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# LARGE-SCALE ONLINE LEARNING SUPPORTED BY INTELLIGENT DEVICES IN THE POST-PANDEMIC ERA

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***Abstract.*** *With the support of emerging technologies such as artificial intelligence and cloud computing, China began learning and teaching online in 2020 to control the spread of the pandemic and implement the "Classes are suspended, but learning continues" policy. Online learning and teaching require modified methods, management, and evaluation compared with traditional instruction. Moreover, teachers' and students' thinking styles and ways of communication have also changed in terms of practice, places of study and tasks. The large-scale online teaching-learning model has ushered in new teaching and learning reform trends in the post-pandemic era. Therefore, this study investigates students' and teachers' readiness for, acceptance of, and satisfaction about comprehensive online teaching and learning and explores the effect online learning has on students. To achieve the research aim, 67 students from one city and one village in China were surveyed.*

*The results revealed that online teaching was met with medium levels of readiness and acceptance and gave little satisfaction. For students, attitudes toward learning, support (or lack thereof) from instructors, effective interactions, motivation to learn, and self-regulation influenced online learning satisfaction. In addition, the students' grade levels and locations.*

***Keywords:*** *acceptance of online teaching and learning, intelligent devices, large-scale online learning, post-epidemic era, readiness for online teaching and learning, satisfaction about online teaching and learning.*

## Introduction

The global outbreak of COVID-19 in 2020 has considerably impacted Chinese society. According to the Ministry of Education requirements, all schools across China have conducted online teaching and learning. Such large-scale online education tests and reviews China's informatization and modernization of education.

Currently, research on online education mainly focuses on constructivism, behavior, and cognition online and the knowledge management of online teaching and learning and technical support research (San & Min, 2014). However, there is


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controversy over whether online education can improve learning. Clark (1983) points out that the media does not affect learning. In addition, according to Man and Wei, in the fall semester of 2019, online teaching was nearly equivalent to traditional classroom teaching (Man & Wei, 2019). Therefore, there is no difference in the learning effect between online and in-person education, and there is no relationship between the learning effect and media application.

The aim is to investigate students' and teachers' readiness for, acceptance of, and satisfaction about comprehensive online teaching and learning and explore the effect online learning has on students.

To explore methods that do indeed promote students' deeper learning online, improve learners' online participation and augment online learning's effects, this paper studies the following three questions:

Q1: How do learners prepare for online education?

Q2: How can we deal with mass online education?

Q3: How should intelligent online education develop in the post-pandemic era?

In this paper, a literature review and questionnaire were used to understand and study students' readiness, acceptance, and satisfaction for massive online teaching and learning and the effect of online education on students.

## Literature Review

There are two main views on the effectiveness of online learning. One idea is that online education during the outbreak has generally failed. Ru (2020) believes that schools across the country had to carry out emergency online education because of the uncertain duration of the epidemic. Online learning and teaching, which hastily started with insufficient experience and technology, went wrong, causing complaints from teachers and students. In addition, educational researchers have raised doubts about online teaching and learning. After reviewing the international literature on the effects of educational technology applications, Gang (2018) believed that educational technology did not have stimulating effects overall. Mang (2017) believes that information technology has not met its high expectations. He also hopes that non-educational technology professionals can understand educational technology from a philosophical perspective and guide technology and stakeholders to establish correct values instead of going to the extreme of technism, which fails to respond to the fundamental contradiction between education and technology and ignores the understanding of the nature of humanity and education (Mang & Dong, 2020).

On the contrary, the optimistic view is that online teaching and learning is the inevitable trend for education in the future, so attention and affirmation should be

devoted to promoting education informationization and the modernization of power. Yong (2020) assumes that, for education informationization and network teaching, the global outbreak is an opportunity to encourage reform. Jun et al. (2020) believe that the epidemic significantly improves the awareness of online learning. Hong (2020) confirmed that professors' recognition of online teaching has improved compared to before the pandemic.

