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Research Article

Modeling and Analysis of the Impact of Big Data on the Development of Education Network

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The arrival of the big data era not only provides corresponding technical support for the development of Educational Networking but also promotes the acceleration of Educational Networking. Therefore, this paper puts forward the research on the impact of big data on the development of education network and constructs a Bayesian knowledge tracking model to collect and analyze the behavior data of teachers and learners in network education. The experimental results show that big data technology provides greater development space for Education Networking. Its market scale has reached 502.47 billion yuan in 2021, and there is a trend of continuous growth. At the same time, the increase in the number of users also makes its teaching content richer and teaching methods more diversified and personalized. And, through the analysis of relevant data, learners and teachers can more comprehensively and truly understand their own level, achieve the purpose of accurate assistance to learners and teachers, and help learners and teachers find their own problems and make targeted adjustments. In addition, the campus intelligent management system based on big data technology can achieve the purpose of multipurpose and information management.

1. Introduction

The emergence and development of Internet technology has not only changed people's lifestyle, but also changed the development of education and promoted the reform of education network [1]. Education Networking is to integrate information technology into the field of education and realize teaching networking, so as to make the teaching mode more modern, the teaching content spread more rapidly and networked, and the teaching resources can be shared, so as to promote the fairness of education and cultivate modern talents with innovative ability [2, 3]. With the advancement of the network process in the field of education, the current teaching methods are very different from the traditional teaching methods. More and more teaching courses are presented by network teaching. To a certain extent, this has improved the efficiency of teaching and the enrollment rate, promoted the fairness of education and the sharing and popularization of educational resources, and provided more learning opportunities for people in different regions and different cultural levels [4, 5]. However, there are also many problems in the process of the development of education network. For example, it is difficult for teachers to carry out effective learning supervision on the students of network learning, it is also difficult for the teaching effect of network teaching to get timely and effective feedback like the traditional teaching classroom, and the school information management is not in place. The solution of these problems requires the processing of massive data through complex data analysis methods, which greatly improves the work difficulty of relevant educators [6, 7]. The application of big data technology in the field of Educational Networking can effectively process the relevant massive data and obtain the corresponding correlation results according to the data analysis, so as to realize the purpose of supervising the students' learning process and promoting the teachers' teaching level. The arrival of the big data era has undoubtedly accelerated the development process of Educational Networking, but there are also many challenges [8].

This paper puts forward the research on the impact of big data on the development of education network and constructs a Bayesian knowledge tracking model to collect and

analyze the behavior data of teachers and learners in network education. The innovative contributions of this paper include the following: (1) The analysis of the number of users is increased, which makes its teaching content richer and teaching methods more diversified and personalized. (2) The evaluation index system of education network level ha been constructed. (3) It has promoted the reform of traditional education mode and is conducive to more and more teachers' teaching through online platform and more truly understand their own level, achieve the purpose of accurately helping learners and teachers, and help learners and teachers find their own problems and make targeted adjustments.

Therefore, this paper puts forward the research on the impact of big data on the development of Educational Networking and discrete dynamic modeling analysis. Through the big data Bayesian knowledge tracking model, this paper collects and analyzes the behavior of students and teachers in the process of Educational Networking, so as to analyze the impact of big data on the development of Educational Networking in a diversified and multidirectional way. This paper is mainly divided into three parts. The first part is an introduction to the application of big data in the field of education and the development of Educational Networking. The second part is the construction of big data related model and gives relevant evaluation indicators. The third part is the analysis results of the impact of big data on the development of Education Networking.

2. Related Work

The development of information technology not only provides technical support for educational development and reform, but also provides more development possibilities and directions [9]. Educational Networking is to realize the purpose of development and meet the needs of change through modern information technology in the development of education, so as to promote education to a new educational form. The main technical characteristics of Educational Networking are digitization, intelligence, and multimedia in education and related fields [10, 11]. From the perspective of education itself, it is characterized by the openness, interactivity, sharing, and globality of education [12]. In terms of students' learning, the reform direction of Educational Networking is autonomy, management, and cooperation [13]. Compared with traditional education, Educational Networking can not create more educational opportunities but can change traditional education and adapt to contemporary educational needs. With the advent of the big data era, the development of Educational Networking is also accelerating. The concept of big data first came from the fields of genetics and astronomy. In its early stage of development, it was only concerned and valued by the academic community as a technical field [14, 15]. It was not until 2012 that the research on big data began to develop rapidly. At present, the accepted definition of big data is that it is a data set whose size has exceeded the capabilities of typical databases in acquisition, storage, analysis, and data management and has four characteristics of scale, diversity, high speed, and great value [16, 17]. With the development of big data technology, its application in the field of education has gradually attracted the attention of scholars. Some scholars proposed to introduce big data technology into education data management system and use intelligent decision support system to classify and manage education big data [18]. Other scholars proposed to use big data technology to establish personalized educational resources and teaching resources database and put forward corresponding implementable methods according to objective conditions [19]. In addition, some scholars believe that the combination of big data and cloud computing technology can promote the reform of teaching evaluation and realize objective and quantifiable teaching resource evaluation through the analysis of students' behavior data on the educational resource database [20]. From the aspect of learning development law, some scholars have proposed to analyze the data of learners' learning process through big data technology to predict their future learning process and put forward corresponding optimization countermeasures, so as to provide corresponding data basis for teachers' teaching decision-making [21]. It can be seen that, in the field of education, whether it is the management and evaluation of students' and teachers' information, the supervision of students' learning, or helping teachers make educational decisions, big data shows its strong performance and advantages and promotes the development process of educational reform and Educational Networking.

3. Construction of Relevant Models and Evaluation Indicators of the Impact of Big Data on the Development of Education Networking

The core of Educational Networking is educational informatization, and big data technology and Internet technology are important factors to promote Educational Networking [22, 23]. The impact of big data on the development of Education Networking can be classified into three aspects, namely, the impact on distance education, the impact on teaching mode, and the impact on campus, as shown in Figure 1. As can be seen from the figure, the impact of distance education can be further divided into richer teaching content, the realization of network real-time teaching, ensuring the security of teaching resources, and improving the efficiency of teaching and learning. The impact on the teaching mode can be further divided into realizing the multisource of teaching resources, realizing students' independent choice and learning, and realizing the individualization and accuracy of education. The impact on the campus can be further divided into the impact on teaching, the impact on student management, the impact on the application of campus intelligent service, and the impact on scientific research.

