

# A Comparative Study of Educational Informatization in the Post-Pandemic Era

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**Abstract.** Along with the rapid growth of technology, education has recently undergone steady change. Before China, of many developed countries started the process of incorporating digital resources and technology into education. The execution of a new education infrastructure program has been given priority by China's Ministry of Education at the moment. Comparatively speaking, the United States has made more advancements in the integration of instructional technology thanks to a comparatively developed sector. Despite being at a higher overall level than China, Japan's development in integrating educational technology is nevertheless lagging behind the U.S. and other quickly emerging nations. Through a study and comparison of the educational advancement in the United States, Japan, and China, this article evaluates the future opportunities and problems of China's education "New Infrastructure" business. The analysis includes market analysis in the post-pandemic era as well as the process of developing educational "New Infrastructure" and the educational environment during the COVID-19 period. Currently, the United States and Japan represent different phases in the integration of global educational technologies.

**Keywords:** Educational Informatization, Post-Pandemic Era, Comparative Study.

## 1. Introduction

Every country has a different education system with its advantages and disadvantages. Education in the US places a strong emphasis on developing students' knowledge, abilities, creativity, innovation, and teamwork. It encourages diversity by enabling students to select majors and courses that are in line with their areas of interest and expertise. Despite these advantages, the American educational system struggles with inequality due to poor access to resources and expensive tuition at colleges and universities. Each state in the United States is in charge of establishing its own rules for education policy. Japan places great importance on education and emphasizes rules, memorization, and a strict examination system. Early instruction in compliance and discipline results in great academic achievement. Routine memorizing is common, and prospects are greatly influenced by standardized tests. The Ministry of Education sets policy for Japan's centralized educational system. Education in China is deeply ingrained in the culture and has advanced significantly. The government has made investments in educational policy, materials, and the raising of standards. However, issues including educational disparity, regional differences, and rising student pressure continue to exist. The emphasis of China's relatively centralized educational system is on economic development and labor training. Critics point to the overwhelming emphasis on memorizing and rote learning as well as the pressure placed on students, even though it has generated a sizable, highly educated workforce and world-class universities. , ,

## 2. The New Educational Infrastructure

### 2.1. United States

Online education is changing traditional forms of education in the United States. More and more students are learning through online courses, virtual labs, and electronic textbook. The process of electronic education in the United States started early, with many schools experimenting with digital tools such as computers and tablets in the classroom as early as the 1990s. With the advancement of technology, many schools have now moved to digital education altogether.

In the United States, there are certain issues with the electronic education process. Due to budgetary constraints, many families are unable to buy digital gadgets, which restricts the opportunity for their kids to engage in digital education. In addition, due to the relative newness of digital education, some teachers may lack the knowledge and skills to use digital tools.

## 2.2. Japan

The usage of digital tools in education has significantly increased in Japan. The Japanese educational system now heavily relies on digital teaching resources including learning management systems and electronic classrooms. Classrooms become more engaging and intriguing thanks to these tools, which also give students and teachers access to more resources for learning and teaching.

Japan has allowed the combined use of paper and electronic textbooks in elementary, middle and high schools since 2019, but because of restrictions on the length of classroom screen use, which cannot exceed 1/2 of the instructional time for each subject, Japan has abolished the limit on the length of classroom screen use from April 2021 in order to promote teachers' familiarity with digital materials and drive more diverse classroom learning, and is expected to fully introduce e-textbooks in 2024. However, due to the cost of introducing e-textbooks, it is not possible to use e-textbooks in primary and secondary schools. Only 8.2% of schools have adopted e-textbooks as of March 2020 due to the cost of introducing e-textbooks and previous policy restrictions on screen time.

The Japanese government will plan to provide tablet computers as e-textbooks for students in grades 1 to 9 but will not prohibit the use of regular textbooks. On the other hand, the government is recommending health-related countermeasures in conjunction with the removal of the restriction on the number of hours spent using screens in class, such as "resting your eyes for about 20 seconds every 30 minutes," "keeping your eyes at least 30 centimeters away from electronic screens," "suppress the reflection of light from electronic screens," and so forth. Since Japanese textbooks will be revised, the full introduction of electronic textbooks is scheduled for that year. Possible measures are to use both paper and electronic textbooks, to use electronic textbooks for some school years or subjects, and to leave it up to local boards of education to decide when full electronic implementation is necessary. At present, most of the paper textbooks issued by Japanese publishers are also issued in electronic form, and the number of electronic textbooks for elementary and junior high schools can reach approximately 95% of the paper textbooks.

## 2.3. China

The pandemic period has also brought new opportunities to the Chinese education system. Schools and educational institutions are starting to adopt new teaching methods and increase the level of e-learning in education.

One of the main advantages of e-learning in China is the ability to provide quality education to students in many remote and poor areas. Through e-learning, students in these areas can access high-quality educational resources and online courses, thus providing access to quality education regardless of location.

Information technology in education also has the potential to improve teacher training and professional development in China. Through online professional development courses and workshops, teachers can expand their knowledge and skills and keep up with the latest educational trends and innovations.

However, the current situation in China has revealed a number of problems, such as the lack of hardware and the unwillingness of schools and parents to bear the financial cost, which has seriously affected the quality of online classes, the possibility of students being tempted by undesirable content on the Internet and the low attractiveness of online classes to students.

