Internet-based Intelligent Mobile Device-assisted Precise Management of Distance Education System

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Abstract Education is an important manifestation of civilization and the basis of social development and progress. The teaching work of schools is crucial for the future growth of students. However, due to the outdated traditional teaching methods, many students lack the awareness of autonomous learning and cannot form good learning attitudes and habits. It can be seen that teachers need to innovate and reform the teaching according to the changes of the times and environment. In this case, the distance education model has emerged. It not only combines textbook knowledge with practical problems, but also focuses on cultivating students' logical thinking ability and hands-on operation ability. It is welcomed by parents and teachers and students with its flexible, convenient and interactive features, becoming the most popular teaching method at present. This paper combined the basic idea of test paper generation algorithm to build a remote tutoring platform system based on test paper generation technology. By designing corresponding functional modules for the test paper conditions and verification process, it can realize online synchronous interpretation of homework, test paper analysis and solutions, and help students develop scientific problem-solving methods, thus improving the ability to comprehensively use knowledge points to solve practical problems. This paper has compared the traditional classroom education mode with the intelligent device-assisted distance education mode, and the results showed that the use of intelligent device-assisted teaching had the advantages of low cost, good effect, strong adaptability, etc., so that the students' attendance rate and classroom activity have been greatly improved, and the satisfaction increased by about 2.03%. It could also effectively avoid the waste caused by manual teaching. As a multimedia information release terminal, Internet-based intelligent mobile devices can enable learners to obtain the required information anytime and anywhere, which greatly promotes the development and application of online course resources and the educational resources, and provides users with convenient and efficient services.

Index Terms Distance Education, Precise Management, Intelligent Mobile Device, Test Paper Generation Algorithm

I. Introduction

I. A. Exploration Background

With the development and application of modern IT (information technology), network teaching, as a new teaching mode, has penetrated into all disciplines. Web-based distance education is broadly used in various fields because of its better openness, interactivity and flexibility, thus greatly promoting the process of education reform and the improvement of teaching quality and also promoting the advent of the information age. Its vitality is strong, and it is welcomed by teachers and students, bringing new opportunities to the transformation from traditional teaching mode to modern teaching mode. In this situation, how to implement effective teaching and learning activities is a subject of concern for every educator, and it is also one of the focuses in the current teaching reform. Therefore, it is essential to reform the traditional education mode and the teaching method, so as to mobilize the enthusiasm of students' independent exploration and achieve the goal of building an efficient classroom.

I. B. Significance of Using Intelligent Equipment to Assist Distance Education

I. B. 1)Creating an Open Environment for Learning and Communication and Improving Students' Autonomous Learning Ability

Since the network is a virtual world, and students can carry out various distance learning activities anytime and anywhere. By using this method, teachers can let more students participate in teaching, thus forming a good interactive atmosphere. This method can also help to realize the combination of "learning first" and "teaching second", cultivate learners to actively participate in the education process, and prepare for better education in the future.

I. B. 2)Providing New Means for Education and Teaching Reform, and Promoting the Scientization and Informatization of School Management

In the past, teachers are the organizers and guides of classroom learning, while modern teaching is student-oriented. Intelligent equipment can effectively help students understand knowledge content, think and express and effectively focus limited time on students. This can make the teaching process more flexible, so that more people can accept and master advanced teaching methods, teaching content and teaching methods, thereby improving teaching quality and teaching effect.

I. B. 3)Promoting the Integration of Modern IT and Subject Courses, and Improving Teaching Quality and Efficiency

In the routine teaching process, most teachers only spend limited time in the classroom, and rarely pay attention to students' activities outside the classroom or even their own life outside the classroom. With the promotion of the new curriculum reform, people pay more and more attention to the cultivation of students' ability to actively participate in learning and the ability to independently explore and solve problems, and require teachers to have advanced teaching concepts. Only with good teaching methods can teachers truly "teach students to fish", helping them master learning methods and learn to effectively use the knowledge learned to solve practical problems. Therefore, in the information age, long-distance network teaching has become an inevitable trend. Teachers can use modern IT platforms and various media resources to carry out teaching activities, make classroom teaching more colorful and vivid. Meanwhile, this method can also make full use of modern educational technology to have a subtle impact on students' knowledge, skills, emotional attitudes and values.

