we should pay special

attention to children's peer relationships, communicate in time, give appropriate guidance, and assist children in establishing a positive and mutually helpful peer relationship.

Self-Esteem Adjustment between Peer Relationship and Academic Pressure

Based on the "individual-environment interaction model," this research constructs a moderated mediation model. We found that self-esteem has a significant regulatory effect in the intermediary chain of "peer relationship—academic pressure." The pressure buffer hypothesis of self-esteem points out that individuals with high self-esteem have more coping resources than individuals with low self-esteem, which helps them to better cope with stressful events. A bad peer relationship may lead to negative interpersonal relationships such as peer rejection, peer rejection, and peer infringement, which can be stressful. Individuals with high self-esteem generally have high self-evaluation and good psychological resilience (Guo & Ye, 2016), can effectively cope with the impact of a lousy peer relationship, reduce the negative consequences of individuals in a bad peer relationship (Zhao et al., 2016), and actively adapt to school life. On the contrary, children with low or medium self-esteem have poor psychological resilience. It is difficult to find a balance point in the peer relationship, which leads to poor school adaptation (Guo et al., 2005) and increases academic pressure.

Conclusions and Suggestions

Based on the above research results, we found that good parent-child relationships and peer relationships negatively predict academic pressure. At the same time, children's self-esteem has positive significance for elementary students to cope with academic pressure. Based on this, the moderated mediation model established in this study to explore the factors affecting elementary students' learning pressure has enlightened educators. Specific to the practical level, we suggest: (1) In terms of family, parents of elementary students should strive to adopt active and practical strategies to establish an open and equal parent-child relationship with their children. For example: communicate with children on an equal footing, listen more and less blame, pay more attention to emotions and life, pay attention to children's efforts, and play down excessive attention to academic performance. Such a good parent-child relationship can promote effective parent-child communication. Children are willing to open up their hearts to confide academic pressure to their parents and receive positive feedback and active support from their parents so that they can effectively cope with external pressure and anxiety, promote children's mental health development, and avoid various negative emotions and behaviors caused by academic pressure. (2) In schools, through the development of a variety of class activities, the communication between children and peers can be increased, and the emotional support, information support, and tool support between elementary students can be enhanced (Solomon, 2004), and children's loneliness and so-

cial anxiety can be alleviated. In short, the effective construction of these two aspects can help elementary students to relieve academic pressure to a greater extent. (3) On the individual side, children's self-esteem has a certain degree of plasticity, increasing the affirmation and support, companionship, and intimacy of children from the three aspects of parents, friends, and teachers (Liu & Zou, 2007), thereby fostering and enhancing children's self-esteem. This will alleviate the impact of bad peer relationships on academic pressure, and help individuals to self-regulate academic pressure.

Limitations and Perspective

The starting point of this research design is based on ecosystem theory and development context theory, and the investigation variables are mainly selected from a positive perspective. It aims to explore the parent-child relationship and peer relationship of elementary students and the protective effect of self-esteem on academic pressure. But as far as the source of children's academic pressure is concerned, there is a clear trend of diversification (Chen, 2004). Therefore, in the future, we should also explore the influence of factors such as interpersonal conflict, peer rejection, parental expectations, and teacher-student relationship on academic pressure, or we can also examine the interaction effects of different factors. This will be more conducive to comprehensively revealing the generation mechanism of elementary students' academic pressure to guide educational practice better and promote children's physical and mental health. Secondly, Folkman's stress cognitive interaction model believes that some potential stressors need an individual cognitive assessment before they can become actual stressors, affecting individual psychological or behavioral performance (Folkman et al., 1986). Therefore, in addition to the self-esteem variable investigated in this study, the individual's cognitive evaluation of academic pressure and assessing their resource coping capabilities may also become moderating factors, so they must be fully considered in the future research design. And add relevant elements to the scope of the investigation.

Excessive academic pressure does indeed cause some children's adverse emotional reactions and various bad behaviors, but the pressure itself is also positive. For example, Martin and Marsh (2008) groundbreakingly explored the psychological mechanism of recovery and growth of students under daily academic pressure, which points out the direction for investigating how students under stressful situations can construct active adaptation mechanisms (Zhao & Yu, 2018). Therefore, in the follow-up research, we can analyze how the dynamic adaptation mechanism under academic pressure is generated? Are there individual differences? These will be more conducive to the transformation and resolution of children's academic pressure and benefit elementary students' physical and mental health.

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REVIEW

Targeted Poverty Alleviation Model of China's Online Education Based on "Triple Classroom": Take the "Shi Shi Xiang Yun" Online School in Chengdu, China as an Example

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***Abstract**: The use of increasingly popularized information technology to improve education poverty and then promote the balanced development of education has become the development trend of world education. On the road to poverty alleviation, China has firmly grasped information technology to encourage school reform in areas with scarce educational resources. Among them, "Triple Classroom" was the accurate result of the deep integration of education, teaching, and information technology. Driven by the "Triple Classroom" project, the Shi Shi Middle School in Chengdu, Sichuan Province, built the online open course with the "Shi Shi Xiang Yun (SSXY)" online school as a platform. Thus, they send high-quality educational resources to areas with scarce educational resources and effectively promote education quality improvement in marginal areas.*

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Introduction

THE popularization of information and communication technology has undoubtedly brought opportunities for the world's development. It can improve or create a favorable learning environment for learners, promote teaching and learning, and help learners develop creative thinking and self-confidence (Das, 2019). Tinio (2003) believes that information and communication technology has broadened access to knowledge and provided unprecedented opportunities for impoverished areas for developing countries. For example, the development of Massive Open Online Courses (MOOC) offers free and open education courses worldwide to help students who cannot receive school education continue to complete their studies (Lambert, 2020; Saputeri & Purwanti, 2021). From this point of view, the popularization of educational information technology has provided help to solve the problem of uneven educational development.

The promotion of Internet technology to education fairness is reflected in the acquisition of knowledge and the advantages of information technology without time, space, and subject limitations. Moreover, it provides more favorable conditions for realizing equal educational opportunities and the balance of educational resources among schools, counties, cities, provinces, and even larger areas (Peng & Lin, 2010). Therefore, with the in-depth integration of education and technology, countries have begun to use information technology to promote educational equity and promote high-quality and balanced education.

The United States is one of the countries with a relatively high level of information technology development globally. It attaches importance to information technology to transform education, formulates national educational technology plans, and puts forward relevant goals, requirements, and measures. For example, the USA began to implement *No Child Left Behind in 2001*, and the *Every Student Succeeds Act* began in 2015 to promote education equity effectively. This series of measures ensured the balanced development of compulsory education from the policy and system level. In addition, they applied information technology to actual teaching practice, which enabled the United States to make long-term progress in basic education information (Harris & Al-Bataineh, 2015; U.S. Department of Education, 2001; U.S. Department of Education, 2005).

