Problems and Realization Path of Intelligent Education in Chinese Universities

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Abstract. The development of intelligent education, on the basis of the deep integration of modern information technology and education, is crucial to improve the quality of higher education in China. Intelligent education has received increasing attention in recent years and has been carried out in Chinese universities successfully in many fields. However, many problems also exist and cannot be ignored. This paper analyzes the current situation and problems of the implementation of the existing intelligent education in higher education based on a linearity regression analysis of the questionnaires retrieved from 62 college teachers in Nanjing. By studying the dependent variables and the relations between the two in terms of the Coefficients, Histogram, and Normal Q-Q plot, this paper tries to put forth a better way to realize the intelligent education in China's universities. It holds the belief that in order to promote intelligent education, innovative teaching modes, an information-based teaching environment, rich teaching resources as well as sufficient teaching support are still in great need in Chinese universities.

Keywords: teaching reform · intelligent education · information technology · Chinese universities

1 Introduction

Intelligent Education is a learning tool which enables students to learn foundational concepts related to their course. It provides a platform that powers course creation, interactive learning, and practical skill-building. Since the outbreak of COVID-19 at the end of 2019, the fact that "offline classes are suspended, while online courses continue" has become a common education trend in many Chinese universities. How to learn well online during the suspension of offline classes has become an important content of intelligent education research in Chinese universities. Under the new situation, higher education in Chinese universities needs to make full use of the advantages of modern information technology, integrate intelligent education into the whole process of education and teaching, change and reshape the traditional one-way teaching mode, and reform class modes. It is of great significance to summarize the measures and experience of intelligent education of Chinese universities in recent years, deeply analyze the existing problems, and explore the path to the realization of intelligent education in Chinese universities, so as to improve the quality of higher education and cultivate high-quality innovative talents.
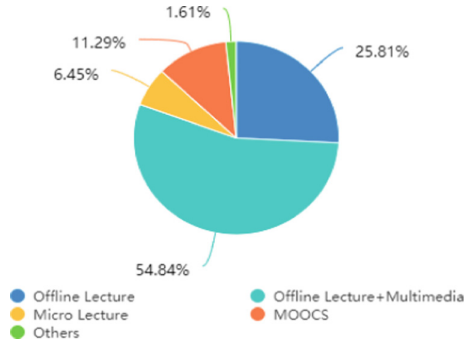
Fig. 1. Teaching Tools Adopted

1.1 Related Investigation and the Likert Questionaire

A total of 62 college teachers from five universities in Nanjing were randomly selected to investigate the current teaching tools adopted by them. The results are seen as shown in Fig. 1.

According to Fig. 1, the mostly adopted teaching method adopted by university teachers are the combination of offline teaching and multimedia (54.84%), and the traditional way of offline teaching method also accounts for a large proportion (25.81%). However, the percentages of the use of micro-lectures and MOOCS, which are vigorously promoted by universities, are not high. All these indicate that the degree of intelligent education in colleges and universities needs to be deepened.

This paper also designs a Likert questionnaire to look into the aspects of the teacher's teaching method, the application of flipped classroom, intelligent teaching environment, technology-assisted teaching, the intelligent education level of the universities and the intelligent training support for teachers. According to the design, the total score of each Likert scale is 315 points. The higher the total score, the higher the degree of the technology-assisted level is. As can be seen in Fig. 2, Q5 has the highest score, nearly reaches 200 points, indicating that today's colleges and universities attach great importance to intelligent teaching. The scores of flipped classroom and intelligent teaching environment in colleges and universities are both higher than the average score of 150 points, which is also a good proof of the emphasis colleges and universities put on intelligent education. However, it should also be noted at the same time that the intelligent level of college education is still generally low, and the degree of technology-assisted teaching in classrooms (Q1) and the intelligent training support for teachers in colleges and universities (Q4) are relatively weak. If the intelligent education in colleges and universities is to be further developed, more investment should be made from into the two aspects.

1.2 Linearity Regression Analysis of the Questionnaires

Figure 3 is a normal P-P diagram of regression analysis, which gives a comparison between the residual distribution of the observed value and the expected normal distribution. It can be seen from the figure that the distribution of most of the scattered
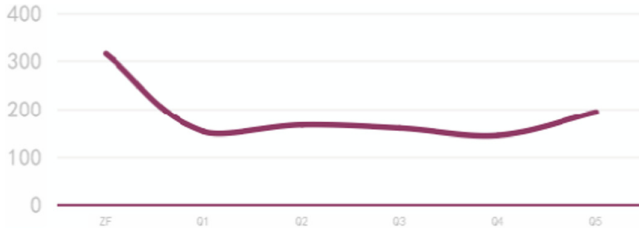
Fig. 2. The Scores of Likert Questionaire

points of the standardized residual is close to the straight line, so it can be judged that the normal distribution of the standardized residual is normal.