The dispute between the two viewpoints is that they hold different value orientations about education. One believes that traditional in-person teaching and learning rationality opposes radical educational reform. Another view is that the existing educational model can no longer meet the needs of today's technological and academic development, so digitalization and informatization reform must be carried out. Therefore, it is not very meaningful to discuss the effectiveness of online education separately, instead of recognizing that massive online education is valuable and has advantages and value. Furthermore, mass-online education under this epidemic is an orderly, mainstream activity subject to multiple conditions compared with in-person teaching and learning. Researcher Yu (2021) points out that the emergence of cloud computing technology in China has ignited new thinking for education and teaching. *If computer multimedia and the Internet, as the previous round of technologies, have brought about changes in teaching presentation, teaching resource acquisition, and education transmission, the new technologies based on cloud computing will not only continue to deepen the previous educational changes, but also bring more profound fission to education.* (Yu, 2021). Therefore, it has specific learning value and presents a brand-new teaching and learning ecology, which will likely lead to significant reform in modern pedagogy. Based on relevant theories, this paper analyses the characteristics and value of this large-scale online education from the educational place, evaluation method, and modes of teaching and learning.

In face-to-face education, learning takes place almost entirely in the classroom. However, in the case of large-scale online teaching, the learning site is mainly at home and on the network. This means that the propagation of knowledge is no longer limited to teachers. It has the characteristics of social, situational, and distributed network transmission (Sheng, Gang, & Jing, 2009). Relying on a network to spread knowledge strengthens the possibility of educational equity. In some provinces, students from different schools and regions can be taught by the same teacher, which unifies educational resources and makes them fair.

In-person teaching is limited by the mismatch between students' and teachers' resources, making personalized instruction impossible. However, relying on the intelligent equipment of online teaching, learning forms can be personalized and diversified. Various materials provide students with multiple learning resources,

while intelligent data statistics and computing tools can accurately analyze students' online learning behavior patterns and habits. These provide data support for satisfying students' personalized learning.

With the development of technology, evaluations are no longer limited to results. A new adjoint evaluation has been realized. Online adjoint evaluation can be embedded in the learning process, including data-based and technology-supported evaluations (Feng & Jiqing, 2018). This evaluation method includes the time of the study, frequency of learning, participation in discussions and completion of tasks. These results enable teachers to grasp the learning dynamics of learners in time and make personalized and objective assessments of students' learning with the help of big data, artificial intelligence and other technologies.

In in-person teaching and learning, learners and teachers can sort out knowledge and deepen their understanding of learning content through communication and discussion. However, in online education, due to limitations in the network transmission of space, the time for communication and debate is reduced, as the opportunity for learners to think independently is increased. This is conducive to improving learners' independent thinking ability from psychological cognition. To meet the requirements of online education in the context of the epidemic, large-scale online teaching and learning across the country has networked and personalized characteristics and solves the problem of face-to-face teaching to a certain extent. Nonetheless, the challenges should be realized. Are learners ready for online learning? How receptive are teachers to online education? The authors refer to the research of Juan et al. (2014) and Kun et al. (2020), who designed a questionnaire and responded to these questions through a small-scale survey. The entire questionnaire consists of two parts. The first part is the survey of the basic information of the respondents, such as age and gender. The second part is a survey of online learning readiness, including the acceptance of online learning, satisfaction, and teachers' support. 5-point Likert scale survey questions were used in the questionnaire, ranging from "very consistent" to "very inconsistent."

## Methodology

The research plan and procedures data provide a solid foundation for the methodology. The study follows the interpretivism research philosophy, in which the researcher builds information and interprets it based on how the participants see the phenomenon. Inductive methods are used in the study to produce theories on how intelligent online education should develop in the post-pandemic period. The researchers utilize the explorative survey design to effectively address the research questions' issues since it provides adequate chances to answer the proposed

questions. The explorative design allows the researcher to investigate how students prepare for online learning and how we can deal with large-scale online learning (Rahi, 2017). Because the qualitative research method is in harmony with the exploratory research design, it was used for data collection, synthesis, and utilization in the current study. The interpretive research philosophy is consistent with the qualitative approach and the exploratory research design.