To realize the role of information technology in education development, the United Kingdom also provides every child with equal access to information technology learning at the legislative level to meet individual students' information technology learning needs. In the "*Harnessing Technology: Transforming Learning and Children's Services*" development strategy, it is established that online information services should be provided to citizens, a digital learning environment for resumes, rich digital resources, advanced teaching methods, and support for children's personalized learning of information. In addition, the UK has built a series of projects, such as the "*2006-2008 Student Computer Project*". These all focus on the learning experience of children's information technology and help students master ICT skills (information and communication technology) and related life skills to achieve educational equity (Fei & Ma, 2008).

With the rapid development of information technology in China, education for poverty alleviation has also embarked on the information model. In 2017, the Chinese government emphasized in the "Decision of the Central Committee and the State Council on Winning the Tough Fight Against Poverty" that "accelerate the implementation of education poverty alleviation projects, so that children from poor families can receive fair and quality education, and block the intergenerational transmission of poverty" (Central State Council, 2017). With the achievement of overall poverty alleviation in 2020, the need for education-targeted poverty alleviation in the post-poverty alleviation period becomes more urgent. Educational information technology is a crucial means to achieve education-targeted poverty alleviation (Chen & Chen, 2017). In March 2020, the Ministry of Education issued the "*Guiding Opinions on Strengthening the Application of 'Triple Classroom*,'" which clearly stated that "promote the deep integration of information technology and education and teaching practice, promote classroom revolution, innovate education and teaching models, promote the transformation of education methods, and build the new ecology of 'Internet + Education'" (Ministry of Education of China, 2020-03-03).

Chengdu Shishi Middle School established "Shi Shi Xiang Yun" (SSXY) online school in 2013 to participate in educational poverty alleviation work. They use information means to import high-quality educational resources into underdeveloped areas and weak schools, and strive to promote the balance of high-quality education among regions, urban and rural areas, and between schools, and ultimately facilitate the process of education equity. In 2019, Chengdu Shi Shi Middle School established an SSXY online open curriculum application practice community. It explores the appropriate application of high-quality resources in remote areas and strategies for improving education quality through in-depth lesson preparation and other teaching models. This is highly consistent with the concepts of "special delivery classroom," "prestigious teacher classroom," and "famous online classroom" advocated by Triple Classroom. Therefore, it was incorporated into the 2019 Educational Information Application Practice Community of the Ministry of Education.

Construction of Targeted Poverty Alleviation Model Based on Triple Classroom

The classroom is an essential channel for educating people. "Triple Classroom," a special delivery classroom, prestigious teacher classroom, and famous online classroom, is a vital means to realize education-targeted poverty alleviation.

"Special delivery classroom" emphasizes specialization. It mainly addresses the problems of weak schools in rural areas, schools lacking teachers, and poorly developing nationally planned courses. Through the use of special online courses or synchronized courses and the Internet to push appropriate high-quality educational resources according to the teaching progress, etc., help develop the nationally planned courses and promote the equitable and balanced development of education.

"Prestigious teacher classroom" emphasizes sharing. It mainly addresses the problems of teachers' poor teaching ability and low level of professional development. Through establishing a network research community, famous teachers and famous courses can demonstrate the demonstration effect, and new forms of teaching and research activities under the network environment can be explored. Realize that outstanding teachers drive ordinary teachers to improve their level so that the resources of famous teachers can be shared on a larger scale and ultimately promote the professional development of teachers.

"Famous online classroom" emphasizes openness. It is mainly aimed at the urgent need to effectively reduce the education quality gap between regions, urban and rural areas, and schools. With high-quality schools as the main body, online courses, online courses, etc., systematically and comprehensively promote the sharing of high-quality educational resources regionally or nationwide. Eventually, meet the needs of students for personalized development and high-quality education (Fan, 2020).

In fact, "Triple Classroom" is not the first time it has been proposed. It first appeared at the "*Education Informatization Pilot Work Symposium*" of the Ministry of Education in 2012. At the conference, the Ministry of Education proposed for the first time the development of "Triple Classroom" to improve the quality of education in remote areas and promote the sharing of high-quality teaching resources (Ministry of Education of China, 2012-07-13).

In 2014, in the "*Implementation Plan for Building an Effective Mechanism to Use Information to Expand the Coverage of High-Quality Educational Resources*," the Ministry of Education pointed out that it is necessary to promote education equity and improve the quality of education through various forms such as "Triple Classroom" (Ministry of Education of China, 2014- 11-24).

In 2016, it was proposed in the "*Thirteenth Five-Year Plan for Educational Information*" to actively promote the construction of "Special delivery classroom " and consolidate and deepen the "Full Coverage of Digital Teaching Resources at Teaching Sites" (Ministry of Education of China, 2016-06-07).

In April 2018, the Ministry of Education issued the "*Education Informatization 2.0 Action Plan*", which pointed out that by 2022, the development goals of "three comprehensives, two highs and one large" will be achieved. In addition, a platform of "Internet + education" will be built to promote comprehensive coverage of online education (The Ministry of Education of China, 2018-04-13).

In March 2020, the Ministry of Education issued the "*Guiding Opinions on Strengthening the Application of 'Triple Classroom*,'" which requires the full realization of "Triple Classroom" by 2022.

After sorting out the relevant policy documents of the Ministry of Education over the years, the issuance of the "*Guiding Opinions on Strengthening the Application of 'Triple Classroom"*" is China's integration of high-quality resource development, education equity, and information technology. The "Triple Classroom" online education poverty alleviation model proposed in the document breaks through the macro-level discussion on how to realize the sharing of high-quality educational resources. Instead,

it focuses on the classroom itself, with the classroom as the prominent position. That is, through the use of information technology to expand the effective mechanism of the coverage of high-quality educational resources, the promotion of educational resource sharing, teacher development, and student development are connected in series to promote the effective closing of regional, urban and rural, and inter-school gaps, and ultimately achieve high-quality and balanced education Ministry of Education, 2020-03-03).

Construction and Application of "SSXY" Online School

There are 21 prefectures, cities, and prefectures in Sichuan Province. Affected by geographical and economic conditions, education development varies across regions, especially in remote areas. Educational resources such as teaching equipment and teachers are relatively scarce, and education is relatively backward. As China vigorously promotes the construction and development of education informatization, high-tech communication equipment and convenient communication channels have become essential to solve the unstable education situation in various regions.