## 2.4. Summary

With more students taking online classes, using virtual laboratories, and using electronic textbooks, online education is advancing significantly in the United States. In American classrooms, digital tools

have been used since the 1990s, and many schools have now made the full shift to digital learning. However, difficulties still exist, such as the necessity for teachers to gain the knowledge and abilities required for efficient use of digital tools, as well as the financial restrictions that prevent some families from having access to digital gadgets. The usage of digital tools in education has increased noticeably in Japan. The Japanese educational system now includes electronic classrooms and learning management systems as essential elements, giving students and teachers more resources and improving classroom dynamics. Even if constraints on screen time in class have been loosened to improve teacher familiarity with digital resources and foster a variety of learning experiences, the use of e-textbooks in primary and secondary schools has been constrained by cost considerations and earlier policy restrictions. The pandemic has provided China's educational system with an opportunity to adopt cutting-edge teaching strategies and improve e-learning. E-learning is especially helpful in isolated and underdeveloped places since it enables students to access top-notch learning materials and online courses from anywhere. Through online courses and seminars, information technology in education has the potential to enhance teacher preparation and professional development. However, challenges persist in China, such as a lack of necessary hardware, financial burdens on schools and parents, potential exposure to undesirable online content, and a limited appeal of online classes to students.

### **3. The Education Systems in the United States, Japan and China in the Context of the Pandemic**

#### **3.1. United States**

During the pandemic, the United States closed schools nationwide to prevent the spread of Covid-19, forcing educational institutions to turn to online teaching.

Despite the relatively advanced technology and resources for online teaching and learning in the United States, there are still many problems with this method of teaching and learning. Many students and parents report that the lack of face-to-face interaction with teachers and opportunities for socialization among peers negatively affects the student learning experience. In addition, online teaching poses technical problems such as equipment and network instability.

However, there were also prospects for educational reform throughout the epidemic period. A growing number of educational institutions and schools started implementing innovative teaching strategies. Additionally, schools and parents started to pay more attention to and offer more help and support for students' mental health.

#### **3.2. Japan**

With the spread of the covid-19 in Japan, many schools were forced to close, resulting in students and teachers having to study and teach at home.

In order to continue providing educational services, the Japanese government and schools began using a onanine learning model. This model utilizes web-based technology to enable teachers and students to continue teaching and learning at a distance through online courses and learning tools.

In addition, the Japanese government is working to increase the level of electronic education to meet the challenges of the future. For example, the government is investing in educational technology to improve the quality and efficiency of education. At the same time, schools are working to develop students' technological literacy to meet the educational needs of the future.

#### **3.3. China**

With the spread of Covid-19, many schools and educational institutions have closed due to the need for pandemic preparedness, and students and teachers have had to turn to online learning due to pandemic closures and other reasons.

Even with China's impressive technological and educational advancements, there are still several issues with online learning. The lack of opportunities for peer socialization and face-to-face interactions with teachers, according to many students and parents, has a negative impact on kids' learning experiences. In addition, the lack of stable networks and equipment is a common problem in remote areas.

Many schools and educational institutions are beginning to adopt new teaching methods and improve the level of information technology in education. In addition, the Chinese government has increased its investment in education to help students and parents with equipment and network problems.

### **3.4. Summary**

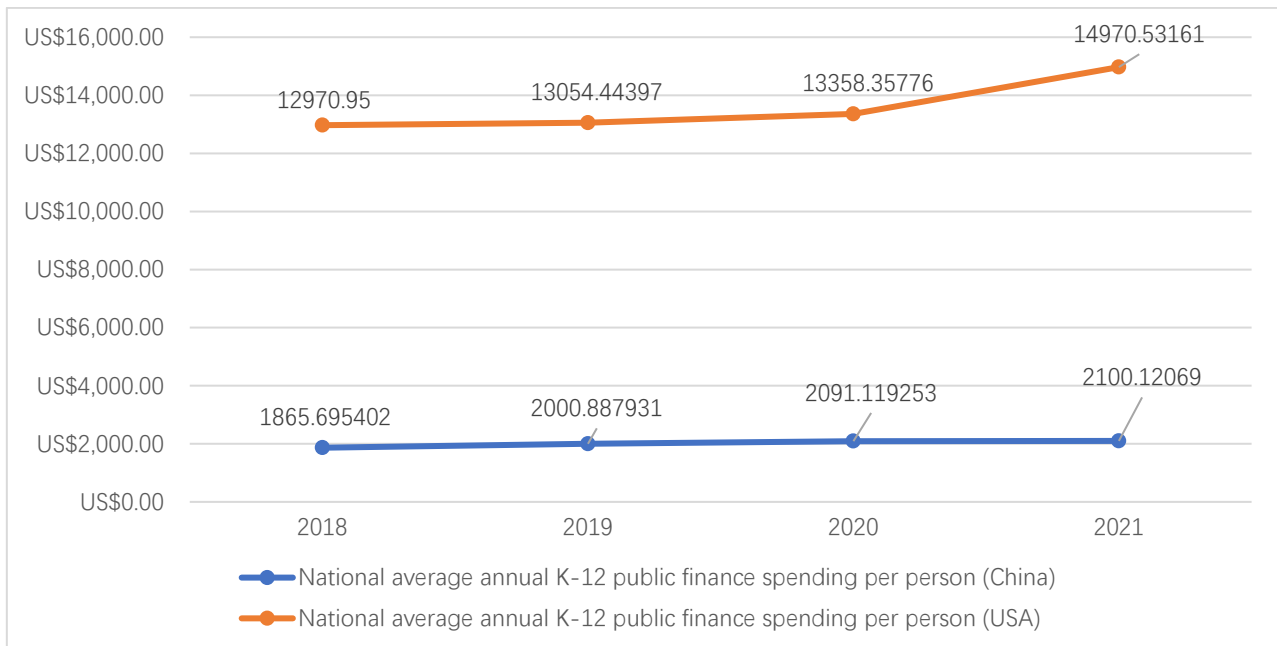
The Covid-19 pandemic had a significant effect on the educational systems of China, Japan, and the United States, causing massive school closings and the implementation of online schooling. Despite the superior technology and resources available in the US, the shift to online teaching presented difficulties. Due to the absence of opportunities for face-to-face connection and socialization as well as technical difficulties with the equipment and unstable networks, students and parents complained that the learning experience was negatively impacted. However, the epidemic also provided chances for educational reform, leading to innovative teaching strategies and a focus on students' mental health in schools and institutions. Similar school closures forced a switch to online learning in Japan. Web-based technology was used by the government and schools to enable distance learning through online courses and tools.

