Research on the Current Situation and Improvement of Three-Dimensional Learning of Compulsory Education in China in the Post-epidemic Era

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Abstract—In the post-epidemic era, compulsory education is carried out simultaneously at three dimensions of school education, family education and online education. Based on the methodology of literature survey, questionnaire survey and interview, and the current status, this paper proposes targeted and practical countermeasures to the compulsory education in China in the post-epidemic era. For the post-epidemic era, this study proposes to form a new three-dimensional education system to enhance the quality of compulsory education in China. To achieve this goal, this paper recommends methods such as optimizing and integrating education resources, constructing a brand-new learner-center education system, and also leveraging modern information technologies. These strategies are necessary to ensure the education system back to normal status under the prevent and control measures during the pandemic and are also in line with the proactive procedures for education reform and development adopted by internationally and domestically.

Index Terms—Post-epidemic era, compulsory education, three-dimensional learning system, status quo and improvement

I. INTRODUCTION

The so-called post-epidemic era [1] refers to an era in which the epidemic rises and falls from time to time, small-scale outbreaks may occur at any time, outbreaks due to returnings from foreign countries and seasonal occurences, andcan protract for a longtime, and has a profound impact on all aspects of the society. The occurrence of the COVID-19 Outbreak is a dividing line breaking the boundaries of the education system's "online and offline", "home and outside", "school and outside school", etc. However, at the same time it brings opportunities for "systematic reconstruction" and accelerates the integration of education development. The integration development includes the integration of online teaching and offline teaching, the integration of home learning and school learning, the integration of on-campus education and off-campus education, and etc. China has taken the lead in entering the "post-epidemic era". For schools in the compulsory education stage, the post-epidemic conduction face-to-face teaching. From that day on, school compulsory education will face many new problems and challenges.

In March 2020, the Ministry of Education of China issued the "Notice on Deepening the Work of "Closing Classes and Non-stop Learning" for primary and secondary schools. Which requires schools in all regions to actively help solve the problem of online learning conditions, adjust and standardize online teaching behaviors in a timely manner, and ensure that the policy of "Not one (student) can be left behind." Qiao [2] pointed out that the gap between urban and rural education is still very large, as teaching facilities and equipment, student source quality, teacher allocation, and family education are still the main obstacles to the improvement of rural education quality. Yin and Chen [3], Li and Fu [4] and others all pointed out that during the outbreak of the epidemic, online education in rural schools exposed problems such as insufficient educational informatization conditions and difficulty for teachers to adapt to the information requirements. Li [5] indicated that artificial intelligence and the pandemic have merged in this special period jointly promote the sharp changes of the pattern and style of future fundamental education. Wu [6] pointed out that the era of global risks is dawning while the historical mission of educational technology has yet to be opened; challenges and opportunities coexist, and theoretical transformation is imperative. Wang [7] believes that in the post-epidemic era, offline teaching should be in line with online teaching to form a "dual-line teaching and learning model" and an "online-offline exchange teaching and learning system", and further to create a "new norm" of mixed teaching and learning approach. Through investigation and research, Shan *et al.* [8] concluded that informatization largely promotes fairness in basic education as shown by a balanced configuration of infrastructure but a poor learning experience, timely supply of digital learning resources but lack of high-quality and personalized care, and informatization of teachers. Both flexible teaching flexibility and personalized teaching have shortcomings, such as the students need more trainings to use the new technology and online learning participation need to be strengthened. Meng *et al.* [9] believe that online learning has effectively alleviated the impact of the epidemic on education and teaching, but also shows that the concept of ubiquitous learning has not yet reached a general consensus. Therefore, in the post-epidemic era, studying the current situation and opportunities of compulsory education in China is an important topic for researchers, and it plays a key role in improving the quality of compulsory education under the new educational challenges.