The SSXY online school is a traditional online school based on classroom teaching records of middle schools that emerged under the background of the 1.0 era of China's education informatization[1]. It is an online education platform for Shi Shi Middle School to implement comprehensive education and balance of urban and rural education. It is also a pilot project of the Sichuan Provincial Department of Education for the "Construction and Sharing of High-quality Digital Education Resources" based on the Sichuan Provincial Education Informatization.

"SSXY" was officially launched on September 1, 2013. It actively responds to the national education goal of "three links and two platforms," using the advanced Internet technology to improve the technical architecture of traditional online schools from collection to dissemination and storage to access. It also provides high-quality educational resources and a number of services for the franchised schools. Furthermore, it takes into account the teachers and students of the online classes of participating schools at different levels. Therefore, it has outstanding characteristics such as universality, demonstration, interaction, sharing, economy, sustainability, and ease of use. Furthermore, SSXY adapts to the learning needs of students and promotes the radiation and guidance of high-quality educational resources to areas with weak education.

Specifically, it has the following functions:

Constructed a Network Teaching Application Model Suitable for the Development of Different Schools

SSXY is an organic combination of course output and resource supply. It is a resource and application platform based on general middle school teaching. It can provide vari-

ous services such as synchronous classroom live broadcast, asynchronous course on-demand, synchronous education and research, synchronous evaluation, synchronous training, and synchronous course resources for teachers and students of small schools time. In the SSXY community project research, the application mode of online courses (classroom) is deeply explored. Three practical and practical courses use paradigms, and several typical cases have been formed, namely, resource sharing mode, dual-teacher teaching mode, and intelligent teaching mode.

Different member schools will choose other application models according to their development needs in teacher development, student growth, and teaching quality improvement. For example, as one of the member schools, the No. 2 Middle School of Pidu District, Chengdu, is a local second-level model school in Pidu District. It has a long history, stable development, and exemplary teaching achievements. However, the quality of the college entrance examination (especially the number and rate of critical undergraduates) has always been a bottleneck restricting the further development of the school. Therefore, to improve the quality of students, the school chooses the resource-sharing application mode. Furthermore, with the help of SSXY online open courses, it continuously optimizes the classroom teaching mode and enhances the effectiveness of the classroom.

Among the member schools, most are schools in areas where teaching resources are scarce, represented by Danba County Senior High School and Shishi Baima Middle School. Because of the varying teaching level of school teachers and the poor quality of students, they chose the dual-teaching application model. In this process, teachers with excellent educational experience will share the teaching content in real-time to member schools with weak educational foundations on the network terminal without affecting the typical class. Upload lesson plans, PowerPoint, and videos to the network platform through SSXY to share with other teachers (Nie et al., 2020). Teachers in schools with weak educational foundations are mainly responsible for integrating educational resources and curriculum resources, adjusting teaching according to actual academic conditions, and forming a school-based application model based on their academic requirements.

Abundant Synchronous Teaching Resources Have Been Developed and Constructed.

In terms of resource construction, SSXY integrates teaching tools, subject resources, precision teaching, and wisdom education and develops courses according to the needs of different schools and academic conditions such as region and teaching level. Thus formed the "Six Together" sharing mode, i.e., share together, research together, learn together, practice together, examine together, and analyze together. And a sustainable teacher training program was formed, and the balanced development of education with the supply of high-quality resources was promoted (Xue et al., 2021). At this stage, SSXY online education has achieved the coverage of the entire middle school, including all grades from seventh to twelfth grade. Forty-five middle and high school national

introductory courses and local courses have been built and updated in real-time, and more than 80,000 sets of curriculum resources have been accumulated.

A total of 8 online classes are offered; 42 live courses are covered, with an average of more than 50 daily live courses; nearly 13,000 teaching videos have been generated and got more than 280,000 visits; more than 1,000 interactive teaching and research activities have been carried out, over 50,000 teachers participated; nearly 10,000 copies of teaching resources were generated, and > 250,000 times of resource dissemination and application (Sichuan Sina, 2020).

Clarified the Network Teaching Construction Standards Based on General Middle School Teaching.

SSXY teaching terminal is based on the network high-definition synchronous live broadcast classroom. In addition, each classroom is equipped with several high-definition cameras, audio pickup arrays (including three sets of teacher infrared wireless microphones, student microphones, and spare omnidirectional pickup systems), touch-sensitive interactive teaching all-in-one machines, and other equipment. There is also a standardized interactive teaching and research preparation classroom so that teachers in each course can regularly conduct collaborative, interactive teaching and research with remote teachers.

Established the Implementation Standard of Network Teaching Based on General Middle School Teaching.

The standardization of online classroom teaching based on the general middle school curriculum is an essential factor that affects traditional online school education effectiveness. Therefore, SSXY has determined the direction of standardization in four dimensions.

(i) Standardization of classroom structure. To facilitate remote teachers and students to adapt to the teaching rhythm of the SSXY classroom, each subject combines specific teaching content and strives to create a curriculum structure type with subject characteristics.

(ii) Standardization of classroom teaching. Actively explore the development of efficient classroom teaching, and introduce wisdom education methods to promote the standardization of the online classroom teaching process, enhance classroom teacher-student communication, and improve the efficiency of remote classrooms.

(iii) Standardization of resource format. SSXY provides rich and standardized remote teaching resources such as teaching videos, courseware, exercises, and test questions so that remote teachers can use them flexibly according to the actual situation of students.

(iv) Interactive teaching and research standardization. SSXY teachers and remote school teachers regularly carry out teaching discussions through the network interactive platform to help remote teachers solve how to teach well and how remote students learn.

The Evaluation Feedback Mechanism of All Participants in the Online School Has Been Formulated.

The quality of classroom teaching is the lifeline of an online school and the foundation of a school. Therefore, in teaching evaluation and supervision, it is an essential measure in the evaluation and inspection system to achieve Omnidirectional and multi-channel access to information through classroom evaluation and establish a smooth feedback mechanism to promote online school teaching quality (Dykman & Davis, 2008). Therefore, in response to the actual needs of the participating parties, SSXY Online School has formulated a series of evaluation standards and feedback measures in detail to make the channels for information exchange between each other unblocked and reach a consensus on cooperation with all parties.

Created a Complete Online Network Education Service System.