The article's authors conducted a survey and distributed a questionnaire to get different perspectives on how intelligent devices assist large-scale online learning in the post-pandemic age from the targeted respondents. In addition, secondary data, such as journal articles and books, was used to supplement the research. As a result, much of the data used in the study was gathered through online searches, such as SpringerLink and Google Scholar. Finally, because not all students use intelligent devices, the study will use a systematic sampling technique. In essence, the current study will analyze the outcomes using a qualitative analysis method and investigate the data using a content analysis strategy.

## Results and Analysis

This section reveals the data analysis and results, finding that online education satisfaction is medium, and there is a difference between urban and rural students' readiness for online teaching and learning.

Research subjects are the primary and secondary school students in City B and Town H who completed 90 questionnaires; 67 valid questionnaires were collected. The effective rate of the questionnaire was 74.4%, of which 37 were male students, accounting for 55.2%. The remainder were girls, at 44.8%.

Survey results show that 16.3% of students study more than six hours a day, 29.7% of students study 4–5 hours a day online, and 44% of students study 3–4 hours a day. According to the survey's results, 47% of middle school students study more than five hours a day online. Before the outbreak, only 33.1% of the students said they had ever studied online. Currently, about 92% of students are aware of online education. In addition, 56.6% of subjects said they had no self-control in online learning, and 55.9% said their families did not present a good atmosphere for study. "Poor internet reception" accounted for 17%, and "Lack of familiarity with learning equipment" accounted for 9% (Figure 1).

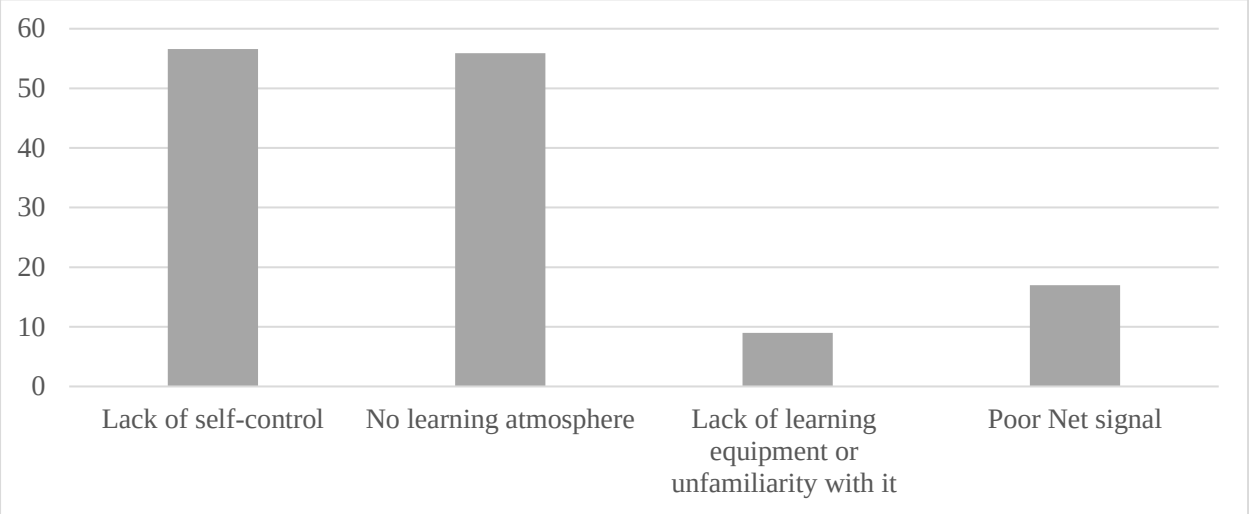


*Figure 1* ***Limits of students' online learning*** *(created by the authors)*

The survey results of "attitude satisfaction and teacher support for online teaching" show that the average score of online learning satisfaction is the lowest at 3.4. On the other hand, the average score of the perceived degree of support for teachers was the highest, at 3.9. Meanwhile, the results also showed significant distinctions in specific items in each dimension. For example, among online learning attitudes, the item that learners "know the characteristics of online learning and can define their learning autonomy" received the highest score of 3.9. This was followed by "I can accept online education," with a score of 3.7.