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II. METHODOLOGY

This study uses the literature research method to understand the learning situation of urban and rural primary and secondary schools in different regions of China before and after the epidemic. At the same time, the researchers selected five urban primary schools, three urban middle schools, five rural primary schools and three rural primary schools in Shandong and Shanxi regions of China, and interviewed10 families. The questionnaires are divided into teacher and student questionnaires, and the questions are divided into three categories: single-choice questions, multiple-choice questions, and fill-in-the-blank questions. The content includes working years and academic qualifications, school informatization construction, teaching management, online learning effects, and the application of information technology. The interviews are mainly aimed at the parents of the students, including the students' school education and family education effects and integration development under the epidemic situation. Table I and Table II are the main contents of the questionnaires for teachers and students.

TABLE I: MAIN CONTENT OF THE THEACHER QUESTIONNAIRE

Essential elements	Specific contents
Educational Resources	Including online teaching resources that support teachers' lesson preparation, teaching and research, and online learning resources that support students' personalized learning.
Information infrastructure	Including the network, equipment, and teaching environment required to support the development of information-based teaching.
Teacher's online teaching ability	Including the use of teaching platforms, teaching design supported by technology, implementation and evaluation, etc.
Students' online learning literacy	Including students' conscious behavior, skills of using equipment, self-control from moral and legal aspects, learning effect, etc.

TABLE II: MAIN CONTENT OF THE STUDENT QUESTIONNAIRE

Essential elements	specific contents
Online learning infrastructure	Including learning equipment, network coverage, network speed etc.
E- Learning resources	The quality, timeliness, and personalization of learning resources etc.
Teacher's online teaching ability	Including teaching attitude, teaching clarity, teaching activity arrangement, teaching evaluation, etc.
Students' online learning literacy	Including the use of equipment, online learning participation, learning effects etc.

The survey was divided into four aspects including education resources, information infrastructure, online teaching capability of the faculty, and online learning quality of the students (from top to bottom plot panels). In each plot panel, different color represents relative percentage of subjects from different category.

From Table III and Fig. 1, it can be concluded that 92% of teachers are satisfied with online teaching resources, and 98% of teachers believe that online teaching resources can well meet students' personalized learning needs. 55% of teachers believed that the teaching environment had a bad impact on students' learning, and only 16% of teachers were very satisfied with online learning.

TABLE III: THE RESULTS OF THE TEACHER SURVEY QUESTIONNAIRE

Elements	Classification	Very satisfied (%)	Satisfied (%)	Not very satisfied (%)	Not satisfied (%)
Educational Resources	Online teaching resources to support teachers	71.2	20.78	6.66	1.36
	Online learning resources to support students' personalized learning	85.36	12.79	1.72	0.13
Information Infrastructure	Network coverage	90.44	8.97	0.57	0.02
	Teaching equipment configuration	72.7	18.49	3.53	5.28
	Teaching equipment configuration	21.25	23.83	34.6	20.32
Teacher's online teaching ability	22 to 35 years old	35.17	51.32	11.89	1.62
	36 to 50 years old	23.22	45.67	26.34	4.77
	51 to 60 years old	11.76	34.97	37.58	15.69
Students' online learning literacy	Conscious	56.73	24.8	10.21	8.26
	Use equipment skills	43.56	31.42	16.35	8.67
	Self-control ability	27.32	36.74	20.22	15.72
	Learning effect	15.75	29.44	32.49	22.32

III. RESULTS

A. Questionnaire Results

Through the questionnaires of teachers, the main results are shown in Table III and Fig. 1.

Through the questionnaires of students, the main results are shown in Table IV and Fig. 2.