Online education service is a critical factor in the quality assurance of online distance education. It is also an essential guarantee for the academic success of distance education students. However, due to various reasons, there are still problems such as inadequate understanding of the critical role of online education services, lack of uniform standards for service quality, lagging improvement in facility service capabilities, weak humanistic emotional services, and incomplete learning support service systems (Jiang, 2021). In this regard, SSXY escorts online education in 7 aspects, including user experience and service system construction, teaching resource guarantee, learning situation tracking, teacher training, user care, consultation, and answering, and remote troubleshooting, thus a scientifically complete online education service system was built up.

From the perspective of overall development, SSXY adheres to the development concept of "adhere to in-depth integration, lead educational reform, focus on collaborative advancement, and common service growth" from the construction of synchronized resources to the teaching application model, from the structure of application standards to the establishment of a feedback mechanism. It helps alliance schools develop together in the form of the SSXY community. Of course, its contents are also continuously improved and enriched with the needs of the times and the progress of member schools.

For example, in practice, SSXY adapts to the differences in the actual needs of the development of the community member schools with the in-depth lesson preparation teaching concept and achieves resource co-construction by adding and deleting the

substitute "five preparations," forming a dual-teaching application mode. Thereby, it is critical to adapt to the learning situation of member schools, realize the localization of high-quality resource teaching application, trigger the reform of remote class teaching mode, and promote the balanced development of education through teaching reform. Furthermore, in the face of pandemic-catalyzed personalized online learning for students, SSXY has introduced wisdom classrooms to expand the online and offline teaching and learning of teachers and students with "three ends," forming personalized learning space students. Use data to efficiently and accurately help student growth, teacher development, and school governance, and use technology to empower education and promote balance. The introduction of a wisdom classroom has greatly helped SSXY Community School to realize classroom reform and promote the steady improvement of the quality of education and teaching.

Achievements

Since its establishment in 2013, SSXY has continued to link many remote schools with the curriculum concept of "open sharing, integration, and symbiosis" to form a school development community, a teacher development community, and a student growth community. Finally, teacher development, student growth, school quality improvement, teaching reform, and mechanism innovation have been achieved. After nearly ten years of development, SSXY online school has covered 13 cities and prefectures in Chengdu, 118 member schools, and 246 classes, and benefited over 300,000 teachers and students (Luo et al., 2020).

In the past ten years of development, Shi Shi Middle School has gradually explored an effective educational assistance action plan based on the "SSXY" online school. Relying on financial support, improving infrastructure and school conditions; relying on talents, strengthening teaching training, and improving school quality; relying on social participation, leveraging various forces to help students realize their dreams. Through flexible resource application forms, online schools help students directly improve their academic standards and promote the professional growth of participating teachers and the quality of remote schools.

Empower the High-Quality and Fair Development of Regional Education.

As a public welfare platform for Shi Shi Middle School to implement comprehensive informatization of education and balanced urban and rural education, and as a pilot project of the Sichuan Provincial Department of Education based on the pilot project of Sichuan Province's education informatization of primary and secondary schools, SSXY online school uses the Internet and Big data analysis empowers and strengthens classroom teaching reform. Various delivery methods, including webcast teaching, web-on-demand teaching, and IPTV, have been constructed. Through classroom live broadcasts, remote students can synchronize all teaching links such as listening, practicing, activi-

ties, testing, and guidance in class with Shi Shi middle school students. It enables remote students and Shi Shi middle school students to obtain an undifferentiated high-quality education, realizes the output of high-quality educational resources of prestigious schools, leads and drives weak schools' development, and promotes regional education balance and equity.

It has effectively narrowed the educational gap between regions, urban and rural areas, and schools. To a certain extent, it curbed the "school choice fever," thereby improving the overall educational quality of Chengdu. According to the 2020 "*Annual Report on the Monitoring of Resource Allocation for the Quality and Balanced Development of Compulsory Education in Sichuan Counties*," the results of the basic and balanced development of compulsory education in Sichuan in 2019 have been further consolidated. About 20% of the elementary and middle schools in Sichuan Province have allocated seven indicators to meet the supervision and evaluation requirements. At the same time, the inter-school difference coefficients of 7 indicators[2] for the resource allocation of elementary schools in 15 counties and the inter-school difference coefficients of 7 indicators[3] for the resource allocation of middle schools in 31 counties met the supervision and evaluation requirements (Sichuan Education Monitoring Center, 2020).

Promote the Improvement of the Quality of Member Schools.

Since 2013, using SSXY as a platform, a large number of member schools have been contacted, and a close-knit SSXY online open curriculum practice application community has been formed. Under the leadership of the community, front-end schools (resource-providing schools) have been improved in terms of connotative development, and the quality of education and teaching has been significantly improved. It pays more attention to constructing a digital campus, refines and summarizes the school-running philosophy, implements teaching experience that can be replicated and promoted, and leads the joint development of remote schools (resource application schools). In addition, a large number of small schools have used high-quality network resources to alleviate problems such as shortage of teachers, conflicts between work and school, and insufficient subject allocation. As a result, it not only improves the quality and efficiency of education and teaching but also pays more attention to the organizational reconstruction and process reengineering of the school-running philosophy, management system, and school culture, reshaping the education and teaching ecology, and gradually becoming a leading school of regional education.

Taking the No. 2 Middle School in Handan District of Chengdu as an example, the school uses SSXY online open courses to continuously optimize the classroom teaching mode and enhance the effectiveness of the classroom. In 2018, Pidu No. 2 Middle School ushered in the first college entrance examination for the SSXY online teaching class. As a result, Pidu No. 2 Middle School broke the 100-person mark for the first time, reaching 132 students. In the 2019 college entrance examination, there were 152 students in the first category of Pidu No. 2 Middle School and 500 students in the

second category of undergraduates, reaching 515. In 2020, the college entrance examination rate for undergraduates' first and second categories hit a record high. The Municipal Education Bureau has commended the school for education work for three consecutive years, and the students have developed in an all-around way.

Help Teachers and Students Continue to Grow.

The SSXY community pays particular attention to the improvement of teachers' teaching and research capabilities. A new teacher training model has been created through the combination of the online and offline practical skills learning platform. Leading schools with rich teaching resources, represented by Shi Shi Middle School, radiate their teaching, research, and teaching to small schools in the form of live broadcasts and recording. Finally, the teachers and students of the front-end schools are encouraged to stimulate endogenous motivation continuously and continuously improve the quality of teaching, research, and teaching in the process of self-regulation and self-motivation. Teachers from remote schools have optimized their educational concepts, teaching behaviors, curriculum design, and other abilities through full-time accompanying "remote follow-up" and have become vital teachers in the region. Remote school students have long-term infiltration and influence of the culture, system, value pursuit, and spiritual outlook of the prestigious school by studying online and in the same place as the front-end students. As a result, the overall quality of students has been improved, the norms of behavior and values have been reshaped, and cultural confidence and quality have been cultivated.