In China, online learning has become very popular as a result of school closings and the necessity to be prepared for pandemics. The lack of face-to-face interaction and students' restricted socializing, particularly in rural locations with unstable networks and subpar equipment, continued despite substantial technical developments. Schools and organizations are introducing new teaching strategies and improving information technology in education to solve these concerns. In order to assist parents and kids in overcoming network- and equipment-related challenges, the Chinese government has boosted its investment in education. Overall, the pandemic acted as a catalyst for the uptake of online education and the investigation of fresh methods of instruction in these three nations. While obstacles still exist, attempts are being undertaken to lessen their effects and use technology to enhance the quality.

Overall, the pandemic served as a catalyst for the adoption of online learning and the exploration of new teaching approaches in these three countries. While challenges remain, efforts are being made to mitigate the negative effects and leverage technology to improve the quality and accessibility of education.

## **4. Comparison between the Current Situation in China, Japan and the United States**

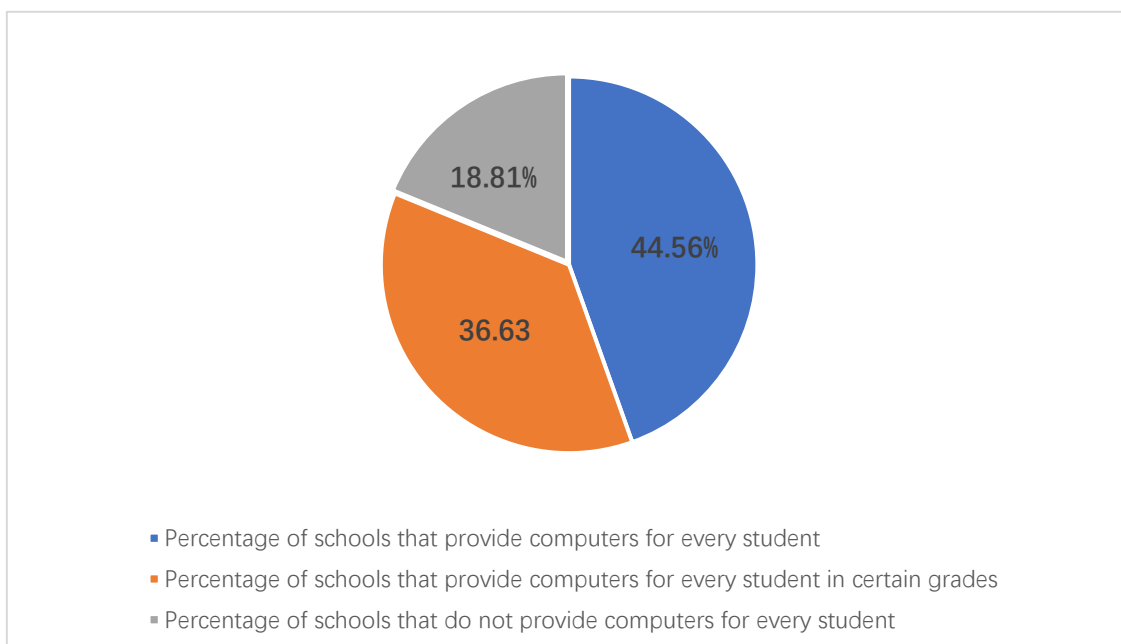
According to Figure 1, judging from the average annual K-12 public education expenditure per person in the U.S. and China, there is still a big difference between China and the developed countries in the world in terms of education investment. The national trend of Figure 1 increases from 12970 to 14970 in the USA. From the analysis of the development trend, this difference continues to increase, which means that if China does not improve education expenditure, the gap with other countries in education will become bigger and bigger. In the United States, for example, the annual per capita spending on education is six times higher than the per capita spending on education in China, and the financial resources for education are still rising at a constant rate year by year. This large disparity has attracted China's attention, and adjustments and changes have been made in education policy. China will need to invest more money and resources if it wants to catch up with the world's developed countries in the field of education.