The survey was divided into four aspects including necessary resources for online study, digital learning resource, online teaching capability, and online learning quality of the students (from top to bottom plot panels). In each plot panel, different color represents relative percentage of subjects from different category.
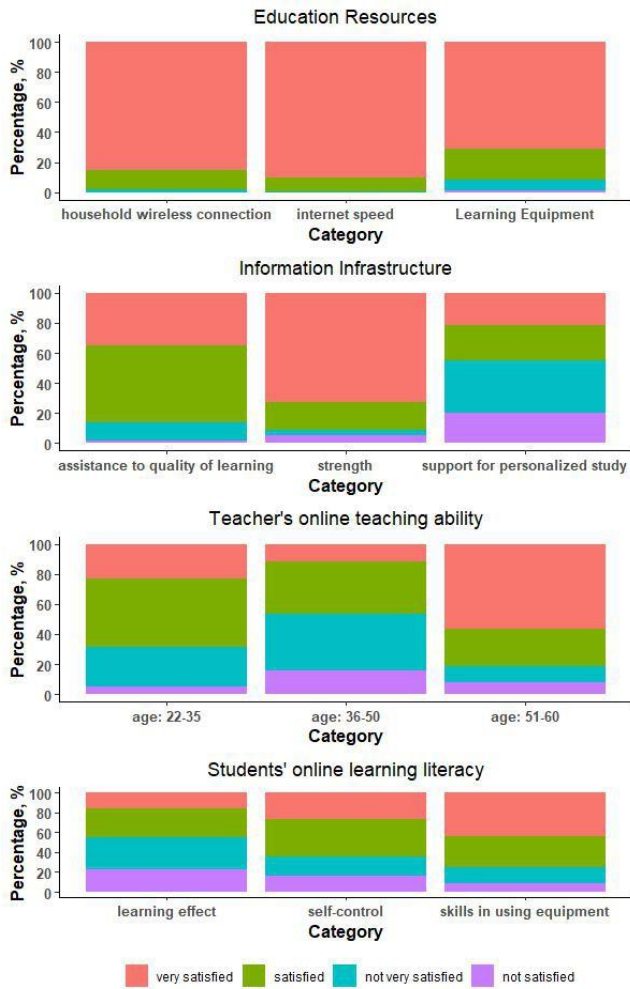
Fig. 1. Results of the teacher survey questionaries.

and literacy. Students' skills in using devices are obviously disadvantaged in the lower grades of primary school and in rural areas. Students' self-control in learning in a home environment is significantly lower than in school teaching. 55% teachers and 42% students believe that fully online learning is effective and efficient. There is a big gap in the teaching effect.

TABLE IV: THE RESULTS OF THE STUDENT QUESTIONNAIRE STUDY

Elements	Classification	Very satisfied (%)	Satisfied (%)	Not very satisfied (%)	Not satisfied (%)
Online learning infrastructure	Learning equipment	89.22	10.07	0.63	0.08
	Home Wi-Fi coverage	68.34	21.32	7.0	3.34
	Internet speed	65.33	30.17	3.65	0.85
E-Learning resources	Quality	72.68	22.95	2.73	1.64
	Timeliness	36.83	37.65	15.72	9.8
	Degree of personalization	78.51	11.34	4.55	5.60
Teacher's online teaching ability	22 to 35 years old	85.33	10.55	2.93	1.19
	36 to 50 years old	73.64	15.47	7.11	3.78
	51 to 60 years old	43.52	32.79	17.86	5.83
Students' online learning literacy	Conscious behavior	28.96	45.24	17.69	8.11
	Use equipment skills	20.68	43.27	18.55	17.5
	Self-control ability	23.61	35.22	26.70	14.47

From Table IV and Fig. 2, in terms of the provision of information infrastructure and the supply of learning resources, the proportion of students who used teaching equipment such as laptop computers, desktop computers, and tablet computers and learning and communication equipment such as mobile phones to conduct online learning during the epidemic was as high as 99%. The wireless network coverage rate is 90%. Basic information-based learning equipment and network coverage rate can meet the online learning needs of the majority of Chinese students, and students do not need to worry about infrastructure. 96% of the students indicated that the digital information-based learning resources that support daily online learning are of high quality, 6% of the students believed that the current learning resources could not help their own learning, and 10% of the students denied digital information-based learning resources can support personalized learning. The quality of students' access to learning resources is relatively weak, and the resources cannot well meet the needs of personalized learning. 26% students indicated that they were not proficient in using online learning tools, and at the same time, could not solve technical problems effectively, and had insufficient online learning experience.