Taking Shishi Baima Middle School as an example, the school has innovated and perfected the SSXY online open curriculum resource co-construction and sharing model; the participating teachers have found professional development through subject research. Among them, 30 participating teachers have achieved significant professional growth performance, and seven participating teachers have won awards in various essay competitions at all levels. The academic performance of online class students has also continued to improve. Under the influence of the high-quality resources of SSXY online open courses, the college entrance examination scores have been continuously improved. By 2020, the undergraduate rate of online classes will reach 97%.

In the wave of "Internet + Education," SSXY Online School uses the platform as a carrier to join hands with schools in remote areas and areas with weak education in Chengdu to form a collaborative community of distance teaching, teaching, and research. The advantages of network big data resources use network media to realize large-scale and flat disseminating excellent educational resources. In practice, a balanced and high-quality development model of the entire school period, full time and space, full coverage, and normalization has been gradually established so that excellent educational resources can move from the elite to the masses, batch to individualization and closed to open. It provides an effective path for promoting the sharing of high-quality resources, assisting education-targeted poverty alleviation, and blocking the intergenerational transmission of poverty. As a result, it has become a very distinctive and

effective regional sample in the targeted poverty alleviation model of online education in China.

Notes

1. *The education informatization from 2000 to 2016 was called the 1.0 era. At this stage, the construction of education informatization has received full attention. For example, through the promotion of the "School-School Link" project, "Agricultural Distance Project," "Three Links and Two Platforms," and other projects, 90% of elementary and middle schools nationwide were connected to the Internet, 83% of classrooms were multimedia classrooms and more than 6,300 online learning spaces for teachers and students. Thus, an environment for teaching and learning based on the Internet is gradually being built, and digital education resources are greatly enriched.*
2. *The seven inter-school resource allocation indicators are the seven indicators for the evaluation of inter-school resource allocation in the "County Compulsory Education Quality and Balanced Development Supervision and Evaluation Measures" issued by the Ministry of Education in 2017, including the number of teachers with academic qualifications shall be 4.2 or more and 5.3 or more in elementary and middle schools respectively; the area of sports venues per student shall be more than 7.5 square meters and 10.2 square meters in elementary and middle schools respectively; the value of teaching equipment and equipment per student shall be in elementary and middle schools. They reached above 2,000 CNY and 2,500 CNY or more. The "Methods" requires that at least six indicators of each school meet the above requirements, and the rest cannot be less than 85% of the requirements.*
3. *The coefficient of inter-school difference is also called the coefficient of variation or the dispersion coefficient, which is the ratio of the standard deviation of a set of data to its mean. The larger the coefficient of difference, the greater the degree of imbalance between schools within the county; on the contrary, the smaller the coefficient of contrast, the smaller the degree of inequality between schools within the county. According to the requirements of the Supervision and Evaluation Measures for the Quality and Balanced Development of Compulsory Education in County Areas, the inter-school difference coefficients of all indicators for each school are ≤ 0.50 for elementary schools and ≤ 0.45 for middle schools.*

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REVIEW

Using Information Technology to Improve the Quality of Education in Areas Lacking Educational Resources: Taking Southwestern Guizhou Prefecture in Guizhou, China as a Sample

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***Abstract**: Comprehensively improving the quality of education in resource-poor areas is an urgent challenge to achieve balanced development of basic education in China. In the process of educational development in resource-lacking areas, information technology has: (1) changed the traditional teaching mode and teaching environment, (2) provided high-quality educational resources, (3) promoted the professional development of teachers, and (4) promoted the overall improvement of education quality. Southwestern Guizhou Prefecture in Guizhou Province, China, has become a typical case in using information technology to promote education quality improvement in areas with scarce educational resources. This article explores educational information technology in the region as an example to discuss how to grasp the regional characteristics and local needs in the layout of information technology, integrate information technology into teaching practice, and steadily improve the overall teaching quality of the region.*

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Question

DUE to historical, geographic, and natural reasons, the ethnic minority areas in the border areas of China have a low starting point, small scale, and low quality of teaching. Compared with the national education level, there is a significant gap. Technology is regarded as an essential means to influence education development, especially the influence of information technology on education development. Xu and Luo (2009) believe that the application of information technology to design and develop ethnic-cultural courses and participate in network communication has an invaluable effect on improving the quality of education in resource-poor areas.

In recent years, the implementation of policies such as the "Rural Distant Project"[1], the "Reconstruction Plan for Weak Schools in Rural Compulsory Education"[2], and "Full Coverage of Digital Education Resources in Teaching Sites" has been adopted. And China has invested a lot in "weak" schools in compulsory education in poverty-stricken areas, including marginal ethnic regions, western regions, and rural areas. It has extensively promoted educational modernization in schools at the stage of basic education in remote ethnic areas. Many educational information technology hardware and resources have been rapidly deployed in elementary and middle schools in ethnic areas, enabling local students to share high-quality educational and teaching resources and receive a good education in an information technology environment (Yang & Liang, 2006).

Southwestern Guizhou Buyi and Miao Autonomous Prefecture in Guizhou Province was established in 1982. It is one of the youngest among the 30 ethnic minority autonomous prefectures in China. It is located in the hinterland of southwestern China, covering an area of 16,800 square kilometers. It is home to 35 ethnic groups, including Han, Buyi, and Miao, among which ethnic minorities account for 42.47% (Guizhou Provincial Development Research Center, 2013). As a minority-dominated region, in the context of a relatively harsh natural environment and a relatively poor economic foundation, the regional education foundation is weak. Based on the "Southwestern Guizhou Prefecture Education History," from 1949 to 1950, only 82 high school students were enrolled; and from 1978 to 1979, there were 12,783 high school students. In 1978, colleges and universities enrolled 554 persons, including 323 undergraduates and 322 associates (Sun, 2019). So, catching up with the national-level education became a challenge, and information technology construction has become an important starting point.

Before 1997, Southwestern Guizhou Prefecture had set up video playback points in elementary and middle schools in the county town and very few township sites. At that time, four middle schools at the county level and above had phonetic classrooms, and four county-level middle schools set up computer classrooms with their funds. More than 2,000 schools across the prefecture only rely on chalk, blackboard, and dictation (He & Liu, 2016). After 1997, China's "Full Coverage of Digital Education Resources in Teaching Sites" project and the Guizhou Province "Modern Educational Technology Experimental School" project have been implemented. Therefore, the re-

mote mountainous areas of the prefecture have been significantly improved in terms of insufficient teachers, single courses, and low teaching standards.