This paper will track and supervise learners and teachers through big data Bayesian knowledge tracking model, mine and analyze the collected relevant data through association rules, and study the impact of big data on the development of Educational Networking from many aspects.

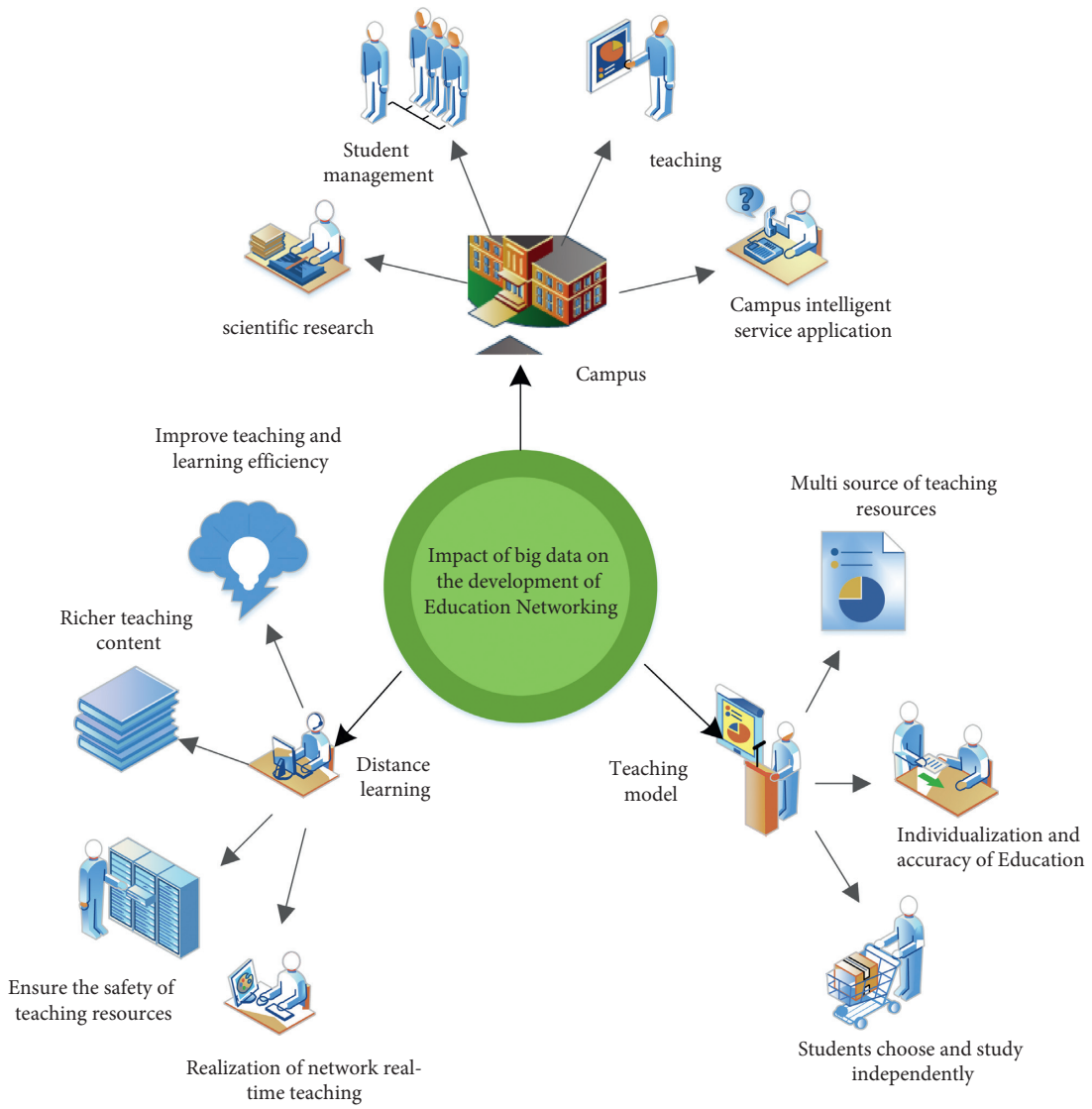


Figure 1: Impact of big data on the development of Education Networking.

3.1. Construction of Bayesian Knowledge Tracking Model for Big Data. Bayesian knowledge tracking model (BKT) is a very important model to simulate students' knowledge. It was introduced into the field of intelligent education by Corbett and Anderson in 1995 and applied to intelligent tutoring system (ITS). An important problem in it is when a student can be judged to have mastered a certain knowledge point. A relatively simple way is to require students to answer correctly n questions related to the same knowledge point continuously. Although this way is still used by some systems, BKT can solve this problem in a more intuitive and easy to understand way.

In the development of Educational Networking, not only have the requirements for learners and the way of supervision and management changed, but also the teaching requirements for educators have changed. Therefore, both learners and educators need to adapt and learn the new model in the process of Educational Networking. Bayesian knowledge tracking model is one of the classical evaluation methods for learners, and it is a typical application of hidden Markov model [24]. Yebess knowledge tracking model represents the knowledge points that learners have mastered and not mastered through binary variables, and each knowledge can be obtained through a group of corresponding binary variable training results, that is, learners' correct or wrong answers to questions [25]. As shown in Figure 2, the structure diagram of Bayesian knowledge tracking model is shown. It can be seen from the figure that the observed variables are learners' answers, while the implicit variables are learners' knowledge states, which will change continuously with the changes of learners' answers.