Both Fig. 1 and Fig. 2 reflect the differences in the online teaching capability of teachers of different age groups. The group of teachers under the age of 35 has the highest information technology and literacy, while the age of teachers is negatively correlated with information technology
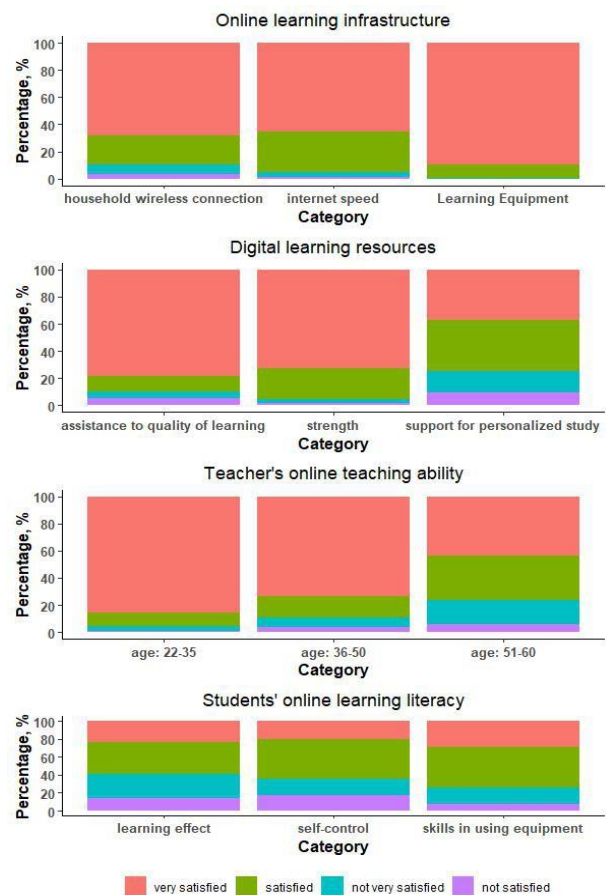

Fig. 2. Results of the student survey questionaries.

In addition, 78% teachers and students believe that information technology ability and literacy are important factors affecting the quality of online learning. There are significant differences between different regions and different groups The differences between counties and districts are relatively high. 90% teachers believe that teachers play an important role in guiding and promoting students' autonomous learning, 84% teachers are willing to provide guidance and help for students' autonomous learning, but less than 30% teachers believe that they are familiar with and mastering the service of students' autonomous learning The ability and methods of most teachers to serve students' self-learning ability and methods are seriously insufficient. Teachers are generally concerned about the weakening of teachers' knowledge authority and role authority in the process of online learning, and 60% teachers are dissatisfied with the role and interaction status between teachers and students during online learning. Students' information technology and literacy have clear regional differences and is also positively correlated with the age of the students. 65% students think that online learning is an interesting and meaningful thing, and only 19% students think that online learning is more suitable for them than offline teaching. Students' motivation and acceptance of online learning is low.

B. Interviews with Parents of Students Yielded the Following Findings

In terms of family education: Family capital with family environmental conditions and parental companionship as the main connotation has a significant impact on the effect of on line learning. Teachers generally believe that home environment and conditions, such as hardware facilities and home learning atmosphere, are the biggest challenges for students to learn online. The degree of parental companionship is positively correlated with parents' satisfaction with students' online learning effect, i.e., the higher the degree of parental companionship, the better the online teaching effect. The survey shows that 67% parents in rural areas believe that they haveweak educational awareness, improper educational concepts, and insufficient educational ability during students' home study. In the post-epidemic era, there may be a small-scale sus pension of classes and home learning at any time. 32.3% parents believe that they are not fully prepared. This shows that there is a certain degree of positive correlation between the effect of online learning and family capital, which highlights the importance of home-school cooperation and family education. At the same time, whether in the city or in the countryside, parents' reliance on "make-up lessons" has not changed in time, and the phenomenon of "lag adjustment" in family education has magnified the problem of family education simultaneously.