Regarding learning satisfaction, "I would like to continue online education in the future" received the lowest score of 2.9. Regarding perceived teacher support, "teachers can help with the operation of the online learning platform" scored highest, while emotional factors came second. (Figure 2).

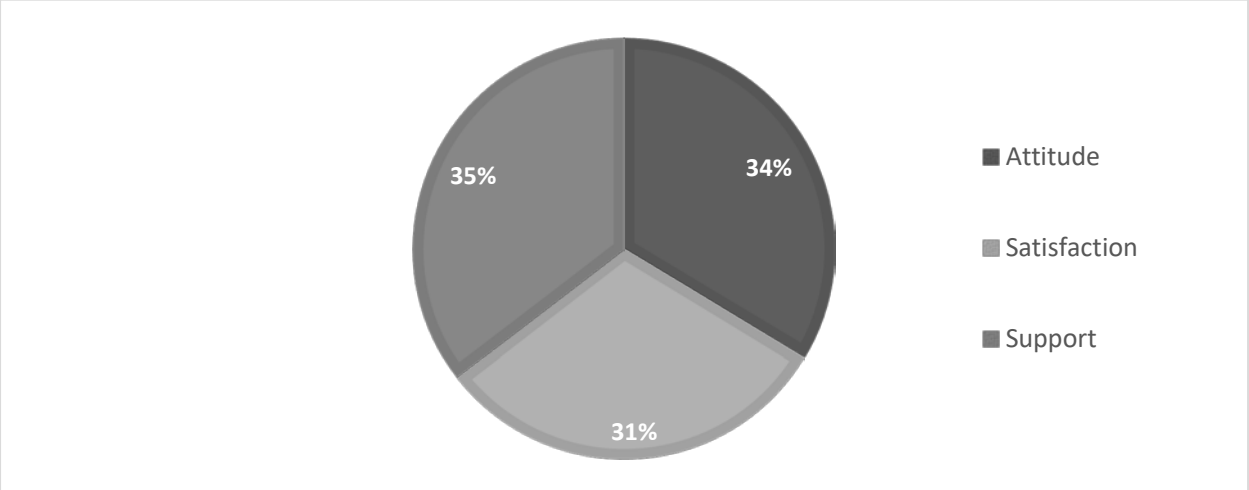


*Figure 2* ***Online learning attitude, satisfaction, and teacher support*** *(created by the authors)*

The survey results of learners' readiness for online learning are depicted in Figure 3.