II. Development Status of Distance Education

With the continuous development of modern IT such as computer technology, network technology and communication technology, distance education has been widely used in society with its convenient, fast and efficient advantages. How to take full advantage of advanced technology to improve the quality of teaching has become a common concern of educators. However, the rise of distance education is a gradual process, which requires continuous investment of time, energy and money. Therefore, there must be a complete set of management systems and norms to ensure its quality.

Distance education has always been a hot spot in the development of education and the focus of social attention. Many scholars have explored it. Fidalgo Patricia investigated learners' views, attitudes and willingness to try distance education to understand their motivation in learning and provide guidance and suggestions for expanding higher education institutions in the form of distance education [1]. Williamson Ben studied digital technology and distance education during the coronavirus emergency and provided a vivid, intuitive and effective learning environment for students through online video teaching [2]. Hebebci Mustafa Tevfik revealed the views of teachers and students on the application of distance education in the coronavirus pandemic. He put forward the opinion that distance education can be used more effectively in the future, and necessary improvements and on-the-job training can be carried out [3]. Bergdahl Nina analyzed the transition process of schools from traditional teaching to distance teaching and pointed out that modern distance education is a new model based on network and characterized by learning environment and technology. This study provided information for schools to make preparation plans [4]. Bozkurt Aras discussed the trends in the field of distance education research during 2009-2013 and used content analysis and descriptive analysis to explain the problem, which helped to explore potential research fields and identify neglected areas in the field of distance education [5]. Saba Farhad overcame many methodological and theoretical limitations of physical science in distance education. He further revealed the complexity of distance education [6]. The development of distance education is a dynamic process. With the continuous improvement of people's cognitive ability and practical level, its scope continues to expand and its functions become more and more, but there are still many deficiencies and challenges.

Intelligent device-assisted distance education has become a trend, and more and more scholars conduct research based on it. Anderson Terry reviewed the three generations of distance education teaching methods, focusing on the teaching methods that define the learning experience included in the learning design, focusing on the social, cognitive and teaching existence, and emphasizing the process of learners' effective mastery of knowledge and skills in the classroom [7]. Garrison Randy reviewed the important theoretical contributions of distance education in the last century. He also revealed that the theoretical development in this field is developing from organizational issues and assumptions to transaction issues and assumptions, and assessed whether the development of distance education can keep up with the pace of innovation in technology and practice [8]. Zawacki-Richter Olaf reviewed the distance education literature to describe its current situation, and he determined the gaps and priority areas in distance education research according to the field classification, proving that distance education is largely dominated by issues related to instructional design and personal learning process [9].

Downes Stephen identified learning objects and objectives from the perspective of global distance education resources, and proposed an online open course model based on learners' behavior, which is of great significance in meeting learners' personalized needs and improving learning effects [10]. Shachar Mickey evaluated and compared the academic performance differences between students who participated in distance education courses and students who participated in traditional education courses to reveal the mechanism of different learning methods' influence on learners' learning effects [11]. Zhang Zuochen discussed the learning experience of three students who participated in the online master's program offered by a large university, and also learned about the experience and views of international students on the online learning environment [12]. The introduction of intelligent devices has made a qualitative leap between distance education and traditional education in terms of content, form and function.

Although distance education has many advantages over traditional education, due to the limitations of time, space and technology, it has also encountered some difficulties in the current development process, such as the unbalanced allocation of educational resources, the lack of unified supervision and the single teaching organization, which restrict the healthy and orderly development of distance network education. With the advantages of fast information transmission, large coverage, strong interactivity and low cost, Internet intelligent mobile devices have become an important driving force for the vigorous development of distance education. Therefore, this paper analyzed the factors affecting the speedy growth of distance education from the problems existing in the education system and proposed relevant measures in order to provide useful references for the fine management of modern distance education.