Let the probability of learners mastering knowledge points be expressed as $P(L_0)$ and the transfer rate of learners mastering knowledge points be expressed as $P(T)$. When learners are in the state of not mastering knowledge points, the probability of correct guessing is expressed as $P(G)$ and the probability of wrong guessing is expressed as $P(S)$. Then the probability of learners answering the n question correctly

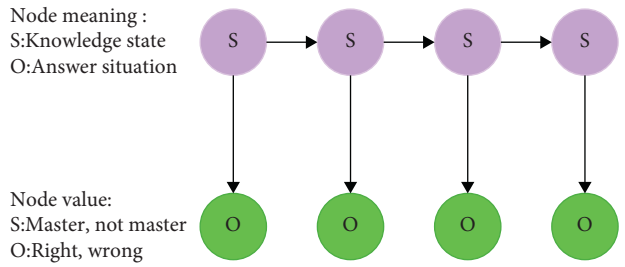


Figure 2: Structure diagram of Bayesian knowledge tracking model.

is the sum of the probability of correct guessing without mistakes and without mastering knowledge, as shown in

$$P(\text{Correct}_n) = P(L_n)(1 - P(S)) + (1 - P(L_n))P(G). \quad (1)$$

The probability of answering the n question incorrectly is shown in

$$P(\text{Incorrect}_n) = P(L_n)P(S) + (1 - P(L_n))(1 - P(G)). \quad (2)$$

The probability of the degree of the learner's accounting knowledge points can be regarded as the sum of the degree of mastery of the knowledge points and the transfer rate from never mastery to mastery after answering the previous question. It can update the learner's knowledge state, as shown in

$$P(L_n) = P\left(\frac{L_{n-1}}{\text{Evidence}_{n-1}}\right) + \left(1 - P\left(\frac{L_{n-1}}{\text{Evidence}_{n-1}}\right)\right)P(T). \quad (3)$$

The probability of the learner's correct answer to question $n+1$ is the sum of the probability of the learner's mastery of knowledge without mistakes and the probability of guessing correctly without knowledge. It can predict the learner's answer, as shown in

$$P(C_{n+1}) = P(L)(1 - P(S)) + (1 - P(L))P(G). \quad (4)$$

If the learner needs to answer n skills, it needs to carry out $4n$ parameter training. The probability of the learner's mastery of knowledge point k can be expressed as $P(L_{t+1})^k$, and the calculation result is the sum of the learner's knowledge mastery rate and the conversion rate without mastery, as shown in

$$P(L_1)^k = P(L_0)^k, \quad (5)$$

$$P(L_{t+1}|\text{obs} = \text{correct})^k = \frac{P(L_t)^k \cdot (1 - P(S)^k)}{P(L_t)^k \cdot (1 - P(S)^k) + (1 - P(L_t)^k) \cdot P(G)^k}, \quad (6)$$

$$P(L_{t+1}|\text{obs} = \text{wrong})^k = \frac{P(L_t)^k \cdot P(S)^k}{P(L_t)^k \cdot P(S)^k + (1 - P(L_t)^k) \cdot (1 - P(G)^k)}, \quad (7)$$

$$P(L_{t+1})^k = P(L_{t+1}|\text{obs})^k + (1 - P(L_{t+1}|\text{obs})^k) \cdot P(T)^k, \quad (8)$$

$$P(C_{t+1})^k = P(L_t)^k \cdot (1 - P(S)^k) + (1 - P(L_t)^k) \cdot P(G)^k. \quad (9)$$

The knowledge learned by learners is not an independent individual but is interrelated and influential. Therefore, on the basis of the above, the parameter matrix of the interaction between the skills learned by learners is added, as shown in

$$R_{ij} = \text{the influence of learning skill } i \text{ on skill } j. \quad (10)$$

Therefore, when the learner needs to answer n skills, there are n^2 more parameters to be trained than the previous model, and the learner's final mastery level of a skill is the sum of $P(L_{t+1})^k$ and the influence probability of other skills on the skill, as shown in

$$\widehat{P}(L_{t+1})^k = P(L_{t+1}|\text{obs})^k + (1 - P(L_{t+1}|\text{obs})^k) \cdot P(T)^k, \quad (11)$$

$$\Delta P(L_{t+1})^k = \widehat{P}(L_{t+1})^k - P(L_t)^k, \quad (12)$$

$$P(L_{t+1})^k = P(L_t)^k + R_k \cdot \Delta P(L_{t+1})^k. \quad (13)$$

Figure 3 shows the flowchart of Bayesian knowledge tracking model in this paper.

3.2. Construction of Evaluation Index of Educational Network Development. Education Networking is the most valuable only if it is fully utilized in all links of education. To study the impact of big data on the development of Education Networking, we should understand the application level of Education Networking. Therefore, the group should build a corresponding index system. The system needs to conform to the development law of Educational Networking and follow the principles of scientificity, systematicness, consistency, feasibility, typicality, and guidance. Based on the corresponding educational network policies and documents, this paper constructs the evaluation index system framework from the perspective of learners and the application of Educational Networking in all aspects, as shown in Figure 4.

As can be seen from the figure, the evaluation index system is divided into three levels of indicators. The first-level indicators include five aspects: teaching networking, management networking, service networking, application effect, and application guarantee. Below each first-level indicator, there are specific divided second-level indicators and third-level indicators. In addition, this paper selects analytic hierarchy process to determine the index weight. After constructing each index judgment matrix, the feature vector and the maximum feature heel are calculated, and then the consistency test is carried out. As shown in formula (14), it is the product of each row element in the judgment matrix:

$$m_i = \prod_{i=1}^{n} B_{ij}, \quad (14)$$

where $i = 1, 2, \ldots, n$ and m_i represent the product and n represents the number of indicators at the same level.

The geometric average value of each element is shown in

$$\overline{W}_i = \sqrt[n]{m_i}. \quad (15)$$

The weight coefficient of each index after standardization is shown in

$$W_i = \frac{\overline{W}}{\sum_{i=1}^{n} \overline{W}_i}. \quad (16)$$

The eigenvector of the obtained judgment matrix is $W = (W_1, W_2, \ldots, W_n)^T$, and the maximum eigenvalue is further obtained, as shown in

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(BW)_i}{W_i}, \quad (17)$$

where B represents the judgment matrix and $(BW)_i$ represents the i element in BW.