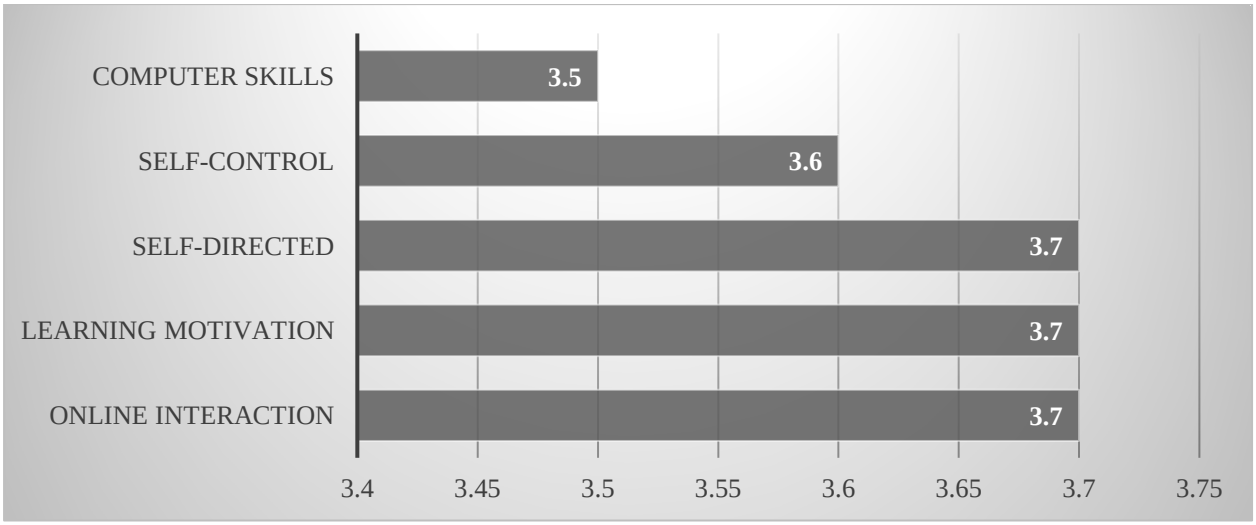


*Figure 3* ***The average score of all five dimensions of online learning readiness*** *(created by the authors)*

Among all the sub-items, the average score for the operation ability of computers and other intelligent devices is the lowest, which is consistent with the fact that Chinese primary and secondary school students in villages and towns lack information technology. In the dimension of learning self-control, the results demonstrate that the average score of being attracted to social or entertainment software is 3.8, higher than the average level of 3.7. This shows that self-control plays a vital role in online teaching, and learners should be fully guided to focus their attention. The average score for online interaction ability is 3.7. Among the different dimensions, learners' confidence in "using online communication software" is 4.2, and "being able to review online learning content by themselves" is 3.5. The average score of "able to find suitable materials according to the teaching content" is 3.1, which indicates that students have good application ability of social software. Such findings fit the character of students in the digital era. However, due to many learning materials on the network, primary and middle school students cannot screen those enormous materials and sources.

Results of urban and village students' readiness for online education. To explore whether urban and township students' readiness for online learning is consistent, the author selected students of the same grade from a school in City B and a school in Town H. As shown in Table 1, from the perspective of gender, there was no significant difference in readiness. However, from the standpoint of region and age, there were substantial differences in readiness.

*Table 1* ***Readiness for online learning*** *(created by the authors)*

| | | Mean ± Standard Deviation | P-Value |
|---|---|---|---|
| Gender | Male | 3,51±0,71 | 0,21 |
| | Female | 3,52±0,67 | |
| Grade | Primary school | 3,73±0,31 | 0,00 |
| | Junior middle school | 3,52±0,60 | |
| Area | City | 3,75±0,79 | 0,03 |
| | County/Town | 3,64±0,73 | |
| | Village | 3,60±0,52 | |
| Study time | 1-2 hours | 3,09±0,78 | 0,00 |
| | 2-3 hours | 3,43±0,66 | |
| | 3-4 hours | 3,67±0,61 | |
| | 4-5 hours | 3,69±0,56 | |
| | 5-6 hours | 3,56±0,67 | |
| | More than 6 hours | 3,51±0,70 | |

*n=67*

According to the results, the online learning readiness of middle school students was higher than that of primary school students. The online learning readiness of students living in cities is higher than that of rural and township students. The authors found this correlated with hardware devices, such as smartphones and computers. Students who studied online for four to five hours a day scored highest on their learning readiness. Students who studied 1–2 hours a day were least prepared to study online.

## Discussion

The survey results reveal that learners' readiness for online learning is moderate. Accordingly, for the development of online education in the future, the following should be noted:

Educators should strengthen students' independent learning abilities. Autonomous learning is a modern way of learning that can encourage learners to explore knowledge independently and form good thinking habits and autonomous learning habits. In addition, it is conducive to the improvement of teaching quality and lays a good foundation for further study (Jian, 2020). Carrying out large-scale online learning is an opportunity to strengthen students' autonomous learning abilities.

Teachers guide students to set learning goals, arrange learning time reasonably and provide online learning strategies to promote deeper learning. In this context

deeper learning is understood as the process of learning for transfer, meaning it allows a student to take what's learned in one situation and apply it to another. (Briggs, 2015). In addition, through the guidance of teachers and other students, students can carry out self-study monitoring and evaluation and gradually learn to plan and study independently.