By the end of 2004, 337 computer engineering project schools in the prefecture, with 10,919 computers, 1,308 televisions, 123 multimedia projection classrooms, and 82 schools, established campus LANs. In 2005, the province fully launched the modern rural distance education project construction project, equipped with 1,617 "Rural elementary and middle school distance education project engineering schools" in Southwestern Guizhou Prefecture (Southwestern Guizhou Education Public Service Platform, 2015).

Since 2013, Southwestern Guizhou Prefecture has closely followed the pace of China's information technology development and issued the "Southwestern Guizhou Prefecture Educational Information Technology Project Implementation Plan." It clarified work goals and tasks and completed the construction of the hardware environment of the "three links and two platforms" through the model of "government-enterprise cooperation, school-enterprise cooperation, and school-school cooperation" (Chen et al., 2019).

While information technology equipment is deployed, how to deeply integrate information technology with education and teaching to promote the improvement of teaching quality and the development of students is now an urgent problem for education in ethnic minority areas. Some scholars have investigated the current situation and application of educational technology equipment in schools in ethnic regions and pointed out that teachers lack initiative in learning and using modern educational technology, and the related teaching facilities purchased are rarely used for teaching practice and are artificially idle. Lack of funds restricts the purchase and renewal of modern teaching equipment and cannot keep pace with the development of modern educational technology. At the same time, various software resources supporting modern education and teaching are insufficient and lacking features (He, 2006; Li et al., 2017).

In response to these problems, Southwestern Guizhou Prefecture, relying on the Chinese platform and supported by big data technology, boldly explores a new "1+4+N" education cloud big data development model. This depends on a platform (Jin Zhou Education Cloud Platform) to highlight the four major functions (targeted poverty alleviation, education fairness, balanced development, and quality improvement), forming a circle centered on Jin Zhou Education Cloud big data. This will drive the radiation of N regional schools and related work in the surrounding areas to "Internet + collaborative lesson preparation before class, + platform online live broadcast, + integration of learning, teaching, research, and training, + online and offline training, + teaching skills improvement, + education group assistance" (Wei, 2017).

In just a few years, Southwestern Guizhou Prefecture has gone from consolidating infrastructure construction to exploring multi-school cooperation with the help of the Internet, hand-in-hand cooperation, strong schools leading weak schools, to achieve education balance and quality improvement in ethnic areas. At the same time, with the "Relying on "Jin Zhou Education Cloud Platform" to expand the Coverage of High-quality Educational Resources," the typical case won the "Fifth China Education Re-

form and Innovation Excellence Award." The Panjang Road Elementary School in Xingyi City of the prefecture was selected as an excellent national school for online learning space application and a particular training base school for online learning space. Southwestern Guizhou Prefecture has achieved tangible results in the ongoing promotion of educational information technology and formed a sample of information technology leading the development of education (Jin, 2019).

Relying on China's National Platform to Build Jin Zhou Education Cloud Platform

In March 2016, China's public service platform for basic education resources was launched in Southwestern Guizhou. It opens the use and exploration of Southwestern Guizhou Jin Zhou's educational cloud platform, "cloud + terminal." To promote the sharing of excellent educational resources in remote and impoverished minority areas and to improve the quality of shared education, Southwestern Guizhou Prefecture took the opportunity of the establishment of China's educational resources public service platform in Southwestern Guizhou, according to its educational information technology level and the characteristic needs of educational resource networking. They quickly started the "six constructions," including high-speed construction, platform construction, terminal construction, space construction, team construction, demonstration construction. With the construction of four databases for teachers, students, parents, and courses as the core, and wisdom management and teaching as the starting point, we will build a cloud platform that brings together high-quality education and teaching "massive knowledge resources" from China, provinces, enterprises and local governments, and realizes the cloudification of resource collection, The integration of learning, teaching, research and training, and the wisdom of the management process.

Construct a "High-Speed" Network

By the principle of "unified plan, unified standards, unified construction, unified supervision, nearby access, and hierarchical management," a high-speed private network covering "Gigabit to school and 100M to desktop" covering elementary and middle schools in all prefectures will be built to achieve Optical fiber network "School-School Link."

Construct a School Platform

Taking the construction of information technology infrastructure as the forerunner, relying on the education cloud platform and big data center, with the four databases of teachers, students, parents, and courses as the core, and wisdom management and teaching as the starting point, 108 online live classrooms or interactive teaching demonstration schools have been built, and 329 schools have opened wisdom campus services.

Construct a Terminal

There are 1,668 elementary and middle schools (kindergartens) in the whole prefecture, with a total of 10,663 teaching classes and function rooms to achieve "high-quality resource class-to-class access."

Construct Space

Integrating various applications such as teaching, management, learning, and communication, the sharing of high-quality educational resources will lay the foundation for innovative learning forms. Through the "learning space for everyone," teachers, students, and parents conduct independent online learning and interactive teaching exchanges. As of March 2020, among the 1,718 schools in the state, 2.5 million "online learning spaces for everyone" have been registered with real names, 57,000 teachers, 979,768 students, and 1,460,200 parents. The total capacity of the downloadable resources on the platform is 27.8T, of which 15T is the landing resource in China, 83 applications of various types, and 37 core applications. More than 5.639 million pieces of material resources (including courseware, teaching plans, pictures, video, and audio), 1.333 million teaching classrooms, 32,000 micro-classes, nearly 16 general high school elective online courses, more than 156,000 unique educational resources and topic resources. Schools in all prefectures and states have achieved "Broadband Network School-to-School Connection," with a network coverage rate of 100%. By constructing a learning model that "can learn by everyone, can learn everywhere, and can learn all the time," individual learning activities can be realized (Zha, 2019a).

Construct a Team

With a large-scale application resource platform as the core and training as a breakthrough point, it adopts the training methods of "send out, invite in" and "localization" to strengthen the construction of four teams of administrative leaders, core talents, key teachers, and ordinary teachers. Finally, the awareness of education information technology has been strengthened, and the driving force for the application of the education cloud platform has been formed.

Construct a Demonstration

Establish 20 schools represented by Xingyi No. 1 Middle School in Guizhou Province as Southwestern Guizhou Prefecture's 2020 educational information technology application pilot schools. The Prefectural Education Bureau provides policy support to the pilot schools regarding construction, application, training, and promotion. It selects 1-3 provincial teachers from Southwestern Guizhou Prefecture from the pilot schools to become members of the development center's educational information technology application and promotion expert database. Take the pilot school as the vanguard, actively

explore, sum up the experience in practice, form a model, and then gradually promote it to create a demonstration, leading, and radiating role.