Figure 4 is the histogram of regression normalized residuals, and the normal curve is also displayed on the histo-gram to judge whether the normalized residuals are normally distributed. It can be seen from the sample curve that the distribution is mostly positive (only 62 samples), indicating that the model is highly correlated.

Table 1 is a list of coefficients[a] of linear regression, which includes the partial regression co-efficient (B), Std. Error, constant, beta, t-statistic observation value and corresponding probability p value (sig.) of regression coefficient test, and collinearity statistics that show the tolerance and VIF of variables.

If x1 denotes the technology-assisted teaching level, x2 denotes the application of flipped classroom teaching, x3 denotes the intelligent teaching environment, x4 denotes support for the intelligent training of college teachers, and x5 denotes the importance attached by colleges and universities to intelligent education, the multivariate linear regression equation established according to the model can be seen as follows:

$$y = 51.346 - 1.332 \, x1 - 3.893 \, x2 + 4.198 \, x3 - 0.346 \, x4 - 7.791 \, x5 \qquad (1)$$
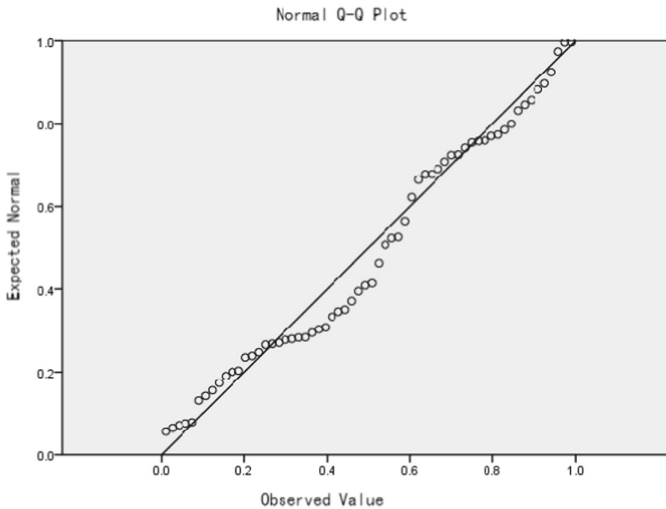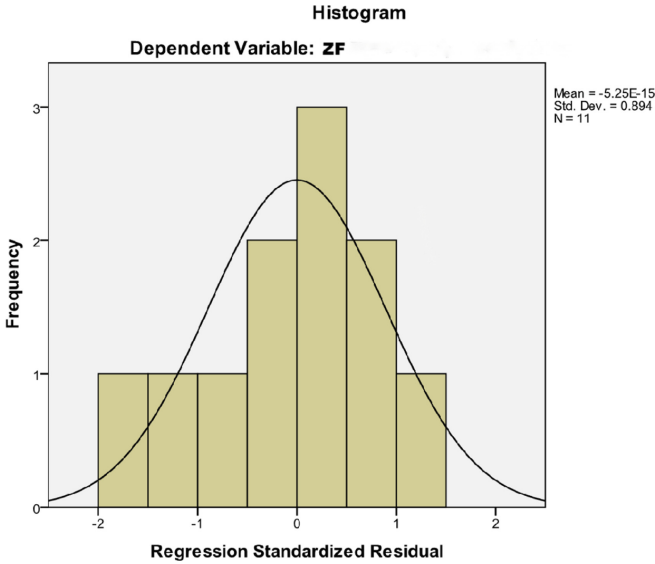