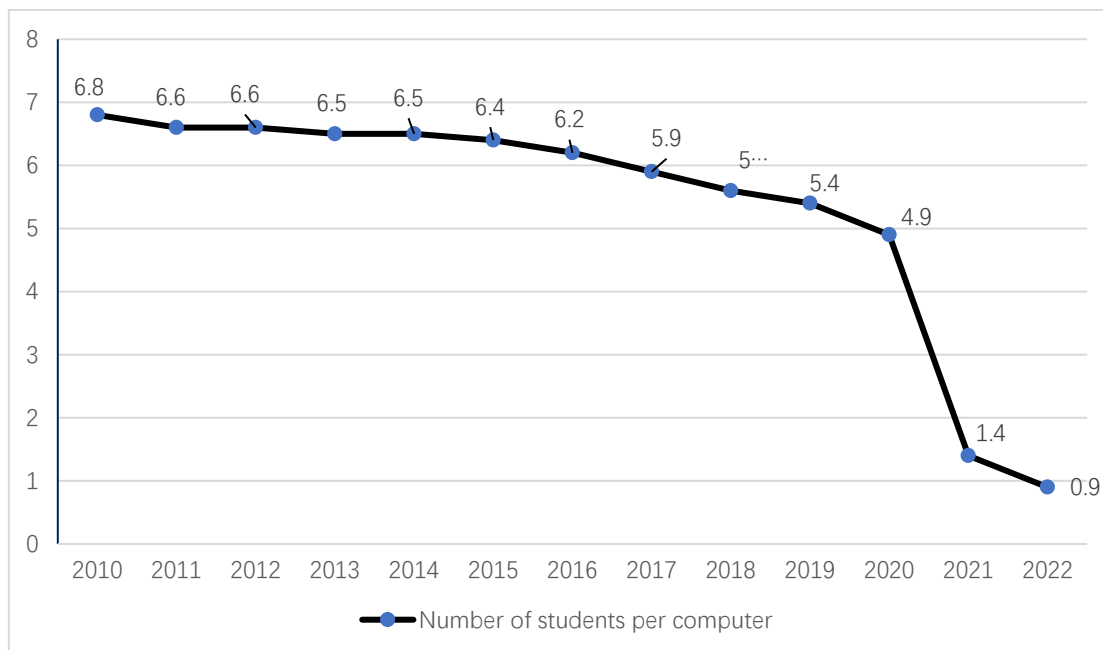
Data source: U.S. Department of Education, Chinese Ministry of Education  
 The exchange rate is as of February 23, 2023

**Fig. 1** National Average Annual K-12 Public Finance Spending Per Person

At the same time, along with the rapid development of Internet technology, information technology will become a major development trend in the world in the future as shown in Figure 2, with every student in certain grades account for 36.63%. Many mainstream developed countries around the world have already started to introduce the information technology education model, aiming to train their students to be proficient in operating and using electronic devices for more efficient and scientific learning at an earlier stage. China is also experiencing the rapid development of Internet technology, and Chinese students also need to be educated in information technology courses while studying in order to adapt to the more advanced and rapid development of information technology in the future. curricula