The calculation of hierarchical single sorting consistency check is shown in

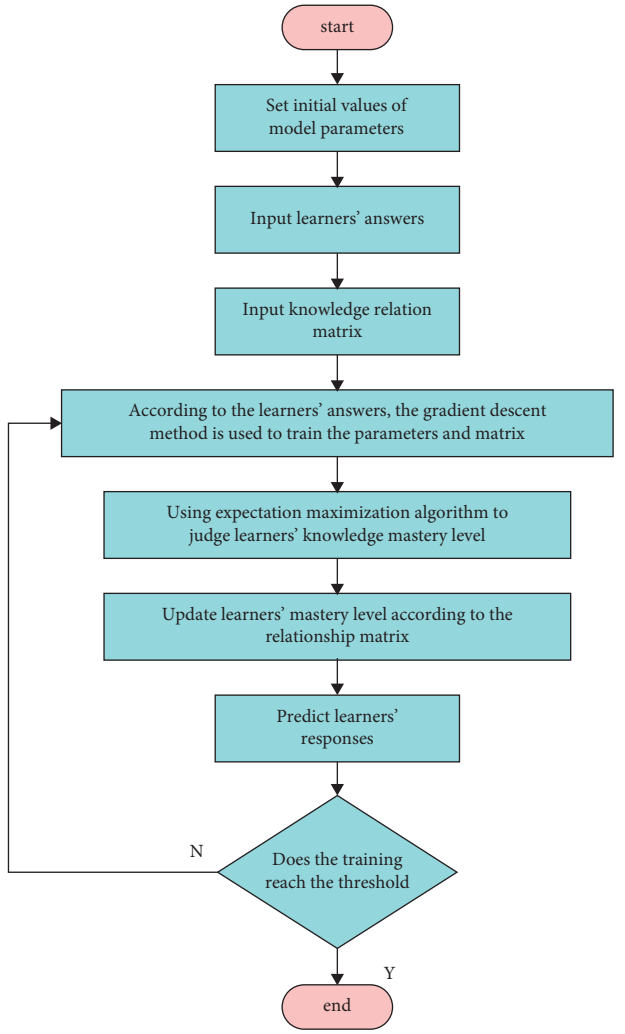


Figure 3: The flowchart of Bayesian knowledge tracking model presented in this paper.

$$\mathrm{CI} = \frac{\lambda_{\max} - n}{n - 1}. \quad (18)$$

The calculation method of average random consistency is shown in

$$\mathrm{CR} = \frac{\mathrm{CI}}{\mathrm{RI}}. \quad (19)$$

The calculation method of hierarchy total sorting consistency inspection is shown in

$$\mathrm{CR} = \frac{\sum_{i=1}^{n} b_i \mathrm{CI}_i}{\sum_{i=1}^{n} b_i \mathrm{RI}_i}. \quad (20)$$

4. Analysis Results of the Impact of Big Data on the Development of Education Networking

The development of big data technology provides the data foundation and driving force for Education Networking. Schools at all levels and educational institutions are vigorously developing distance online education courses. As shown in Figure 5, the statistics and forecast of online

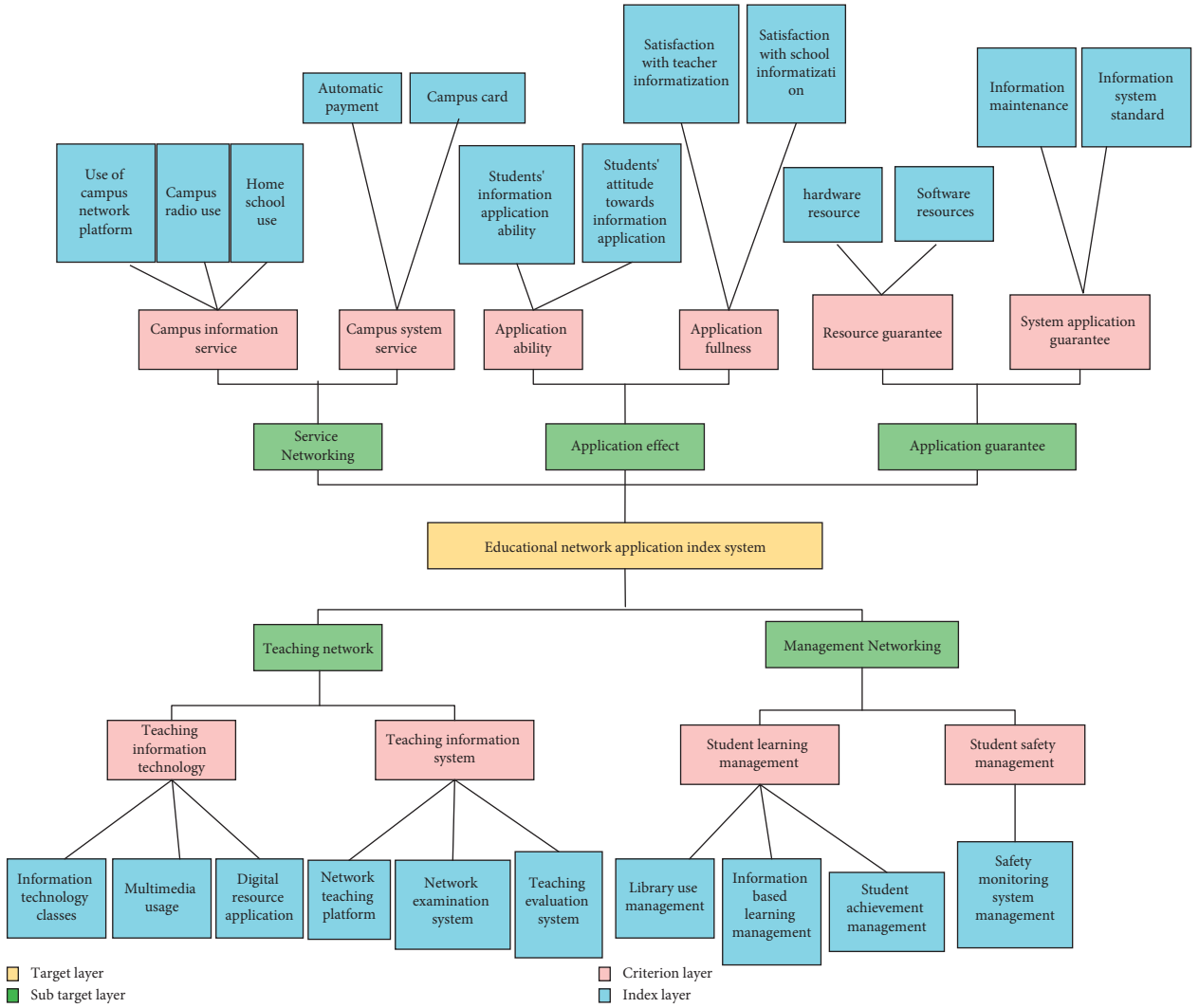


Figure 4: Evaluation index system of educational network development.