Fig. 3. Normal Q-Q Plot

Fig. 4. Histogram

Table 1. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients ts	t	Sig.	Collinearity Statistics	
		B	Standardized Coefficients s				Tolerance	VIF
1	(Constant)	51.346	7.283		7.051	.000		
	Q1	-1.332	3.455	-.070	-.386	.021		
	Q2	-3.893	3.985	-.223	-.977	.033	.669	1.695
	Q3	4.198	3.398	.220	1.235	.022	.683	1.264
	Q4	-.346	2.888	-.019	-.120	.005	.734	1.452
	Q5	-7.791	3.479	-.424	-2.239	.029	.817	1.268

a. Dependent Variable: ZF

The constant term in the equation is 51.346, and the partial regression coefficient b1, b2, b3, b4 and b5 are respectively -1.332, -3.893, 4.198, -0.346 and -7.791. Through t-test it can be seen that the probability p values of b1, b2, b3, b4 and b5 are 0.000, 0.021, 0.033, and 0.022 0.005 and 0.029 respectively. This means there are statistically significant differences in the extent of adhesion among the groups under the given significance level of 0.10. According to the tolerance, the VIF values among independent variables are all less than 2, indicating that the collinearity is not obvious and the correlation between sample tables is strong.

2   The Status-Quo of Intelligent Education in Chinese Universities

In the past decade, modern information technology, represented by "Internet plus", big data, artificial intelligence and virtual simulation, is threatening the traditional educational concepts, modes and methods and is changing the higher education system in a rapid way. The Ministry of Education also clearly points out in The Ten-year Development Plan for Educational Informationization (2011–2020) that it is necessary to promote the deep integration of information technology with education and teaching, and realize an all-round innovation in educational thoughts, concepts, methods and means [1]. Since the 2018 National Conference on undergraduate education in universities in the new era, many policies and measures have been put forward in universities across the country, setting off an upsurge of intelligent education reform of "Internet + Higher Education" [2]. As of August 1, 2022, 7120 relevant research papers can be obtained from the domestic influential Chinese website CNKI with the search theme of "intelligent education". Through the visual data analysis chart (Fig. 5), it can be found that from 2016 to 2022, the number of research papers on intelligent education began to increase rapidly, reaching a peak of 2,000 in 2022. It is obvious that intelligent education in China has received considerable attention in recent years.

Meanwhile, through double screening with the search theme of "intelligent education" + "higher education", 407 relevant papers can be obtained through CNKI. According to its visual analysis chart (Fig. 6), except for 2020 (the first year of the COVID-19 raging in China), the trend of the relevant annual number of papers is basically consistent with the trend of the annual number of published papers related to intelligent education, rising up gradually each year.
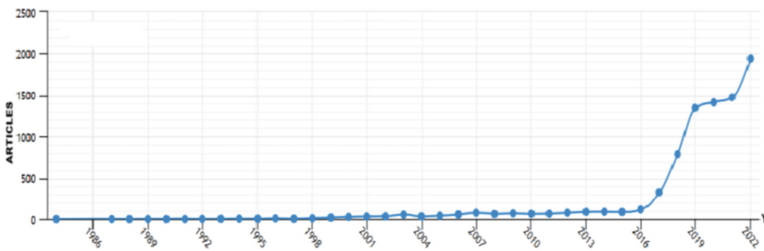

Fig. 5.   Annual Trend of Published Articles on Intelligent Education
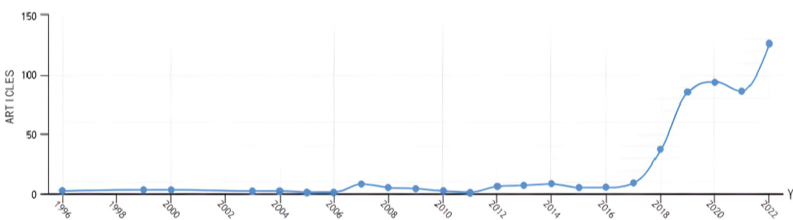

Fig. 6.   Annual Trend of Published Articles on Intelligent Education in Universities

These research papers have discussed the application and development of intelligent education in universities and colleges from different angles and with different themes. By and large, they can be generalized into four parts—teaching resources, teaching methods, teaching environment and teaching support.

2.1 Mooc-Based Curriculum Setting

The current universities in China attach great importance to the the building of Moocs, and have invested considerable human, material and financial resources into it. These universities are devoted to a Mooc-base curriculum setting through self-construction of Mooc resources, introduction of Moocs from other sources, co-construction and sharing of Moocs.

At present, China ranks first in Mooc resources in the world, with more than 1,000 universities and colleges offering more than 20,000 Moocs, including more than 1,000 state-level and 2,000 provincial-level excellent Moocs, covering 12 undergraduate disciplines and 18 specialty categories [3]. Till now, more than 200 million learners in and out of universities have taken Moocs, and 65 million university students have received Mooc credits [3].