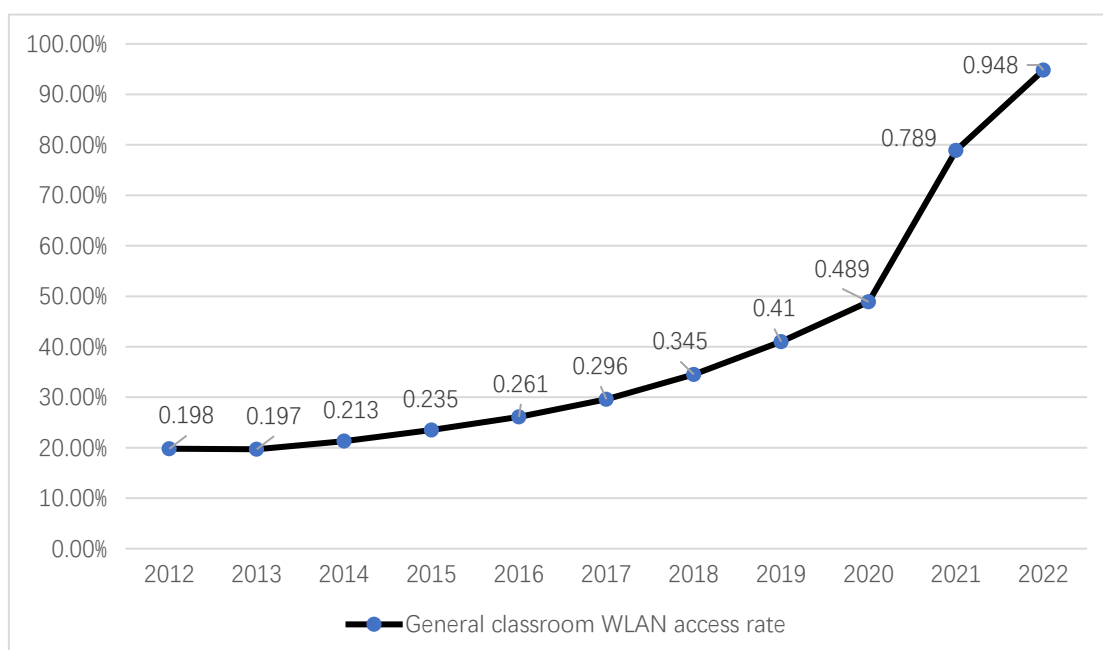


**Fig. 2** School computer availability for students (USA)



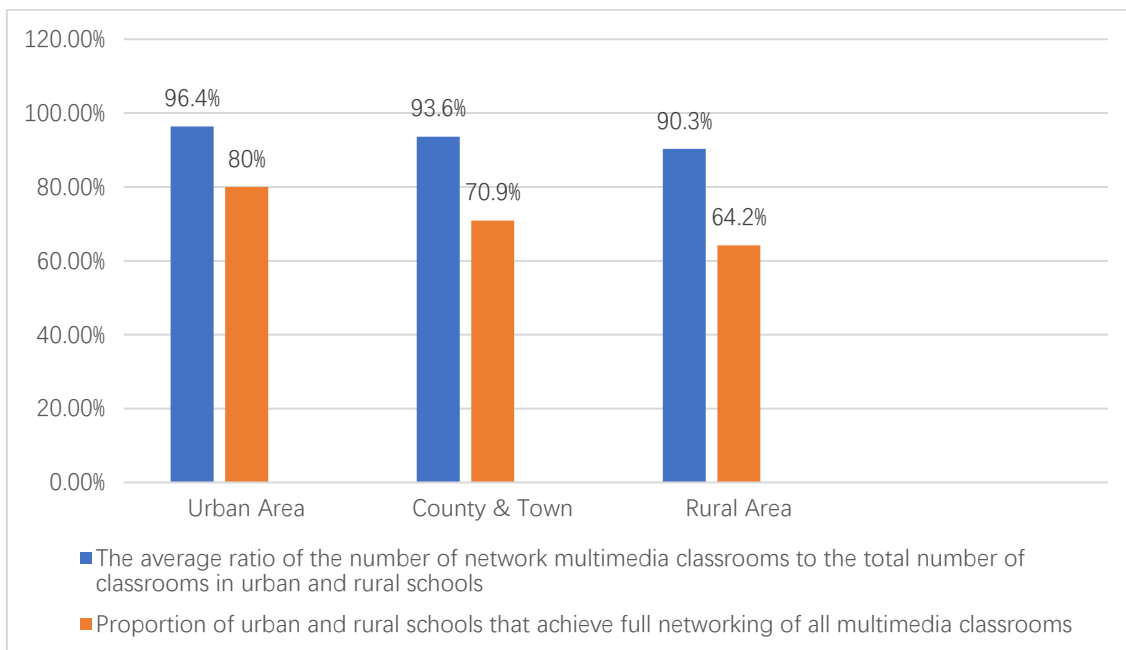
**Fig. 3** Number of students per computer (Japan)

Currently, China is still lagging behind the rest of the world in terms of information technology development. In terms of computer usage, the majority of schools in the United States already offer computer-based curriculum, and in Figure 3, Japan has achieved the average level of providing computers to every student (mostly higher than 4.9), but there are still some urban and rural schools in China that do not provide computers to students. There is still a lot of room for improvement in this area in China compared to the mainstream developed countries. The focus of the new educational infrastructure advocated by China is on the installation and upgrading of hardware facilities.

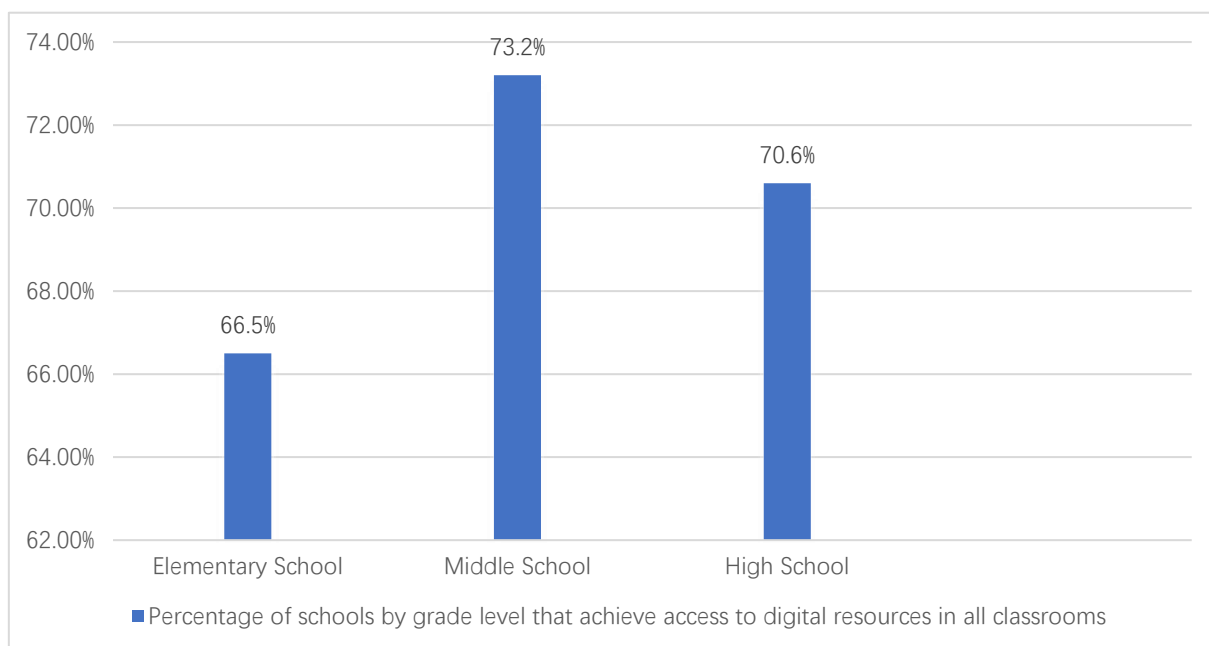


**Fig. 4** General classroom WLAN access rate (Japan)

The most basic hardware facilities are information technology equipment such as computers, interactive teaching electronic screens, and wireless networks. Based on Figure 3 and Figure 4, Japan has already achieved a wireless network access rate of 94.8% in 2022, while the average level in China is about 70.1%. Therefore, a large amount of capital investment in hardware facilities in the early stage will probably be the key task in the next phase of the New Infrastructure” of education.