III. Accurate Management of Education System

III. A. Problems in the Current Distance Education System

The development of distance education is a process connected with the real world. Especially with the rapid globalization of the economy and the rise of the global IT revolution, more and more people begin to take distance teaching as a part of their career. Distance education has become one of the indispensable means to carry out various social activities in the world today. However, due to the impact of the conventional teaching model, many learners are not satisfied with this learning mode after receiving education for a period of time, so there are various kinds of questions. They argue that distance education in the network environment is only a virtual teaching form, and its effect cannot fully meet the current social needs, as shown in Figure 1.
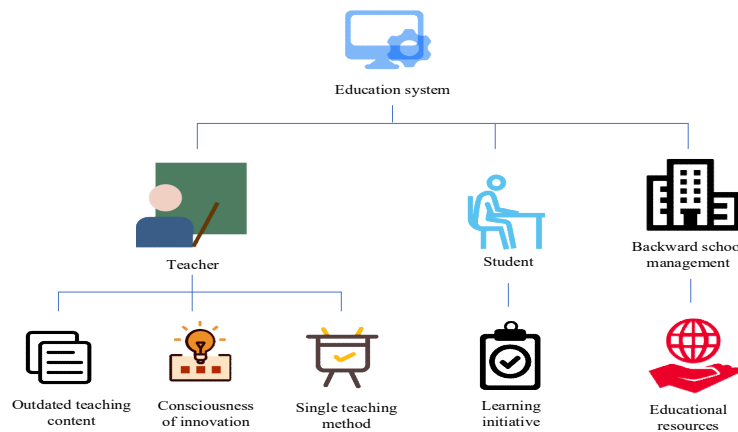

Figure 1: Problems existing in the current distance education system

First, teachers lack innovative awareness and ability. For example, the traditional teaching mode is adopted in the primary school mathematics class, but the students are active in thinking and like to explore, resulting in a lack of communication and cooperation between teachers and students; in junior high school physics class, teachers only attach importance to experimental operation and ignore theoretical analysis. These phenomena are very common. Second, the students' learning enthusiasm is not high, and their weariness of learning is strong, which are mainly reflected in the students' poor performance. They may feel dull about classroom knowledge, and they are difficult to accept new knowledge, even with rebellious psychology, seriously hindering the teaching order. Third, the teaching method is single and the classroom teaching efficiency is low, because in the teaching, teachers only focus on imparting basic knowledge and basic operating skills, ignoring the improvement of thinking ability, which easily leads to the situation "giving fish is better than teaching fishing". In this case, if teachers want to

make a good change in the teaching effect, they must combine various teaching methods. Fourth, the teaching content is stale and monotonous, which is not conducive to cultivating students' good learning habits, with a lack of necessary evaluation mechanism. Thus students' learning behavior cannot be timely and effectively guided, which affects the learning effect. Finally, the backwardness of school management also restricts the development of education, especially in rural areas, where educational resources are very scarce. Many teachers in primary and secondary schools there are weak, and the teaching quality is low. Many students drop out of school due to poor foundation and other reasons, which has seriously damage the local economic construction and bring negative impact to the society. To sum up, although distance education can meet the needs of different groups of people in modern society for knowledge acquisition channels, it has certain risk problems. Therefore, reasonable and effective management must be carried out to guarantee the sustainable development of distance education in a healthy and orderly manner [13].

III. B. Advantages of Intelligent Mobile Devices

With the continuous improvement of people's living standards, more and more people begin to pursue more comfortable and convenient entertainment, which has become one of the future development directions. Intelligent mobile devices are a new generation of electronic products that apply artificial intelligence such as voice recognition and computer vision to mobile terminals or other electronic devices to realize intelligent control through wireless communication technology. Its functions are no longer limited to simple functions such as making phone calls, sending text messages, watching video, etc., but a new human-computer interaction mode based on the Internet, with strong interactivity and convenient use. Smart mobile devices include smart phones, tablets, smart TV, smart audio and other products. It can enable users to complete various operations without entering any information, thus effectively reducing the use cost and improving work efficiency. Specific advantages are shown in Table 1.

Table 1: Advantages of smart mobile devices

Advantage	Description
Data transmission	Communication between cell phones and other electronic devices
Humanized design	Speech recognition, gesture control, etc
Built-in Bluetooth	Wireless transmission, location, etc

Intelligent mobile devices are produced in the era of mobile internet. They can realize data transmission with mobile phones and other electronic devices through the network, so as to obtain various information and help people complete daily tasks. At the same time, it also has powerful functions and humanized design, such as voice recognition, gesture control, photo shooting, video call and other applications. Nowadays, people would pay more attention to all activities needed in daily life. In addition, the mobile phone has a built-in Bluetooth module, so that the voice or image sent by the mobile phone can be received at any time. It can also realize wireless transmission, positioning and other functions, thus making it a multi-functional product integrating entertainment and office. Mobile devices have the characteristics of small size, convenient carrying and simple operation, which can not only meet people's growing communication needs, but also provide more services for users. This would enhance the user experience and further promote the development of enterprise business. In the future, people would also increasingly improve the quality of life through this convenient way.