Improve information literacy and ability. To meet China's requirements for building an intelligent society in 2018 (The China Daily, 2018), schools should ensure that students' information and technology abilities are improved qualitatively. Such skills include computer literacy, programming, and human−machine collaboration (Kai, Yao, & Guo, 2018). Furthermore, to enhance learners' digital reception and processing ability and adapt to future changes in education, educators should pay attention to learners' scientific and technological ability and promote learners' use of various technologies to ameliorate knowledge construction. Moreover, learners should be trained to correctly search for and choose learning materials to use network resources.

Balance, equality and equity can promote the development of the education industry. The premise is that the realization of educational equity needs to solve the phenomenon of inequality and inequity in education (Li, 2016). Mass online learning enables all learners to access online platforms to enjoy the same quality educational resources. However, there is a digital divide between rural, remote areas and urban learners. Therefore, education departments and schools should take a holistic approach to ensure the equipment enables all students to learn online. Simultaneously, schools should organize diverse forms of online teaching programs. Meanwhile, networks and other infrastructure should be strengthened to ensure a smooth network and low costs. Cloud computing not only provides abundant information and powerful computing power but also enables teachers and students to share information resources more comprehensively and quickly. (Yu, 2021). Continue to empower teachers to support online education. In the survey, the authors found that learners gave high scores to the perceived support of teachers. Teachers' support for students includes knowledge support, emotional support, and tool support. Teachers design learning activities and build learning communities to acquire knowledge. In addition, compared with the face-to-face mode, learners lack physical space to communicate during online learning. Therefore, teachers take on emotional communication, which is more important than ever before. Teachers should pay attention to learners' emotions and encourage them to enhance their self-confidence and expressiveness. Finally, teachers should provide understanding and support to students who need extra learning and give them additional platforms to solve problems after class.

## Conclusion

During the pandemic, students in many countries face a suspension of classes. As a result, online education has been forced to develop rapidly and become a mainstream educational model. However, it still has many problems. For example, students' acceptance of online teaching is not high, teachers' online teaching ability and experience are insufficient, and school systems are unprepared for hardware and equipment. However, online education is moving towards gradual improvement. Therefore, the importance of online education to future teaching systems cannot be denied.

Q1: How do learners prepare for online education?

Participants in the study emphasize their perspectives in answer to this research topic. Finally, the findings are compared to the evidence offered in the literature review to determine their validity and credibility. The survey's warm-up questions show a lot about the strategies and other elements that helped students succeed following the Covid-19 pandemic. Online learning gives access to broad types of resources around the country that might have been inaccessible or extremely difficult to attend in person. However, online learning can pose different obstacles if students aren't prepared. Online teaching and learning can be an excellent substitute for traditional classroom instruction, provided students understand how to use them effectively. Online education can target the achievement of students' learning goals and help students develop comprehensive qualities, such as correct lifelong goals and behavior patterns. Furthermore, through human−machine cooperation, students can build self-learning and lifelong learning abilities with the help of intelligent devices.

Q2: How can we deal with mass online education?

Online education is gaining attraction as a potential solution for increasing access to quality education. According to the term "digital gap," access to online education is limited in many countries. Digital education has become much more feasible in recent years due to the fast adoption of smartphones. Even in the most isolated rural areas, people can now access the Internet thanks to mobile broadband technology. To fill capacity gaps, governments are turning to online education. Digital learning, rather than establishing additional brick-and-mortar institutions, promises a more cost-effective and faster solution. It remains to be seen if online education can deliver on this promise.

Q3: How should intelligent online education develop in the post-pandemic era?

As a result of the pandemic's unique circumstances, all education stakeholders must ensure that education resources are used solely to advance learners' interests and talents, i.e., the benefit of all students, to protect the right to education. After online teaching, educators will have new thinking and expectations of the teaching

mode, and the teaching form will change. Now, mass online education works when teachers and students do not see in-person each other. However, the integration of online and offline education modes will become a trend in the future. Therefore, educators should explore the integration of different subjects, the interaction of resources, the relationship between teachers and students in the mixed teaching mode, and the search for intelligent technology in the mixed teaching mode.

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