education market scale and Education Networking market scale from 2016 to 2021 are shown. It can be seen from the data in the figure that the market scale of Education Networking has increased from 339.74 billion yuan in 2016 to 5024.7 in 2021 and is still growing steadily, which shows that Education Networking is not only the demand of the market, but also the inevitable trend of education reform. The advent of the big data era provides technical support for Educational Networking, especially distance education. Combined with AI intelligence, cloud computing, and other technologies, it has built online education systems such as smart classroom and AI problem correction, which can solve any problem anywhere and at any time. Therefore, the market scale of online distance education is also increasing rapidly. Especially during the epidemic in 2020, online distance education has ushered in great challenges, but in the context of the big data era, it has proved the importance of Educational Networking, making Educational Networking and online distance education enter a new stage of development.

Figure 6 shows the statistics and forecast of online education user scale from 2016 to 2021. As can be seen from the data in the figure, the number of online education users increased from 104 million in 2016 to 445 million in 2021. Moreover, with the development of Education Networking, more and more regions will build and improve network education platforms, so that distance education can cover a wider area and provide more opportunities to obtain educational resources for areas lacking educational resources. At the same time, it also means that there are many potential users of online education. On the one hand, the growth of online education users comes from the students and parents of schools at all levels. More and more schools have joined network education on the basis of traditional teaching methods, enriching teaching methods and teaching contents while stimulating students' interest in learning. On the other hand, it comes from users of educational institutions. The big data era has changed the social requirements for talents and provided more learning resources and learning opportunities for people who want to continuously improve

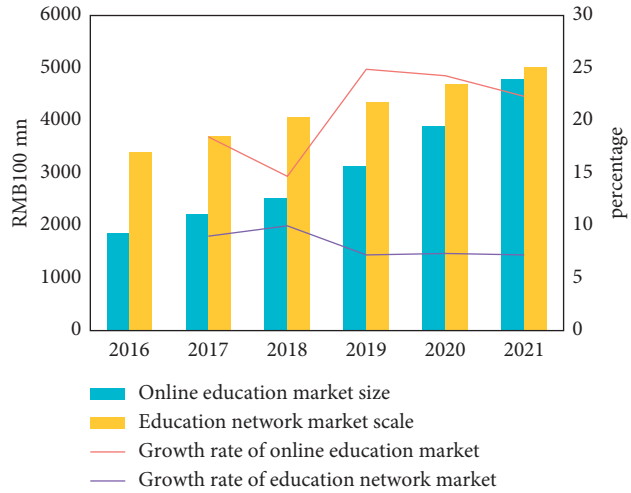


Figure 5: Statistics and forecast of online education market scale and Education Networking market scale from 2016 to 2021.

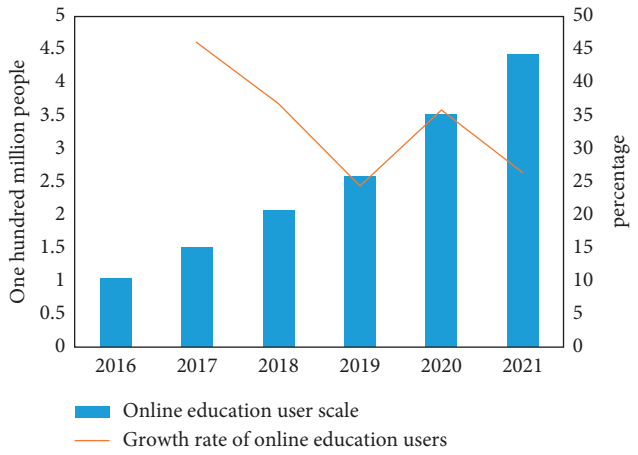


Figure 6: Statistics and forecast of online education users from 2016 to 2021.

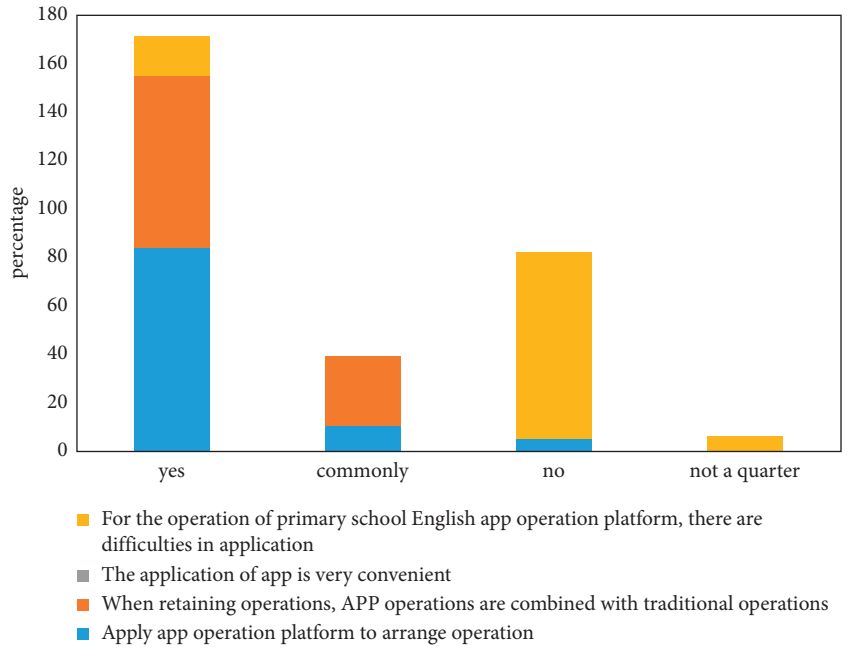
their abilities. Therefore, the networking level of extracurricular counseling and adult education has been greatly improved, and the scale of online users has also been increasing.