In order to ensure the sustainable development of Moocs in universities, various educational administrative departments and university alliances have successively issued credit recognition systems for Moocs. In addition to extracurricular activities, they have also built various high-quality courses at all levels, including small-scale exclusive online courses, online and offline mixed courses, social practice courses and virtual simulation experimental teaching projects. For Fujian province proposes the objective to build five types of "golden courses" by 2021, with a total of 1200 courses, including 400 provincial high-quality online open courses, 200 virtual simulation experimental teaching projects, 500 high-quality hybrid and offline courses, and 100 high-quality practical courses [4]. And the objective of Heilongjiang province is to "build 200 provincial virtual practical teaching projects and about 300 provincial high-quality online open courses" [5].

2.2 Innovation of Teaching Modes Through Flipped Classrooms

With the change of teaching curriculum, Chinese universities have generally begun to pay attention to the reform of traditional teaching modes and encourage teachers to adopt new student-centered methods instead of the traditional teaching mode. According to related survey, most state-run universities and universities jointly run by both the province and the state have actively promoted flipped classrooms, mixed teaching and active teaching, and have paid more attention to how to promote interactive exchanges between teachers and students, in an attempt to achieve meaningful in-depth learning and improve students' ability and quality [6].

In view of the fact that the intelligent teaching tools provide abundant ways for teacher-student and student-student interactions, which can deepen students' understanding of knowledge and promote their transformation and application of knowledge they learned in classes, many intelligent teaching tools, such as "Rain Class", "Blue Moyun Class" and "Mooc Class", are encouraged by universities to be put into use in flipped

classes to carry out interactive teaching [7]. These tools are supposed to enrich classroom interaction and detect students' learning quality so as to provide targeted teaching.

2.3 Improvement of Intelligent Teaching Environment

Chinese universities at present are paying increasing attention to the reform of traditional teaching environment, which is mainly reflected in the construction of smart classrooms. Smart classrooms are usually equipped with teacher-student interactive teaching systems, flexible desks and chairs, and multiple large screens. For example, Sichuan University invested 200 million yuan to build 403 smart classrooms of various kinds [8]. With the aid of various intelligent equipment, the teaching of knowledge, the discussion and the interaction between teachers and students are more convenient, and students are more active in classroom activities. Both teachers and students can use terminals (mobile phones, computers, tablets) to share screens and interact through large screens. Teachers can also initiate classroom evaluation through functions such as "question and answer", "voting" and "interaction" to grasp students' understanding of knowledge in real time, so as to carry out targeted guidance and teaching through instant feedback. Some universities also make full use of information technology means such as 3D, 5G, virtual simulation and holograms to strengthen the interaction of distance teaching.

Apart from the construction of smart classrooms, those universities also pay attention to building smart teaching systems. Online course platforms have been built in most universities. Before the class, teachers will release course materials, set tests and topics for discussion through the platform, while students would learn related course content through the platform. In class, teachers will use the intelligent teaching system to carry out interactive teaching.

2.4 Increasing Teaching Support for Intelligent Education

The smooth development and teaching reform of intelligent education in Chinese universities cannot be separated from the due support and services from the universities and the government. Most universities think highly of the reform of educational informatization and have issued a series of policies and action plans. Related working groups are also set up in many universities, including school leaders, heads of academic affairs offices and other relevant departments. Besides, funds and technical support have also been provided for teachers to make videos and build courses. Teachers in some universities are trained to use smart classrooms and smart teaching systems. Related workshops are also established to improve teachers' teaching ability. Many universities also cooperate with education enterprises to improve teaching services. Most Chinese universities are paying a lot attention to the promotion of information-based education reform atmosphere. They would establish an incentive mechanism of information-based teaching by different means like assessing teaching and learning, rewarding the advanced teachers, deciding teaching reform topics, holding teaching competitions or setting typical examples [9].

3   Problems of Intelligent Education in Chinese Universities

Although Chinese universities have made remarkable progress and accumulated a great deal of experience in the key fields of intelligent education like curriculum setting, teaching methods, teaching environment and teaching support, there are still some problems that affect the further integration of information technology and education and teaching.