The construction and application of Jin Zhou Education Cloud are based on the "cloud +" model to promote the in-depth integration of information technology and education and teaching. It uses educational information technology to drive the modernization of education, vigorously promote the modernization of education, teaching, and management methods, improve the quality of education, and solve complex problems such as education fairness and education balance.

In January 2018, Jin Zhou Education Cloud Platform won the "Fifth National Education Reform and Innovation Excellence Award." In the same year, Panjang Road Elementary School in Xingyi City was selected as the National Excellent School of Online Learning Space Application. In 2019, it was chosen as a candidate school for the 2019 Online Learning Space Special Training Base School of the Ministry of Education (Liu, 2019).

Take Advantage of Jin Zhou Education Cloud Platform to Promote the Development of "Internet +" Teachers.

The professional development of teachers is one of the critical factors to improve the quality of school education (Darling-Hammond, 2000). Hanushek (2011) found through research that if 5% to 8% of the worst quality teachers in the United States are replaced with average teachers, the United States can be close to first place in the international mathematics and science rankings. This is equivalent to creating an economic value of 10 trillion US dollars. Therefore, strengthening the professional development of teachers is also of great significance for promoting the quality of basic education in China.

To break through the geographical limitation of teachers, Southwestern Guizhou Prefecture actively promotes the professional development of teachers through a combination of online and offline methods. On the one hand, by carrying out activities such as sending teachers to famous teachers and famous schools, expert lectures, special meetings, teacher skill competitions, key teachers, and selection of renowned teachers, the scope of training is expanded and the training efficiency is improved. Use "school-school pairing" and "famous teacher pairing" activities to realize the sharing of high-quality teachers and promote the balanced development of education. On the other hand, in the "Internet +" environment, through Jin Zhou education cloud platform + shared classroom (prestigious schools, famous teachers, high-quality and urban and rural simultaneous classroom delivery), "Jin Zhou education cloud platform + school management," Jin Zhou education cloud platform +Teachers prepare for lectures "Jin Zhou Education Cloud Platform + Online One-course Two-Teacher Teaching," Jin Zhou Education Cloud Platform + Online Same Class Heterogeneous," etc., to make up for the shortage of teachers in remote areas and the lack of high-quality curriculum resources. At the same time, it achieves the effect of accurately assisting a group of rural schools,

improving teacher education and teaching ability, and realizing the "1+N" education model that integrates learning, teaching, research, and training.

Collaborative Preparation before Class

According to the teaching goals, the lecturer completes the teaching design of the new knowledge points of the course and collects related resources, uploads them to the personal space, and publishes them to N remote teachers in the lecturer space. The remote teachers and the principal lecturer express their opinions, conduct online exchanges, and discussions, and optimize and perfect the lecture preparation of the principal lecturer. The main lecturer and remote teachers carry out tutoring and classroom practice trials according to their students' conditions to prepare both teaching materials and students during the whole process.

The Platform is Live Broadcast Online

The principal lecturer teaches in the main classroom and uses the live broadcast platform to spread through the "optical network" to remote elementary and middle schools and teaching points in rural areas lacking teachers and teaching. In teaching new knowledge, the main teacher completes the teaching, and the remote teacher guides the students in the class to learn together. After the new knowledge learning is achieved, the main lecturer and the remote teacher will each teach the students in the class to complete the consolidation of knowledge and classroom exercises and complete the teaching objectives and tasks of the course.

Integration of Learning, Teaching, Research, and Training

Through the teaching of the main teacher, students learn new knowledge and complete the learning process. In the teaching process, the remote students and the anchor students learn excellent learning habits and finally form a good learning atmosphere to complete the education process. The lecturer and remote teachers prepare lessons collaboratively, improve each other, and complete the teaching and research process. The main lecturer uses his unique teaching methods to teach, and remote teachers learn their teaching methods to improve their professional level and complete the training process.

Combination of Online and Offline Training

Actively carry out inter-regional teachers' online collaborative research and training to promote teachers' peer exchanges. Through famous teachers (famous principals) studios, renowned teachers, and backbone teams as leaders, network learning spaces are used as research carriers, and collective lesson preparation, observation, research, and other methods to promote the organic integration of teaching, researching, and training, and

to give full play to the basic role of school-based study and training and promote the comprehensive reform of the training model.

Deepened Application Led by Famous Teachers

To deepen the "Jin Zhou Education Cloud," promote the in-depth integration of information technology and education and teaching, cultivate the backbone of education information technology application disciplines, provide a reference for the construction of "smart education" in schools across the prefecture, and make good use of the application of the "Jin Zhou Education Cloud" platform Guidance, service and professional development of teachers. In March 2020, seven "Jin Zhou Education Cloud" information technology master studios were established, and well-known domestic professors were hired as consultants and experts. The trainees came from the leaders of various disciplines and state-level backbone teachers across the prefecture. Organize and carry out teacher information technology application skills training, study the in-depth integration of educational information technology and disciplines, improve the quality of education and teaching with big data, and develop education and teaching resources for corresponding fields.

Jin Zhou's education cloud platform has solved educational imbalance, narrowed the gap between urban and rural areas, and promoted educational equity. It has realized the construction of a new carrier of "learning, teaching, research, and training," comprehensively enabled the "cloud + terminal" application of educational information technology, actively explored a new model of teacher development in ethnic areas under the background of "Internet +," and comprehensively promoted the "Internet +" teacher training.

Multi-Dimensional Model Based on the Internet to Promote Regional Education Quality Improvement

In minority areas, rural education is a shortcoming, and teaching sites are the location of the problem. Faced with this reality, Southwestern Guizhou Prefecture has created various models to solve the problem of insufficient rural teachers and shortage of high-quality curriculum resources through the "cloud + terminal" Jin Zhou education cloud under the "Internet +" environment. This has achieved the effect of accurately helping a group of rural schools and improving regional education and teaching (Hai, 2021).

Use the Famous Teacher Studio to Lead the Improvement of Teaching Quality

Nine famous teachers were selected from prestigious schools such as Xingyi No. 8 Middle School, Xingyi No. 1 Middle School, Xingyi Middle School, other prestigious schools in the prefecture, and nine high-quality talent training studios were established. Through online training and offline seminars, various work such as studio construction

and learning, key teacher training and training, college entrance exam preparation guidance, poverty alleviation, and education are carried out. Through the review and training seminars and seminars before the college entrance examination, the college entrance examination papers were split to create a question bank, dozens of high-quality documents and courseware were shared, and the common learning consensus was shared, benefiting thousands of teachers and tens of thousands of students in the third year of high school.