The increasing scale of online education users and the promotion of Education Networking have changed the traditional teaching methods, including homework and examination forms, personalized selection, and education targeted poverty alleviation. As shown in Figure 7, the application status of a homework app in teachers and parents is shown. It can be seen from the data in the figure that more than 80% of teachers will assign homework through app, and 70% of teachers will combine homework on app with traditional homework. At the same time, more than 60% of parents believe that their children can complete their homework independently through the app, and about 70% of parents believe that their children have no difficulty in operation. This shows that the teaching mode and homework mode are constantly changing in the era of big data, and the new methods have been basically popularized and recognized.

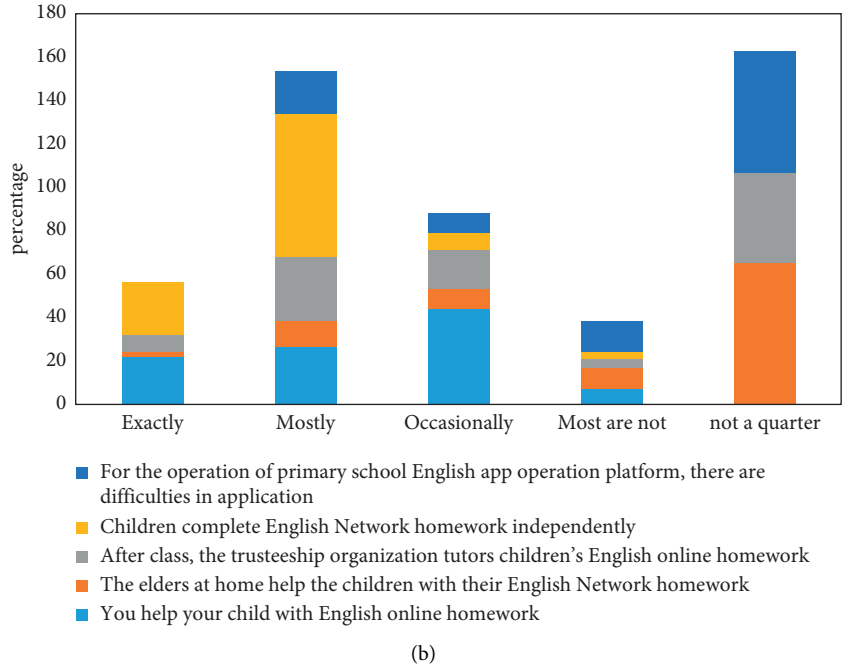
During the epidemic period, schools adopted online teaching and examination. Therefore, there were new developments in student learning supervision. In addition to teachers' attention to students' situation in the teaching process, some schools also collected and analyzed students' learning status and teachers' teaching quality through big data technology and implemented education targeted poverty alleviation policies. The education targeted poverty alleviation here refers to helping students with unsatisfactory results and teachers with substandard professional level. As shown in Figure 8, it is an analysis of students' online learning. From the data in the figure, it can be seen that teachers can understand students' practice and answer exercises in various subjects through the analysis of big data, so as to take different assistance methods for students in different situations, avoiding the problem that most students can only be considered in traditional teaching.

As shown in Figure 9, the change of the average test score of teachers assisted accurately is shown. From the data in the figure, it can be seen that accurate assistance can effectively help teachers overcome their own shortcomings and improve the corresponding professional level, and the effect is good. This shows that big data analysis can be combined with the actual needs of teachers to help teachers improve their professional level and be more personalized.

The change of teaching methods has also led to changes in student management, teaching feedback and teaching evaluation. As shown in Figure 10, it is the feedback on the achievement rate of teachers' teaching objectives at all levels. From the data in the figure, we can see the goal completion degree of teachers at all levels and the relevant data of students. Combined with Figure 9, we can find that the goal completion degree of Chinese teachers at all levels is relatively low, which is complementary to the evaluation of their teaching ability. Similarly, the changes in their students' learning enthusiasm and quality are relatively poor. Through the analysis of big data, teachers can timely find teaching problems and receive students' learning feedback and make targeted adjustments according to the actual situation.



(a)



(b)

Figure 7: (a) Application of a homework app in the group of teachers. (b) Application of a homework app in the parent group.

Figure 11 shows a learner's mastery of different knowledge points. It can be seen from the figure that the student's mastery level of several other knowledge points is better except for knowledge point 2. Through the analysis of big data, learners can more intuitively see the overall situation of their mastery level and understand their mastery of each knowledge point, so that students can choose to continue to strive to consolidate the foundation or focus on improvement according to their own situation. This not only can let teachers understand and master the actual learning situation of learners, but also is conducive to learners' autonomous learning and choice.

The management of students has always been the focus of school management, especially in colleges and universities with a high degree of freedom. Big data technology not only realizes the multipurpose of Campus All-in-One Card, but also improves the service quality of Campus All-in-One Card. Therefore, more and more colleges and universities have built campus card intelligent system, as shown in Figure 12. It can be seen from the data in the figure that the function of Campus All-in-One Card has expanded from the original simple functions such as student ID card and meal card to more than a