First, there have been too much focus on the building on MOOCS and micro lectures over their application. Some universities pay more attention to the extensional development of Moocs and micro-lectures, focusing on quantity instead of quality. There is a need for an overall plan and top-level design in curriculum construction of Moocs and micro-lectures, and many courses are even overlapped and may result in a waste of resources. The quality of many courses, from design to production, is below standard, and the relevant post-maintenance is also unreasonable, affecting the teaching effect. In addition, most universities are keen to build Mooc and apply for the building of various national or provincial level courses. Their understanding of the key role of modern information technology in university talent training is immature, and have not given due attention to the application of intelligent education tools like the Mooc, leading to a waste of curriculum resources. Besides, many universities are into the external development of micro-lectures which they are unable to provide sufficient technical support, resulting in poor quality of micro-lectures without expected results. Even more, some universities are keen on holding competitions of micro-lectures so as to improve teachers' ability of making and teaching micro-lectures. However, most of those micro-lectures are just for the contest or display, few of them are applied to the real teaching at a large scale.

Second, online courses are overvalued while offline courses are devalued. The traditional offline courses are the main content of university courses. However, in the process of promoting intelligent education, most universities prefer the building of online courses over offline courses so as to catch up with the trend. Consequently, the educational reform of offline courses is carried out slowly, and the support for it is far less than that of the online courses. Moreover, some universities misunderstood the concept and equate teaching reform with the building of several Mooc courses. Although many and universities have recognized the disadvantages of traditional teaching methods and the necessity of reform, they have not yet taken them as the core task of teaching reform. As a result, The teacher-centered way of teaching still occupies a leading position, and the basis of teaching reform has not really taken shape. The causes of this situation lies not only in the lack of attention and determination of teaching reform in universities, but also in the fact that the universities have not found specific reform paths and effective implementation methods, which might affect the real implementation of the concept of educational reform.

Third, undue emphasis on hardware instead of software. In spite of the fact that many universities have invested considerable resources in building smart classrooms, generally speaking, most of these smart classrooms do not live up to their name and do not really play a role in assisting smart teaching. Actually, of all those functions of smart classrooms, screen projection alone becomes the mostly used function, while the other functions are always forgotten because either of their complex operations, or of their improper and unreasonable functions. To make things worse, different smart classrooms vary greatly for lack of standardized regulations to regulate the chaotic

market of smart classroom building. Some smart classrooms are very expensive and cost millions of Chinese Yuan, while some are really cheap with no quality guarantee. Those smart classrooms differ greatly in their hardware configuration, spatial layout and functional design. Moreover, the lack of clear thinking and planning in universities and manufacturers leads to the accumulation of hardware in many smart classrooms, which results in unnecessary waste.

Fourth, undue emphasis on management instead of services. It is a common scene that universities attach great importance to intelligent education, and have issued relevant policies and measures to encourage teachers to carry out teaching reform. However, these universities focus on management and lack a strong sense of service, and the support they provide is not comprehensive enough to effectively motivate teachers to reform teaching. Some universities are keen on issuing management documents on education informatization, and have not formed a system in the top-level design of educational administration regulations, teaching evaluation, team building and teaching freedom. The lack of specialized technical service departments in universities makes it difficult for teachers to get professional help when they encounter problems related to information technology. Besides, related incentives are also less concerned with the workload and professional title evaluation of teachers.

4   The Realization Path of Intelligent Education in Chinese Universities

An ideal development of intelligent education in Chinese universities is an integration of offline and online teaching that is realized through innovative teaching methods based on sufficient support and services provided. To achieve this goal, four conditions need to be met: (1) Universities should implement flipped classrooms and other innovative teaching models that can effectively transform classroom teaching structure; (2) An information-based teaching environment needs to be created; (3) Universities should develop rich course resources; (4) Adequate teaching support and services need to be provided [9]. These four aspects are interrelated and complementary. Together they constitute the realization path of intelligent education in Chinese universities as seen in Fig. 7.
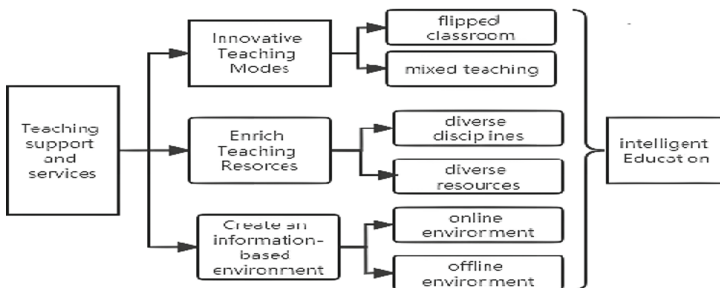