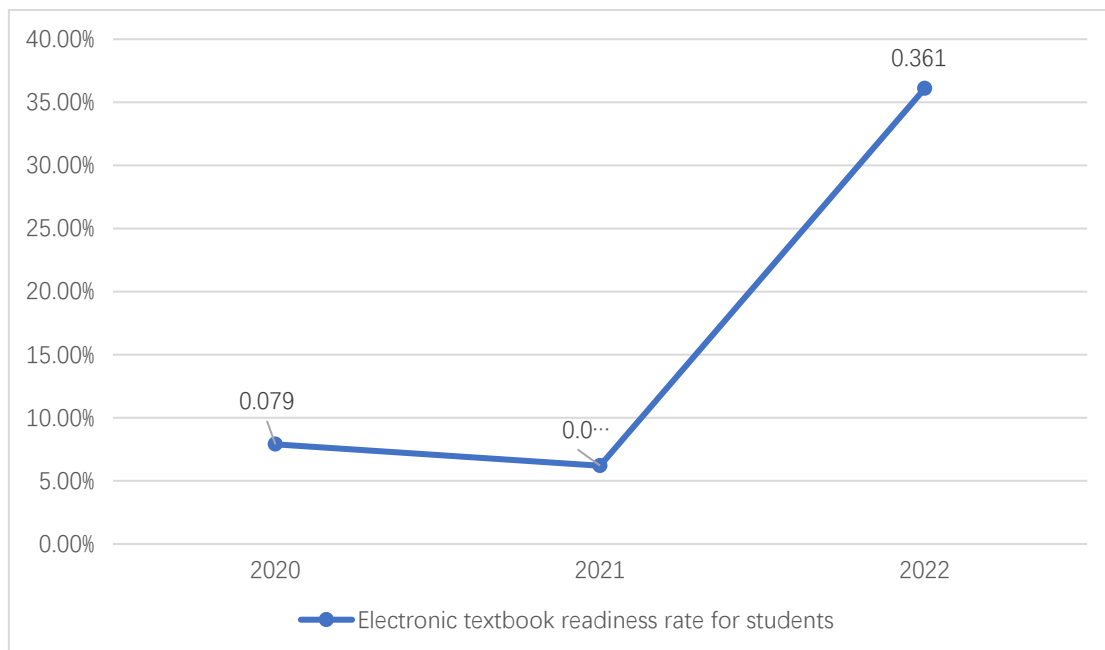


**Fig. 5** Multimedia classroom coverage and networking rate in urban and rural areas of primary and secondary schools in China in 2019

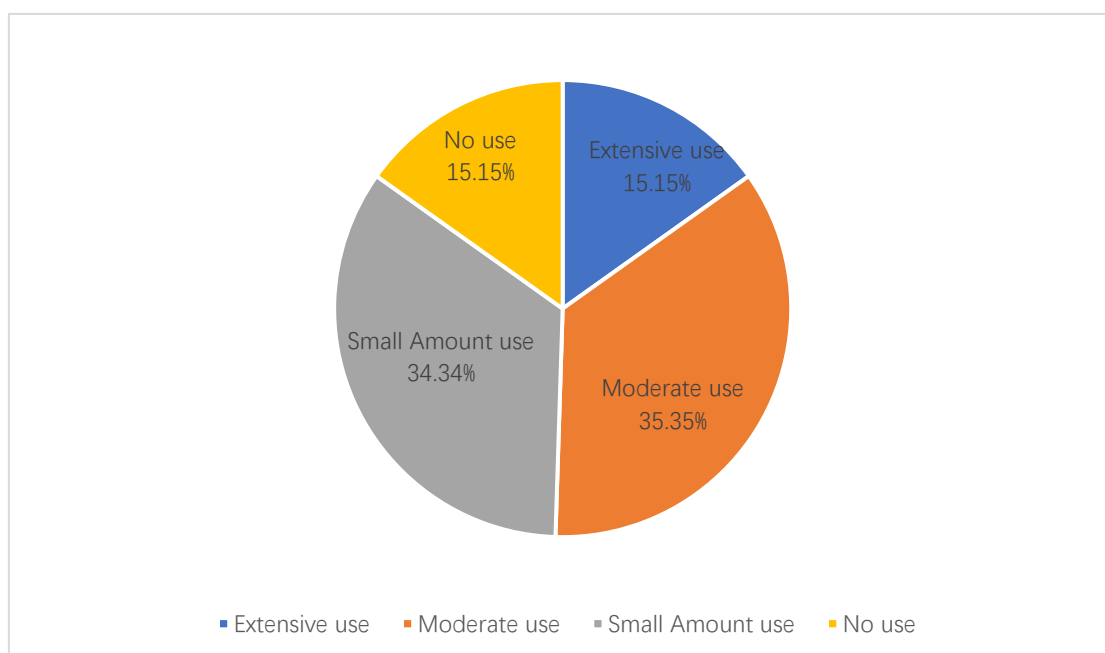


**Fig. 6** Access to digital resources in primary and secondary school classrooms by section in 2019

In addition, according to Figure 5 and Figure 6, from the analysis of the specific implementation of the New Infrastructure” of education, knowledge informatization will also become the focus of the realization of the New Infrastructure” of education in China. In Figure 5, the average ratio is generally higher than the proportion of urban and rural schools. In Figure 6, the middle school accounts for 73.2%, which is the highest ratio among the three kinds of schools. The U.S. has already started the layout in knowledge informatization several years ago, and most of the schools in the U.S. have introduced and actually used e-textbooks in teaching as shown in Figure 8. Although Japan is a late starter as shown in Figure 7, its overall availability has increased to 0.361 which is the highest ratio in the electronic textbook readiness rate.countries



**Fig. 7** Overall availability of electronic textbooks for students (Japan)



**Fig. 8** Interactive e-textbooks (USA)

Compared to the United States, it is also actively laying out the introduction of knowledge informatization and e-textbooks. Knowledge informatization is a much larger task than in China, and it will take several years of extensive work to catch up with other countries' development levels. As shown in Figure 8, small amount use and moderate use are very similar to around 30%, which account for two of the largest use.