There are differences in the satisfaction of different groups of learning effects: There are significant differences in the satisfaction of online learning effects among different groups. Students' satisfaction with online learning effect is significantly higher than that of parents and teachers, and teachers' satisfaction with online learning effect is the lowest; teachers and students of different grades have certain differences in the acceptance and satisfaction of online learning. This shows that different groups and different academic stages have different needs for the content and presentation methods of online learning resources, and the diverse needs of different groups put forward higher requirements for the diversification, personalization and refinement of the subsequent development of online resource platforms.

IV. DISCUSSION

A. Reconstruction of Compulsory Education Learning Resource Platform

For China's education, which is undergoing profound transformation in the post-epidemic era, with the increasing popularity of compulsory education, the public's demand for high-quality educational resources has risen sharply. The goals to reconstruct the education system include: accelerate the educational reform in the information age; give full play to the advantages of online educational resources; break the boundaries of time and space and the limitations of educational objects; further integrate provincial educational resources and public service platforms, and promote the interconnection of public service platforms for municipal educational resources and provincial platforms interoperability; build a provincial-level public service system for high-quality educational resources, and provide access and services to digital educational resources. The procedures to facilitate the transform include: introduce digital teaching materials, build a basic and public welfare digital teaching resource library that matches the new national curriculum standards, and form a digital teaching material supporting resource system with various forms and rich contents. Moreover, integrating various high-quality resources, realizing the interconnection, multi-level distribution, co-governance and sharing, and collaborative services of the provincial, municipal, and county-level educational resource public service platforms, narrow regional, urban-rural, inter-school, and group gaps are important steps to achieve equality in compulsory education services. Educational modernization is an important strategic task, and the reform and development of compulsory education also a core value pursuit.

B. The Role of Family Education in the Post-epidemic Era

In the special period of the post-epidemic period, online education has been forced to be upgraded to an important as pect of compulsory education, and it has always run through family education. For online learning, parents should keep the same educational concept with the school, and understand and support the various educational activities of the school, which will effectively promote family education and school education to truly form an educational synergy. On the contrary, after the epidemic is basically over and students return to school, parents will find that students who have a good foundation but poor self-awareness will have poor grades due to the lack of family education.

C. In the Post-epidemic Era, a New Form of Education Development

The Education 2030 Framework for Action released by

United Nations Educational, Scientific and Cultural Organization (UNESCO) proposes the overall goal of global education in 2030 to "ensure inclusive and equitable quality education and enable all people to enjoy lifelong learning opportunities". "China's Education Modernization 2035" further outlines the goal of realizing education modernization in 2035 from the aspects of quality, equity, structure, service capacity, and more specific concepts, content, method, system, institution, and governance. In the post-epidemic era, the task of education reform and development is still very arduous, but the context and focus of reform and development are clearer. The refined development of education driven by technology will replace the extensive development model of education and become a new form of production that replaces the "assembly line" of education and teaching. Starting from the real needs of students, it is important to proactively explore the transformation of education in the post-epidemic "Internet +" era, promote the deep integration of information technology and education and teaching, and use information technology to support students' comprehensive and individual development. Steps should be implemented such as taking student development as the center, docking and integrating the original provincial and municipal educational resource platforms, bringing together static and dynamic learning resources, and building a basic education that matches the new national curriculum standards on the basis of improving the construction of the online service alliance platform for high-quality educational resources. Digital teaching resources form a resource system with various forms and rich contents. Providing students with services such as high-quality educational resource sharing, comprehensive quality evaluation, learning status and effect feedback, and learning exchange and interaction will help to play an important role in the realization of students' online and offline integration or complementary blended learning growth.

V. CONCLUSION

The changes and breakthroughs in the "three major boundaries" brought about by the COVID-19 epidemic have increased the mobility and integration of different teaching methods and learning methods. Teachers and students are teaching online and learning online at the same time. There is frequent flow and deep integration between "teaching at home", "learning at home" and "learning at school", "on-campus education" and "off-campus education". The frequency and quality of this flow and integration will become a new dimension and standard for measuring the quality of school education and home education. This may lead to the flipping of basic education in the overall sense: from offline teaching, on-campus learning and on-campus education to remain unchanged, flipping to online teaching, home learning and off-campus education have a prominent position, resulting in mixed teaching and mixed learning. The new form of educational integration and symbiosis will eventually lead to the "flip" of the entire basic education. Education is quietly undergoing great changes. The effect of online learning is more dependent on students' autonomous learning ability. What teachers can do is to stimulate students'

learning motivation, strengthen emotional communication between teachers and students, and carry out targeted education through effective teaching design, studying guidance and building a shared learning vision. In short, the outbreak of the new crown epidemic is not only a disaster faced by mankind, but also a major opportunity: an opportunity to transform basic education, an opportunity for school reform, and an opportunity for future teachers and students to develop together.