III. C. Construction of Internet-based Education System

As a new way to disseminate information, the Internet is playing an especially significant function in the field of education. Especially for traditional classroom teaching, information construction is particularly important. Sharing teaching resources through the Internet can greatly promote the improvement of teaching effect. Nowadays, people have higher requirements for the information teaching environment. It also makes school education more intelligent and networked, and provides better learning conditions for students. The process of building an internet-based education system is shown in Figure 2.
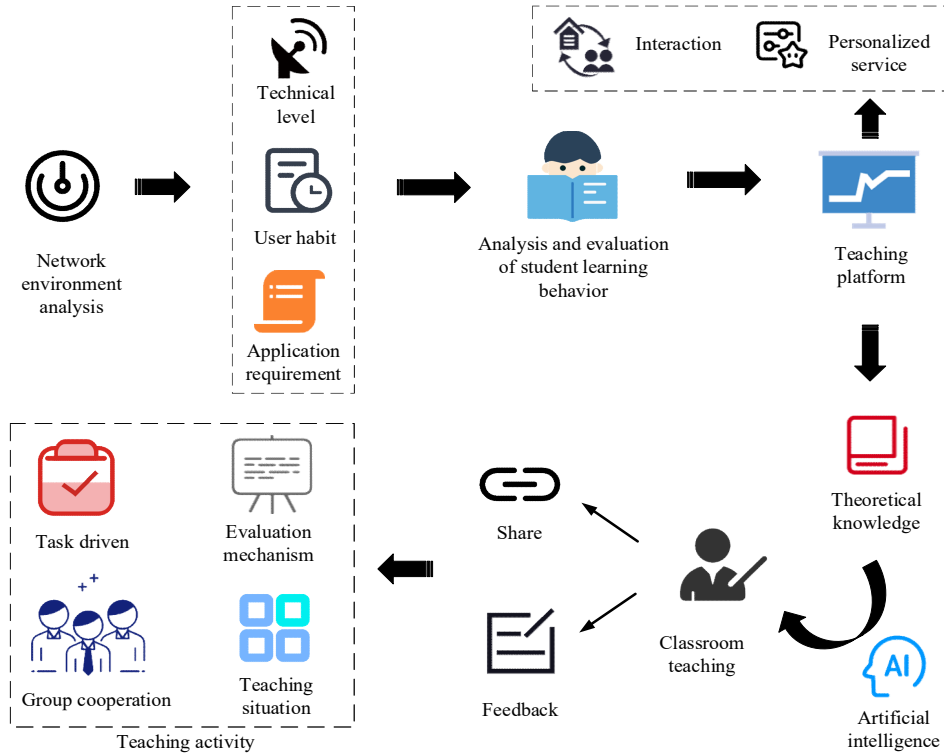
Figure 2: Internet-based education system construction

First, it is required to analyze and understand the existing network environment, including the current level of technology development, user usage habits and network application needs. An intelligent network environment with student learning behavior analysis and evaluation as the core, and a new teaching platform based on it, so as to achieve the goals of student learning and teacher interaction, open teaching resources and personalized information services. Secondly, from the theoretical level, it discusses how to apply AI to classroom teaching, and designs the corresponding teaching content to realize the two functional modes of "online feedback" and "knowledge sharing". Finally, by building an intelligent network teaching system and using it to conduct educational events, the purpose of optimizing the teaching effect is achieved. Specifically, it can be divided into the following parts: in terms of teaching content, problem-oriented teaching situations should be established; in terms of teaching methods and processes, a task-driven teaching model is proposed; for the evaluation system, a comprehensive curriculum evaluation mechanism is built; in response to the current situation of low interest in learning, poor learning results and shortage of autonomous enquiry capability, the use of group work is proposed to cultivate students.