#### 4.1. Introduction to the basic information of China's new Education Infrastructure view

A comprehensive system aiming at reforming and modernizing education in the digital era is called the "New Infrastructure" for education in China. Information networks, platform systems, digital assets, smart campuses, cutting-edge applications, and security are some of the topics it focuses on. The objective is to continuously build, iteratively improve, and renew the education infrastructure by 2025 in order to create a system that is optimized and effective. As part of this, a specialized education network and a "Internet+Education" platform are being built, as well as high-quality resources are

being gathered, new campus spaces that combine real-world and virtual components are being created, cutting-edge educational applications are being created, and security precautions are being strengthened. Since the Covid-19 pandemic, when online education and informatization proved beneficial, China's education system has undergone substantial innovation and transformation, with increased investments in education informatization. It is anticipated that state support for the New Infrastructure in education would rise as the economy improves. Although the epidemic had some influence on the distribution of cash, it is expected that this will gradually change as the economy and fiscal system recover. Furthermore, China's advancements in educational technology are consistent with the global trend of the sector's digital transformation. China has plenty of room and opportunities for the development of education informatization thanks to the fast development of digital technologies and a robust economy. The development of education informatization in China is supported by the ongoing improvements and applications of digital technology. informatizationthe all-around

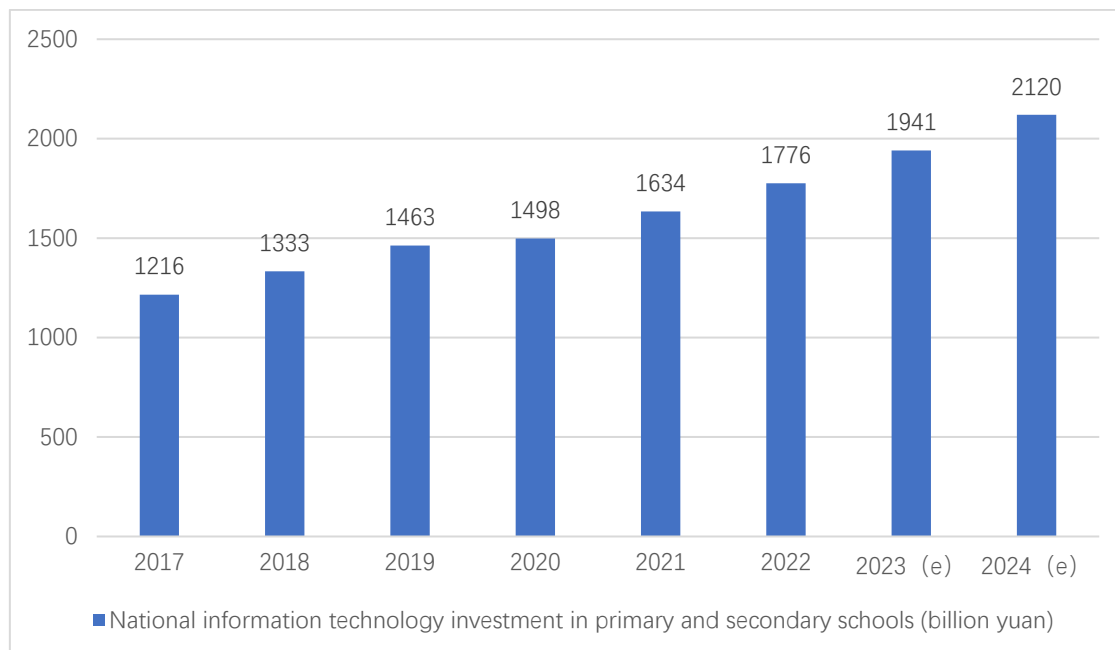
#### 4.2. Analysis of Market Development Prospects

The direction of China's education reform is clear. In recent years, the Chinese government has clearly put forward the five development concepts of "innovation, coordination, green, openness, and sharing" and incorporated them into the national development strategy. This has also promoted the rapid development of information-based education, making it an important part of the educa reform.

President Xi Jinping has repeatedly stressed the importance of education and put forward the concept of "a prosperous country is a prosperous country when education is strong, and a strong country is a strong country when education is strong", establishing the policy that education is a major plan for the country and the Party and the basic state policy of strengthening the country through education. The Chinese Communist Party's 20th National Congress reaffirmed the idea of developing the country through science and education, determined and clarified that "implementing the strategy of developing the country through science and education, strengthening the support of talents for modernization" as the basis, and accelerated the construction of a strong country in education, science, and technology as well as talents in the new journey of building a modern socialism. In addition, President Xi Jinping has repeatedly emphasized the need to hasten China's attainment of high-level scientific and technological self-sufficiency and self-improvement, and that the future of China's development will be based on the synergistic development of education, science, and technology. This is a clear indication of the importance China attaches to the education sector and its determination to reform education.