Fig. 7. The Realization Path of Intelligent Education in Universities

4.1 Innovative Teaching Modes

The key to the deep integration of information technology and education and teaching lies in the fundamental reform of the traditional classroom teaching structure [10]. The classroom is the main field of talent training [11]. Only by reforming the traditional teaching mode dominated by one-way teaching and reconstructing the talent training mode can the structural reform of the education system be realized, thus solving the long-term problem that the function of information technology cannot be fully played in education. With the widespread concept of being "student-centered" taking roots in people's hearts, the disadvantages of the traditional teaching method in cultivating students' abilities, personalized teaching and active learning are increasingly prominent [12]. The new teaching mode represented by flipped classroom has attracted wide attention due to its subversive change to the traditional teaching model and its natural fit with information technology. The essence of flipped classroom is that by subverting the traditional classroom teaching structure, a large amount of classroom teaching is realized outside class, thus making full use of precious face-to-face class time for meaningful deep learning [13]. A large number of studies have shown that flipped classroom is an effective way that can integrate the advantages of online and offline mixed teaching, an is a more progressive mode than traditional teaching and is more in line with the requirements of the current era for talent cultivation.

4.2 The Creation of an Information-Based Teaching Environment

Objectively speaking, the promotion of intelligent education and implementation of new teaching modes such as flipped classrooms in universities require an information-based teaching environment to support the smooth development of teaching and learning activities. Information-based teaching environment includes both online and offline environments. The online teaching environment is the online teaching platform, by which teachers can set up courses, manage courses, issue notices, release resources, set tests and activities, assign and mark student works, view learning data, communicate with students, allow live broadcasts and so on. Students can learn the course content, submit homework and communicate with each other through the platform. With the application of the technology in learning and analyzing big data, the platform will be able to build a personalized learning environment based on students' learning behavior data so as to achieve personalized and accurate teaching. The offline teaching environment refers to the physical teaching space and the intelligent teaching tools used in offline teaching. Teachers and students can use information terminals and equipment in the classroom for interaction, communication, demonstration, tests, feedback and guidance [14]. With the further development of ubiquitous education, universities and their classrooms will exist in more diversified forms, and the teaching environment will no longer be limited to the traditional campus and classrooms, but will be extended to museums, laboratories, hospitals, shopping malls, science and technology museums and other places.

4.3 Development of Reasonable Curriculum Settings

Apart from the implementation of the new teaching mode and the construction of information-based teaching environment, a complete system of curriculum teaching

resources is needed. A complete curriculum setting involves rich teaching resources which should be rich, systematic and of high quality, including audio and video materials, text materials, interactive courseware, simulation experiments, teaching activities, exercises, learning tools, software and other forms of resources. In a word, the key to the development of intelligent education in universities is the integration of innovative teaching modes, information-based teaching environment and curriculum resources, assisted by related training of teachers who could apply them to their own classroom teaching.

4.4 Sufficient Teaching Support and Services

Teaching support and services are the guarantee of the change of teaching methods. Universities should upgrade supporting services in all aspects. Universities should adjust the management system with the times to provide policy support for teaching reform. Teachers should be given full freedom in curriculum design, so that they can decide the curriculum content, evaluation scheme and teaching method according to specific courses. Universities should also introduce measures to encourage teaching reform, grant teachers with necessary honor and funding, or take teaching reform into the consideration of professional title evaluation. Moreover, universities can create a more tolerate atmosphere, allowing teachers space to explore and correct mistakes in teaching reforms. Besides, universities should assist teachers in teaching design and necessary training.

5   Conclusion

The current development of intelligent education in universities is at an important historical stage. Ever since the outbreak of covid-19 at the end of 2019, intelligence education in universities have developed in an accelerated speed, and the integration of information technology and education and teaching is obviously accelerated. During the epidemic, universities have significantly improved the intelligent education in every aspects, and university administrators, teachers and students have all deepened their understanding of intelligent education. Nevertheless, there are still many deficiencies and room for development in teaching methods, curriculum resources, teaching environment and teaching support. Universities should firmly grasp this historical opportunity, take advantage of the trend, and strive to promote the further development of intelligent education in universities.

Conflicts of Interest.   The authors declare that they have no competing interest.

Data Availability Statement.   The data that supports the findings of this study are available within the article.

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