III. D. Fine Management Scheme of Distance Education Assisted by Intelligent Equipment

The modern IT uses the Internet as a medium and tool, and enables students to organically combine knowledge and skills, thinking methods and practical abilities through various means. As a new form of education, distance education is being accepted by more and more people. It uses the Internet to innovate the traditional education methods, and realizes digital teaching and networked management. For example, during the COVID-19, intelligent equipment is used to carry out remote teaching, online learning, etc., which not only saves human investment and time costs, but also helps schools to keep abreast of students' situation in a timely manner [14]. By using intelligent equipment to assist the fine management of distance education, it can efficiently reduce the workload and expenses, and realize the optimal allocation and efficient operation of resources. The specific scheme is shown in Figure 3.

Figure 3: Fine management scheme of distance education assisted by intelligent devices

First of all, a distance learning management system based on the network service platform is constructed, including the construction of a website platform for publishing all kinds of education resource information and query data; real-time monitoring is implemented to ensure the quality of teaching content; a library of multimedia courseware has been created to satisfy the needs of different users; the exchange of online teaching resources is carried out. Secondly, the virtual training environment is built and relevant service functions are provided, so that students can choose their own education mode through the network platform. At the same time, it can also interact with teachers and parents in the virtual teaching environment to obtain more information about teaching quality and other aspects. Thirdly, the establishment of a curriculum development system can provide teachers and students with a variety of teaching information resources and various advanced digital teaching equipment, such as electronic lesson plans, multimedia teaching software, online live broadcast platform, electronic whiteboard, etc. It can also realize remote video tutoring and make full use of Internet technology to conveniently collect, store, manage and publish various educational resources. It supports online teaching, and feeds back the problems in the learning process to teachers or other relevant personnel in time, so as to solve and help learners complete personalized needs. Finally, a corresponding evaluation system and examination mechanism are designed, and a reasonable and feasible assessment plan is formulated in accordance with the practical conditions of the learners, which is used as the evaluation criteria to constrain the learners' behavior. In addition, the intelligent privacy protection of users is also a link that cannot be ignored in distance education management. To achieve this, necessary technical measures must be taken to ensure it, such as using computer vision, pattern recognition and other methods to identify user identities, using encrypted transmission to ensure information security, and setting effective security policies [15].

III. E. Design of Test Paper Generation Algorithm for Distance Education

The test paper generation algorithm is a data-based automatic sorting method, which uses the characteristics of certain relationships between elements in a group of data tables to group. This paper provided support for the realization of teaching objectives of distance education teaching system based on the algorithm of generating test papers.

It is assumed that there is completed test paper A; B means to complete all the actions of test paper formation, and C means to consider only the action of test paper formation of knowledge point x, difficulty y, discrimination z and question type i for each question type. The process of volume verification is:

$$Q = D(M_1(x,y,z), M_2(x,y,z),...,M_n(x,y,z)) \qquad (1)$$

In Formula (1), D represents all the actions in the test paper formation process of all the questions, and M_n represents the verification process under the test paper formation condition after the information is adjusted n times.

The difficulty of test paper formation conforms to the normal probability distribution, and its coefficient expression is:

$$S_i = \sum_{j=1}^{i-1} y_j + \frac{y_i}{2} \tag{2}$$

$$r = \sum_{j=1}^{i} y_j \times S_i \tag{3}$$

Among them, y_j represents the proportion of the j-th difficulty, and r is the statistical score. The difficulty of the test paper can be obtained by the level of the interval where the r value is located.

At this time, the calculation formula of test paper differentiation is:

$$H_a = I_a - K_a \tag{4}$$

In Formula (4), H_a represents the differentiation of question a, and I_a represents the ratio of the number of correct answers to the total number of people; K_a is the ratio of the number of wrong answers to the total number of people.

IV. Comparative Experiment of Distance Education System Based on Intelligent Equipment

IV. A. Experimental Method

Two classes A and B were randomly selected from a school to conduct a questionnaire survey, and the results showed that Class A often used traditional classroom teaching methods, while Class B preferred the distance online education mode. It was known that the two classes had the same majors, the same number of students, and the students' academic achievements were basically at the same level. The same teacher taught two classes in two ways. The teaching effect was compared from three aspects of attendance rate, class activity and satisfaction for one week, and the experimental data were recorded and analyzed.