China's information technology education market is promising. China is a country with a large population, so the information technology education market has great potential. In the information technology education market, China already has many excellent education technology companies, and a large number of emerging companies have also been incubated. Due to the huge market scale, the upstream and downstream industrial chain of education informatization has also created a lot of industrial opportunities and room for development.

Judging from the trend of China's education financial expenditure invested in informationization of primary and secondary schools nationwide, China's financial investment in informationized education reform is rising steadily year by year. Due to the impact of the pandemic and the economic recovery in the post-pandemic period, fiscal expenditures may fluctuate but generally maintain a positive trend. The development process and policies on education informatization have been formulated in various places, and there will be huge market demand and market potential in education informatization in the future.



**Fig. 9** National information technology investment in primary and secondary schools (billion yuan)

During the construction of education informatization, many opportunities have been created in many different segments, and some large companies are changing their direction and investing in the education sector. According to the analysis of the current market situation, there will be many opportunities for rapid development in the segments related to the construction of education informatization. These include the provision of network equipment, access to networks, access to informatization terminals, access to educational platforms, access to digital resources, installation of hardware equipment for multimedia classrooms, installation of innovative classrooms, applications for educational teaching and management services, etc. Numerous education-related segments will bring huge market opportunities and profits for related companies. Companies like Longchao and Ruijie, for instance, benefit greatly from the market for network equipment; China Telecom, China Mobile, and China Unicom are in charge of the market for network access; Dushulang and Lenovo hold the top spot in the market for access to information terminals; educational resources Outstanding businesses in China today include Keda Xunfei and Songshu AI; subject networks and Baidu Cloudwise Education are relatively in the field of digital resource access mature; multimedia classrooms also provide a market for many enterprises upstream and downstream; hardware facilities such as projectors, LCD blackboards, LCD whiteboards, live recording and broadcasting equipment, video booths, etc. bring huge demand; enterprises such as Reading Lang and Lenovo take the lead in the market in terms of access to information technology terminals; combined with the current development of the latest technology, enterprises represented by DJI Education and Xunfei Mirage provide Chinese students with application support of the latest technology; companies such as Yundie Technology and Xiaobaozaixian have a relatively high market share share in the application management of education teaching.

At various stages of the development of educational information technology, businesses in various segments must meet a variety of market expectations. Network construction primarily entails network bandwidth leasing and network equipment procurement. The former, which is a policy monopoly market, is primarily provided by the three major carriers, while the latter, which includes switches, routers, gateways, wireless access points, and servers, is provided by market-oriented communication equipment vendors. In the process of building a multimedia classroom, hardware makes up more than 90% of the total construction cost. Information terminals are electronic terminals that rely on digital learning environments, digital learning resources and digital learning methods, mainly referring to tablet PCs, laptops and desktops.

Innovative teaching methods, curricular change, and experimental safety all benefit from innovative classrooms. Information technology can give students more sensory experiences, improve the immersion and enjoyment of teaching, and virtualize experiments that are risky, destructive, or harmful to the environment, which can both lower costs and improve experiment safety. This is especially true for things and phenomena that cannot be observed and controlled in the real world due to time and space constraints. The overall school penetration rate of innovative classrooms is not high due to the immature application of various technologies, the lack of rich content reserves, and the lack of rigid school demand. However, in the U.S., for example, after the outbreak of the covid-19, many K-12 schools in the U.S. considered that home isolation and learning may have an impact on student's physical and mental health, so they have conducted different virtual classroom pilots in different parts of the country, and the application of virtual classrooms has produced many good results and feedback. For example, due to the pandemic, students were unable to go on school field trips as usual, and some schools combined online classes and VR technology to allow students to feel the joy of going on field trips and experiencing the natural environment without leaving home. The use of new smart classrooms is not only applicable during the pandemic, but also allows students to experience and observe a wider world, achieve relatively difficult experiments, and learn more efficiently in the post-pandemic era.

## 5. Conclusions

The Covid-19 pandemic has had a big impact on education, causing online learning to grow and opening up huge commercial prospects in China. In China, the market for online education expanded significantly, growing to 432.8 billion yuan in 2020. The pandemic has brought to light the benefits of information-based education, and the government has put forward encouraging measures to encourage the creation of a "New Infrastructure" for education. This involves developing "Internet + Education" and "Smart Campus" frameworks to make it easier to combine artificial intelligence and educational information technology. Although China's multimedia classroom infrastructure is virtually finished, future growth depends on updating equipment and implementing cutting-edge technologies that give teachers more control, such as Newsela, an app that chooses news stories based on classroom themes. It's anticipated that the idea of cutting-edge classrooms outfitted with hi-tech tools like drones, VR headsets, and AR desks will gain appeal. However, because the market for educational technology is so young, many immature businesses with constrained technological capabilities and uniform software interactions have emerged. The industry draws a lot of businesses, so there is a chance of unstable businesses and probable quality problems. It is significant to emphasize that some businesses involved in educational technology, particularly those specializing in video conferencing, can experience difficulties in the post-pandemic period. Nevertheless, the industry's long-term growth will be supported by investments in education informatization and strong legislative backing, opening up chances in instructional technology, cutting-edge classrooms, and upstream businesses. Overall, due to the nation's large market demand and strong policy backing, the education informatization industry chain will be a long-term sustainable development industry, and we can pay attention to the current market because it has not yet reached saturation, the state's financial investment will also attract and drive a lot of private capital to enter the related industry.

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