VI. COUNTERMEASURES AND SUGGESTIONS

The epidemic brought about not only breaking and changing, but also an opportunity for reconstruction or rebirth, and an opportunity for "systematic reconstruction", which involves the diversity of the basic education concept system, curriculum system, teaching system, school management system, and governance system, and tructured reconstruction. To this end, we urgently need to build two systems and one structure.

A. Build a System for Maximizing the Value of High-Quality Teacher Resources

Teachers should not only pay attention to the application of information technology, but also pay attention to the innovation of teaching methods. Implement education and teaching ability improvement training for primary and secondary school teachers, and promote teachers to update their concepts, reshape their roles, improve their literacy, and enhance their abilities. The resources of high-quality teachers in rural areas are weak, and the traditional method of sending teachers to the countryside cannot fundamentally solve the shortage of high-quality teachers. Information technology has made the benefit of high-quality teacher resources more extensive. Give priority to teachers' ability to use information technology to innovate teaching, develop teachers' online teaching ability standards, help teachers acquire concepts and abilities that match them, and make excellent teachers more adept at using information technology for teaching. Through activities such as education and teaching informatization competitions, the comprehensive promotion of teachers' information technology application results will play an effective role in improving teachers' information literacy and building high-quality teacher resources.

In recent years, live classes in the form of double-teacher classes and elite-teacher delivery classes have been widely recognized in rural primary and secondary schools. High-quality teacher resources can be continuously delivered to rural areas through the network, benefiting more primary and secondary schools, rural teachers, and primary and secondary school students receiving compulsory education. This remote teaching-to-rural model that breaks the time and space constraints can really reduce the cost of education in the long run. The cost of education, in the post-epidemic era, will improve the sharing strength and efficiency of high-quality teachers to maximize the value of high-quality teacher resources.

B. Build a Family Education Guidance Service System

Compared with non-institutionalized and routine family education, relatively complete and institutionalized school

education occupies a dominant position in national education. This determines that parents should play the role of participants and cooperators in education. Family education guidance for the whole society, parents of students have uneven levels of education and cultural literacy, so the school provides parents in the compulsory education stage with approachable, popular, and universal family education guidance, so that the educated parents with relatively low level and cultural literacy can also understand and listen carefully, so that the responsibility, awareness and concept of family education can be truly internalized in their hearts.

From the guidance of students' online learning attitude, online learning ability guidance, and monitoring of students' learning status, learning effect monitoring and other aspects to build a family education guidance system and a home-school linkage management mechanism to achieve the improvement of students' online learning effect.

C. Build a New Educational Landscape with a Student-Centered Approach

Facing the needs of talent training in the post-epidemic era and the information society, compulsory education must be based on student development, follow the laws of education and teaching and the laws of student development, emphasize the student-centered design of online resources, allow students to explore new knowledge, improve their thinking, and transfer applications under the task-driven approach. To vigorously strengthen online learning research, guide education and research workers to deeply participate in online education research, explore and grasp the special learning rules of online learning, refine interest, internalize sensory experience, focus on knowledge transfer, effectively attract and maintain students' attention are important steps to improve the effectiveness of online learning. At the same time, providing rich and diverse educational resources, expanding the choice of educational services, and meeting the needs of integrated education are also important. To meet the needs of learning and independent learning, it is important to realize the synergy and complementarity among schools, families, and online education, form a new education pattern of "trinity", provide students with personalized learning and customized development plans, so that everyone can get the best development possible.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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