IV. B. Data Survey

IV. B. 1) Attendance Rate

According to statistics, the total number of the two classes was 40. The number of students in each class every day was recorded, and the results are shown in Figure 4.

a. The number of students in Class A   b. The number of students in Class B
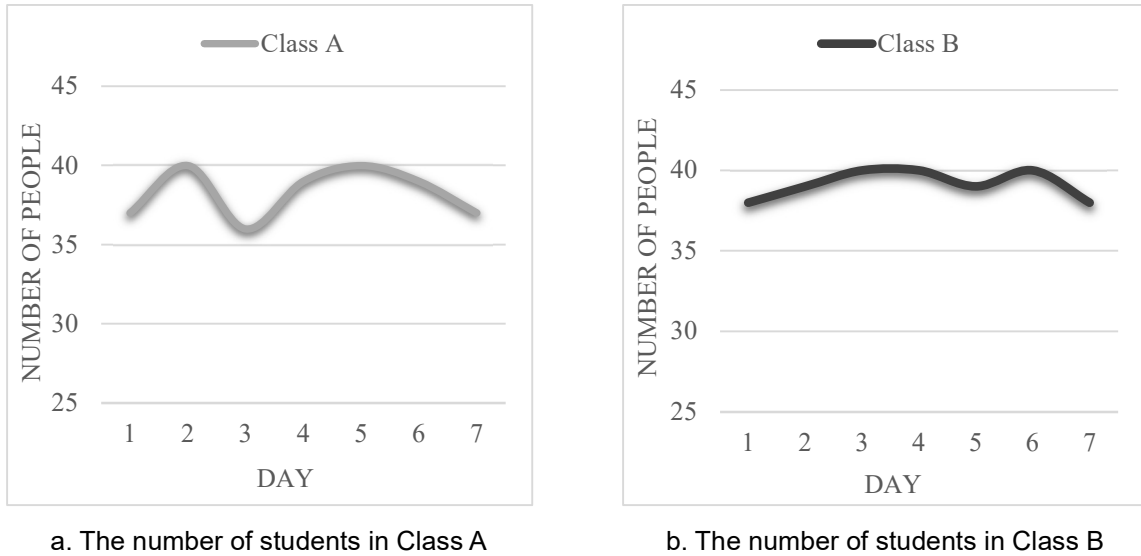
Figure 4: Comparison of attendance rates between the two classes

Figure 4a shows the number of students in Class A every day in a week, and Figure 4b shows the number of students in Class B every day. It can be clearly seen that the curve of Class A fluctuated greatly, so there was certain instability in this class. It is needed to carry out hierarchical teaching for students in this class to improve their learning efficiency. The overall curve trend of Class B was relatively flat, with little fluctuation. The number of students in this class was relatively fixed every day, so it was not easy to have disorder in teaching order, which

was conducive to promoting the stable development of class management and teaching quality. According to the data performance of a week, Class B students have a higher attendance rate, a stronger class cohesion, and more active and competitive teachers.

IV. B. 2) Class Activity

The activity of the classroom was measured by the number of interactions between teachers and students, and the number of interactions between teachers and students in the same class every day was recorded. The results are shown in Figure 5.
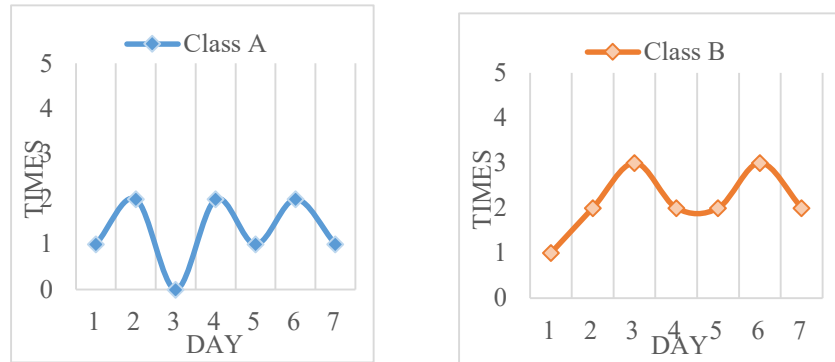
a. The number of interactions in Class A   b. The number of interactions in Class B