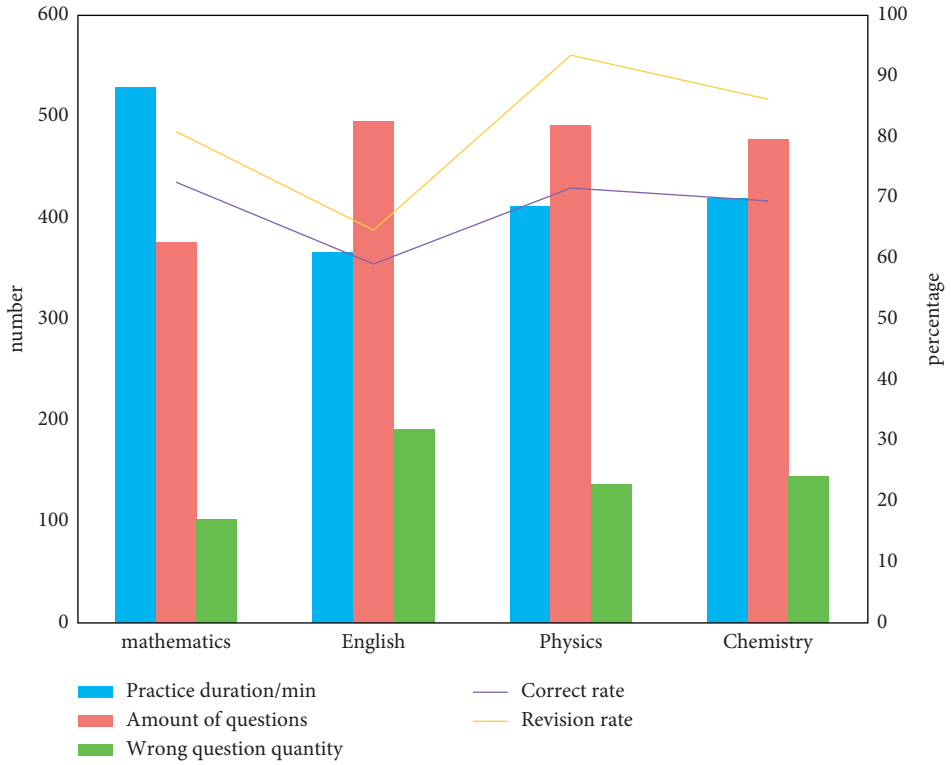


Figure 8: Analysis of students' online learning.

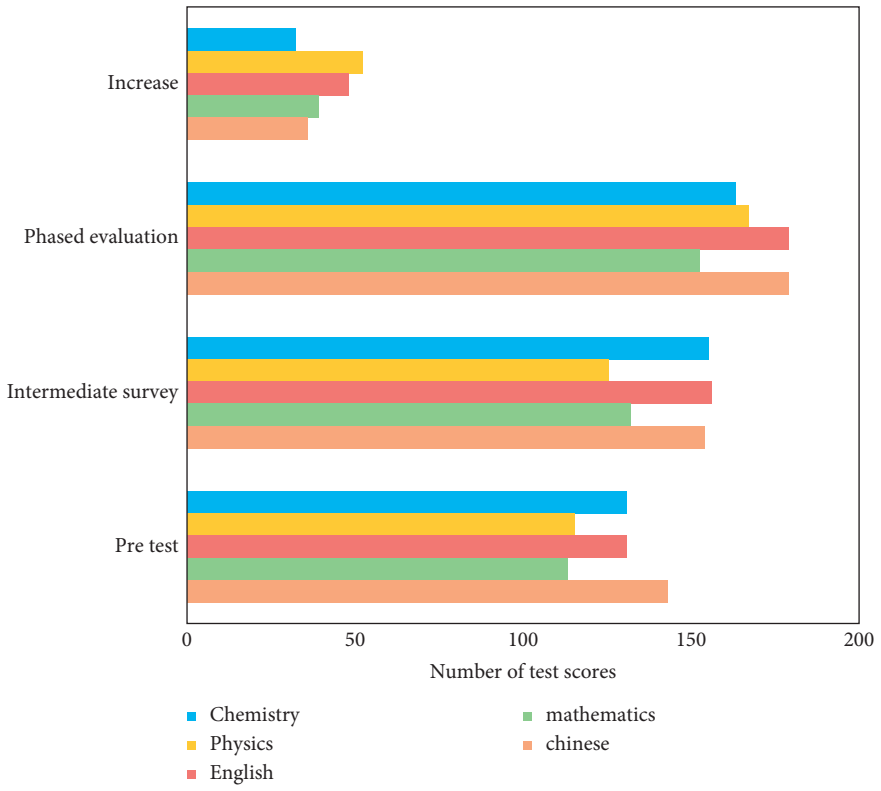


Figure 9: Changes in average test scores of teachers accurately assisted.

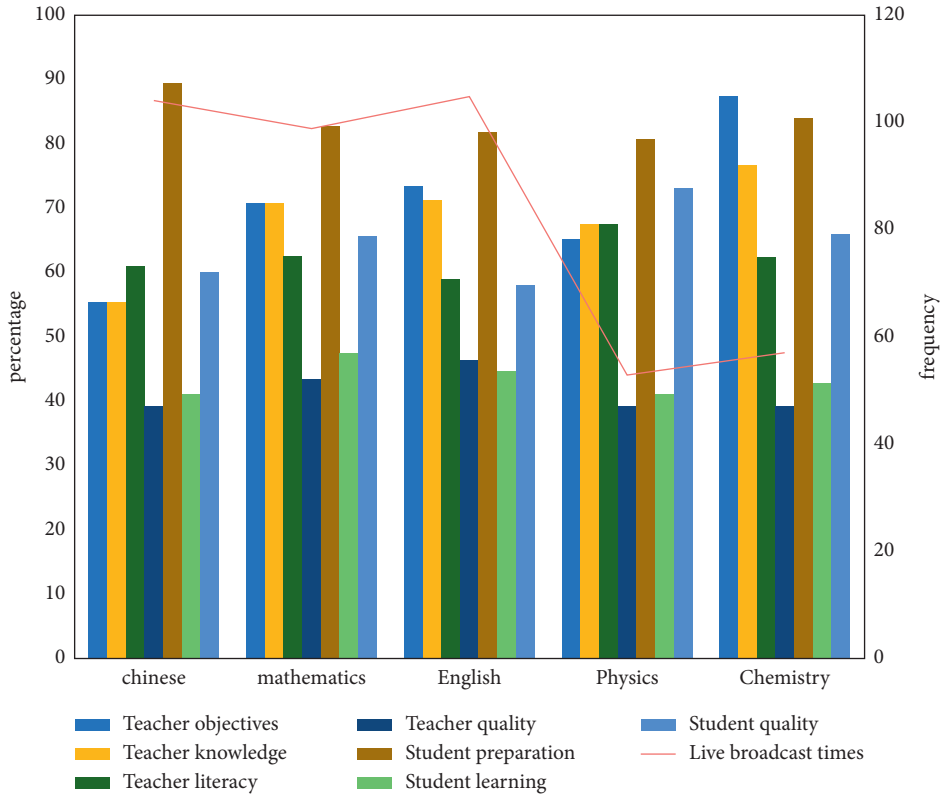


Figure 10: Feedback on the achievement rate of teachers' teaching objectives at all levels.