Carry Out a Variety of Teacher Skill Competitions to Promote the Professional Growth of Teachers

Southwestern Guizhou Prefecture regularly organizes diversified teacher skill competitions every year. Through the selection and recommendation of outstanding players to participate in the prefecture-level finals, they fully demonstrated their high professionalism and on-site adaptability and demonstrated a high level of teacher skills, allowing teachers to compete and communicate while promoting the improvement of education and teaching skills. For example, the micro-class competition held every year aims to promote the deep integration of information technology and subject teaching, to improve teachers' professional quality and teaching level, improve classroom efficiency and teaching quality, promote the sharing of high-quality resources, and cultivate and create high-quality local digital resources. In 2019, there were a total of 5,176 micro-class competitions. After state-level review, 20% of the works (1,035) were selected and submitted to the Provincial Department of Education to participate in the provincial-level competition.

Firmly Pair the Concept of Assistance and Transfer, and Share the Fruits of Education

Make full use of the role of demonstration, guidance, and radiation of excellent schools in the prefecture to promote the overall quality of the teaching staff of schools across the prefecture. Make full use of the Jin Zhou education cloud platform to integrate high-quality educational resources in the state. Through the combination of online and offline methods, school-to-school exchanges and assistance cooperation are effectively carried out. The two sides learn from each other's strengths, share the new achievements and typical experience of reform and development in education and teaching management, curriculum reform, education quality improvement, and the promotion and application of educational information technology, and seek a new path for education development.

Bring in Strength to Help Guizhou Move Forward

(i) Through online synchronization of classrooms and direct recording and broadcasting, the model of Wuhan No. 11 Middle School was introduced. The remote live broadcast of college entrance examination guidance in Southwestern Guizhou Pre-

fecture has promoted the transformation of the state's teachers' third-year teacher education and teaching mode and the steady improvement of the quality of the college entrance examination (Zou, 2018).

(ii) Through the school-local cooperation model with Guangdong University of Foreign Studies, a new model of "National Famous Teacher + Jin Zhou Famous Teacher Studio + Jin Zhou Famous Teacher + Jin Zhou Teacher" was established on the Jin Zhou Education Cloud Platform to comprehensively and effectively improve the classroom teaching of English teachers. And the quality of education and teaching (Cen, 2018).

(iii) The Ningbo wisdom education platform and Jin Zhou education cloud are connected and used through the support and training in Ningbo, Zhejiang Province. It enables teachers in Southwestern Guizhou Prefecture to use Ningbo's high-quality resources to assist classroom teaching and transforms the teacher's education and teaching mode (Zha, 2019b).

(iv) After several years of development, the quality of education in Southwestern Guizhou Prefecture has been steadily improved. In 2019, Southwestern Guizhou Prefecture's undergraduate admission rate and admission rate both increased. A total of 26,930 candidates participated in the college entrance examination. Thirteen thousand eight hundred one reached the undergraduate admission line, with an increase of 1,219 over 2018, and the undergraduate reach rate was 51.27%. Undergraduate admissions were 13,771 candidates (including 3,350 admissions for the first category and 10,421 admissions for the second category). The undergraduate admission rate was 51.15%, an increase of 0.68 percentage points from 2018 of 50.47%, and the number of admissions increased compared with last year was 1077. On the other hand, the number of high-quality candidates has increased significantly. In 2019, a total of 29 students enrolled into Tsinghua University and Peking University (16 into Peking University and 13 into Tsinghua University), accounting for nearly one-third of the total number of students admitted to Tsinghua University and Peking University in Guizhou province (Southwestern Guizhou Prefecture Education Bureau, 2019).

Concluding Remarks

With the gradual improvement of China's educational infrastructure, the development of information technology, and the application of the Internet, the nationwide educational information technology infrastructure is becoming more and more complete. According to data from the China Education Information Technology Work Management Information System, as of the end of 2020, the national elementary and middle school network access rate has reached 100%, and non-networked schools have been dynamically cleared. The proportion of schools with an export bandwidth of more than 100M reaches 99.92%. Approximately 98.35% of elementary and middle schools have multimedia classrooms, with the number reaching 4.29 million, of which 83.16% of the

schools achieve full coverage of multimedia teaching equipment (Science and Technology Department of the Ministry of Education of China, 2021).

In the era when the "Internet +" wave is sweeping, Southwestern Guizhou makes full use of the Jin Zhou education cloud platform with the help of Internet technology to give full play to the advantages of "cloud" + "end" and break through the limitations of time and space. With the help of terminal equipment and mobile devices, a service system for delivering education to prefectures, prefectures to counties, counties to townships, and townships to villages within and outside the province has been preliminarily constructed. Let remote minority mountainous schools share the resources of famous schools and teachers and share advanced educational concepts and teaching methods. This fundamentally solves the shortcomings of the inability to enter and retain teachers in rural schools and the severe shortage of subject teachers, narrows the gap in educational development between urban and rural areas and schools, and solves educational imbalance. At the same time, it has also allowed outstanding schools and teachers to achieve a higher level of improvement and has allowed remote rural schools and teachers to achieve rapid development. This has promoted the overall improvement of the quality and level of education, provided successful experiences for the development of education in remote and impoverished ethnic minority areas, and explored a new development path for targeted poverty alleviation with educational information technology (Wang, 2021).

Notes

1. *"Rural Distant Project" is called the modern distance education project for rural primary and secondary schools. It means to promote the sharing of high-quality educational resources in urban and rural areas and improve the quality and efficiency of rural education. Since 2003, it has adopted information technology to adopt three modes: teaching CD broadcasting points, satellite teaching viewing points, and computer classrooms to transfer high-quality educational resources to the rural teaching method pilot project.*

2. *The Reconstruction Plan for Weak Schools in Rural Compulsory Education was proposed by the Ministry of Education and the Ministry of Finance of China in 2010. Its overall goal is: per the strategic requirements for promoting the standardization of compulsory education schools, to equip rural mandatory education schools with books, experimental educational equipment, and sound, sports, and beauty equipment following the basic national standards. By the requirements of the nutrition improvement plan for rural compulsory education students, gradually improve the eating conditions of rural schools. Under educational planning and existing financial resources, the boarding facilities of rural schools in considerable labor exporting provinces and areas with particular difficulties should be rebuilt and expanded, and boarding conditions should be improved, so that county and town schools can gradually meet the class size standards set by the state.*

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