Figure 5: Comparison of interactions between two groups of students

Figure 5a shows the daily interaction times of Class A, and Figure 5b shows the daily interaction times of Class B. It can be seen that the performance of students in the two classes in the first two days was basically the same, and they were not willing to take the initiative to express themselves in class. However, on the third day, Class B students broke through the psychological defense line and began to express their ideas boldly, which made the classroom atmosphere become active; on the contrary, the students in Class A were more afraid to speak. It can be seen that in the process, teachers should be good at using different methods to stimulate and cultivate students' autonomous learning ability. In particular, in this case, the teacher should give guidance and encouragement in time, otherwise it would cause students to lose control of their emotions and even produce rebellious psychology. It is easy to cause contradictions and conflicts between teachers and students, and lead to chaos in the whole teaching. This is not only bad for cultivating all-round talents, but also affects the quality of teaching.

IV. B. 3) Satisfaction

The two classes rated the satisfaction of the teaching process in this week, and recorded the change trend of the satisfaction of the two classes with the increase of the teaching time. The results are shown in Figure 6.
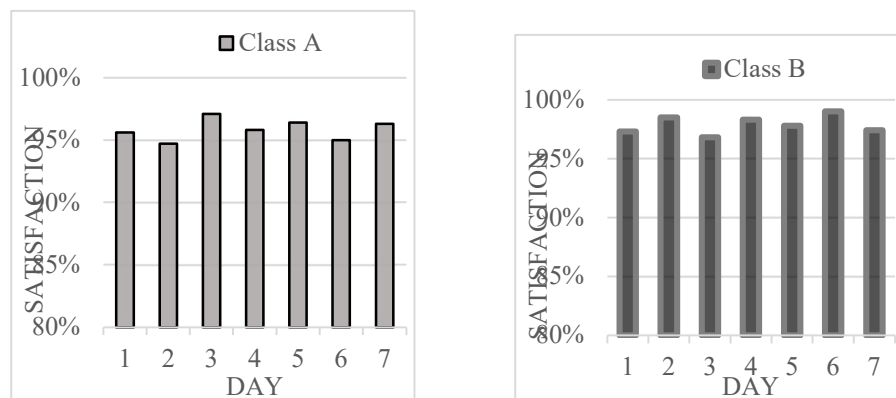
a. Class A satisfaction   b. Class B satisfaction

Figure 6: Comparison of satisfaction between two classes

Figure 6a shows the change of satisfaction of Class A students in a week, and Figure 6b shows the change of satisfaction of Class B students in a week. It can be clearly seen that Class A's satisfaction reached its peak on the third day, about 97.1%; the satisfaction on the second day was the lowest, about 94.7%. Group B's satisfaction reached the highest level on the 6th day, about 99%; the lowest satisfaction was the third day, only about 96.8%. The degree of satisfaction of the two classes fluctuated in a similar range and the overall trend was similar, but overall, the degree of satisfaction of Class B continued to show a high attitude. After calculation, the average satisfaction of Class A was about 95.84%, and that of Class B was about 97.87%; the average satisfaction of Class B was about 2.03% higher than that of Class A. Therefore, distance education management based on smart devices can be effective in improving the teaching environment and learning atmosphere of classes, which is more in accordance with the needs of modern education development and promotes the coordinated, healthy and sustainable development of society and school economy.

V. Conclusions

Education is the product of the development of human society, and also an important way to promote people's all-round development. Both in traditional school education and modern quality education, there are many ways to improve the quality of students. Among them, the Internet, as a new carrier for learning new knowledge and expanding horizons, can help people use resources more efficiently. A distance education platform based on the assistance of smart devices is one such important tool. It allows learners to interact and communicate more with the outside world, and also provides teachers with richer teaching tools, thus making teaching and learning activities easy and convenient. This paper first analyzed the difficulties and challenges faced by the current education system from the aspects of network environment, education content and learning methods, and then introduced the basic technical methods for the development and application of distance education resources using the network, as well as the problems and solutions in this field. This paper also proposed a refined management scheme for distance education based on the test paper generation algorithm to solve the practical problems such as low utilization of educational resources, unreasonable resource allocation, and asymmetric information between teachers and students. This can make distance courses become truly high-quality teaching resources and effectively integrate them into the classroom teaching process.

Funding

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