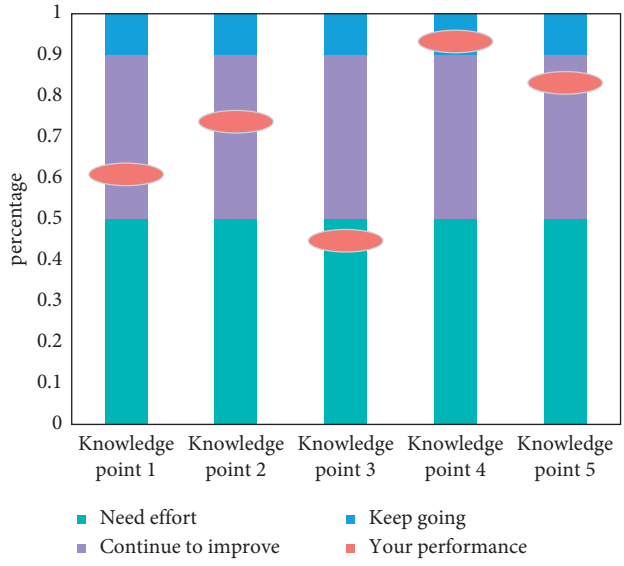


Figure 11: A learner's mastery of different knowledge points.

dozen functions such as time card, bank card, and tuition payment card. It not only is carried by students, but also improves the efficiency of various departments to a certain extent.

To sum up, big data has accelerated the process of Education Networking, provided strong technical support for it, and achieved the purpose of multidirectional data collection, management, and analysis. In terms of teaching methods, teachers' teaching contents are richer, learners have more choices of learning methods, and the forms of homework and examination are more diversified and rationalized. Teachers can more accurately understand students' learning and adjust teaching contents and teaching methods. Teachers can also find their own problems according to the feedback of learners and the analysis of learning data. In terms of campus management, big data

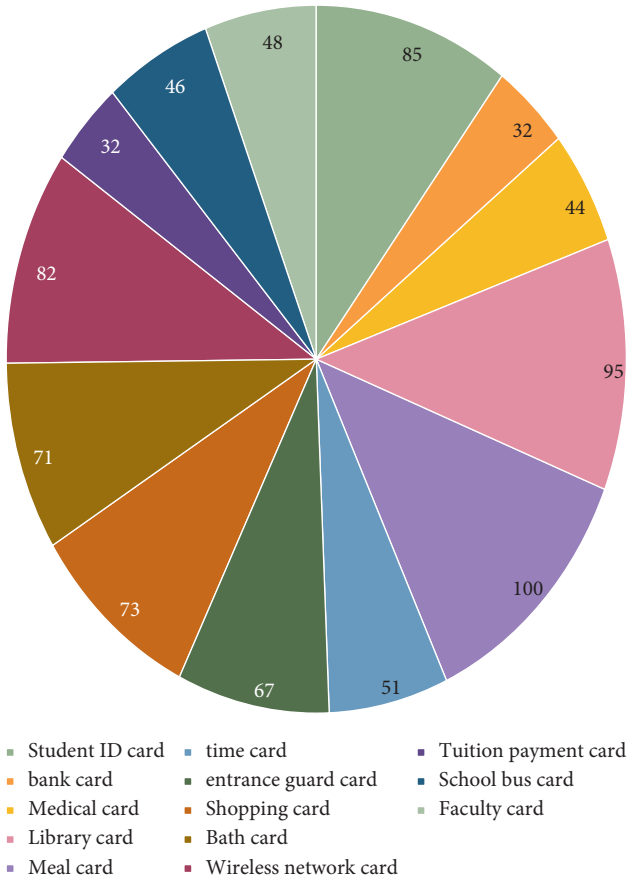


Figure 12: Application of Campus All-in-One Card system in colleges and universities.

improves the efficiency of data management and processing, realizes management informatization, and greatly improves the management efficiency while reducing service links. In addition, big data makes Education Networking more popular and popular, greatly improves people's acceptance of Education Networking, and reduces the operation difficulty and time cost of network education. At the same time, the era of big data has also changed the way of education and training talents and the social demand standards for talents.

5. Conclusion

This paper holds that, in the era of big data, educators and learners are facing challenges and changes, and the impact of big data on Educational Networking is all-round. Therefore, this paper constructs a Bayesian knowledge tracking model to collect the behavior data of educators and learners and uses association rules to analyze the data. At the same time, according to the development law of Educational Networking, this paper constructs the evaluation index system of Educational Networking level. The experimental results show that the development of big data technology provides an opportunity for the rapid development of Educational Networking. The market scale of distance education and education network has expanded year by year, and the number of online users has increased by 445 million. This shows the importance of educational network, and the development of educational network also promotes the reform of traditional educational model. At the same time, the analysis of big data student learning supervision data and the feedback of teachers' teaching quality data can achieve the purpose of accurate assistance and help poor students and teachers find and solve problems. In addition, the intelligent service system based on big data technology can realize multifunctional campus one card and one card and improve the informatization level of campus management. However, at present, the application of big data technology in education network needs further development. However, there are also some problems in China's campus network, such as regional imbalance and uneven quality of relevant systems and platforms, which need to be further solved. In the future, under the influence of big data technology, the development of Educational Networking will enter a new stage, from reality to virtual, from two-dimensional to three-dimensional, or even 4D, so that educational reform has more development possibilities.

Data Availability

The data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

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