PAPER

The Impact of Online Teaching Using Interactive Learning Methods on the Utilization of Learning Resources

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ABSTRACT

The management of learning resources is based on educational information technology, and the interactive learning method can improve teaching efficiency in colleges and universities. However, the diversity of resources leads to differences in teaching levels and attributes. To further improve students' utilization of learning resources and the level of teaching in colleges and universities, the impact of online teaching using interactive learning methods on the utilization of learning resources was explored, and the application of database teaching in online teaching platform was analyzed. Based on this platform, the structure of an interactive learning-based intelligent Q&A module was established to determine the impact of online teaching on the utilization of learning resources using interactive learning methods. Results indicate that the proposed method can effectively save students learning time while improving learning efficiency. The proportion of students who are not interested in online teaching using interactive learning methods is reduced to 0%. The application of the method described in this study is beneficial for enhancing students' interest in online teaching using interactive learning methods, improving their learning outcomes, and increasing their academic achievements.

KEYWORDS

interactive learning method, online teaching, learning resources, availability

1 INTRODUCTION

To adapt to the development of online teaching, interactive learning methods that are closely related to learning resources have emerged. However, traditional learning resources can no longer meet the needs of online teaching methods using interactive learning methods [1–2]. The gradual development of network technology has led to the explosive growth of learning resources but has not promoted the development of interactive learning, resulting in a phenomenon where learners are surrounded by a vast amount of resources but still lack the necessary resources [3]. This teaching method currently faces two main contradictions: one is that interactive online learning

resources are added in all aspects, but these resources are not managed properly; the other is that there is a rapid increase in learning resources, but teachers are unable to choose resources reasonably [4]. As this teaching method belongs to the main technology of future teaching, it has a large demand for learning resources, leading to problems such as low resource retrieval efficiency and high management difficulty [5–6], which are not conducive to the development of online teaching using interactive learning methods. The design of a resource-management platform can solve the problem of resource overload, improve the utilization of resources, and avoid excessive dependence on administrator management in order to meet the long-term development needs of online teaching using interactive learning methods.

Online teaching methods have emerged along with the rapid development of internet technology [7]. Online learning methods refer to the use of network communication and electronic technology learning behaviors; network learning, video conference, and other learning behaviors are all considered online learning methods. Online learning is a highly favored method of education by both students and teachers owing to its ability to overcome limitations in time and space as well as accommodate multiple learners in one-to-one and one-to-many teaching scenarios [8–9]. As a significant branch of education development, online learning has improved the constraints upon the time and location of traditional classroom teaching, which is an important pathway for advancing educational information technology [10]. Online teaching using interactive learning methods has the advantages of extensibility and convenient utilization of learning resources. It can realize integration and organization of information and data so that the learning content can be spread quickly and smoothly and meet the learning characteristics of students. High-quality online teaching has become an important issue in the development of open online teaching on the internet.

This study aims to explore the impact of online teaching using interactive learning methods to utilize learning resources. The learning objectives and context comprise the online learning mode, which includes the learning time, project, and environment. The learning context mainly includes the time spent in and outside the classroom. Online learning methods enable students to utilize their time outside the classroom for online learning. Learning environments such as libraries, classrooms, and dormitories are all considered as part of the learning context. When using an online learning method, students can choose different learning environments based on their learning devices. The content of online learning can change constantly based on what students are learning. Learning abilities of students can be improved through the reasonable management of learning resources.

2   LITERATURE REVIEW

Scrivener et al. [11] proposed to examine the use and acceptability of online learning resources for physical therapists by obtaining data from Google Analytics to determine program usage and user details. The intended users were also invited to complete two surveys; the surveys collected information on user demographics, perceptions about the usefulness of online resources, and general sentiment. Du et al. [12] put forward an adversarial deep-learning algorithm for online resource allocation. Designing online algorithms with finite competitive ratios (in the worst case) can be challenging and often relies on problem-specific assumptions. Inspired by adversarial training from generative adversarial networks and the fact that the competitive ratio of online algorithms is based on the worst-case input, a deep neural network is used to learn online algorithms for resource allocation and pricing problems.

The goal is to minimize the performance gap between offline optimization and learning online algorithms for the worst-case inputs. Palacios et al. [13] proposed machine learning for solar energy resource assessment by using satellite images. The proposed approach analyzed satellite images and solar radiation data from 2012 to 2014 to establish seven solar energy prediction models obtained at different altitudes. Four performance evaluation indicators (mean square error, R^2, root mean square error, and mean absolute percentage error) were used to assess the performance of four machine-learning algorithms. Garg et al. [14] proposed a study on the application of machine learning in human resource management. The design method adopted a semi-systematic approach, which allowed a more detailed analysis of literature from multiple disciplines with different methods and theoretical frameworks. With the improvement of the efficiency and effectiveness of human resource management functions, machine-learning applications improve the employee experience and promote organizational performance.

Zhang et al. [15] proposed the use of heterogeneous device models to perform zero-distance knowledge transfer in resource-limited joint learning, which allows multiple distributed devices to collaborate in learning and sharing prediction models without centralizing the data on their devices. The extracted central knowledge is sent back in the form of corresponding model parameters on the device, which can be easily absorbed on the device side. Papalexopoulos et al. [16] proposed the use of machine learning for efficient, fair, and inclusive resource allocation. They developed an overall framework that combines ethical theory, data modeling, and stakeholder engagement and illustrated it through a case study on the design of organ-transplant allocation policies. They also developed a novel analytical tool based on machine learning and optimization to promote efficient and wide-ranging exploration of policy outcomes across multiple objectives. This tool enables all stakeholders, regardless of their technical expertise, to make evidence-based value judgments based on relevant trade-offs and participate more effectively in the decision-making process. Salehzadeh et al. [17] proposed how to increase organizational learning and knowledge sharing through the human resource management process; assumed and tested the relationship among the human resource management process, knowledge sharing, and organizational learning; and collected data through investigation and research. The path-modeling method was used to analyze data and conceptual models.

Lim et al. [18] proposed dynamic resource-allocation strategies for learning edge network applications and presented a dynamic resource allocation framework based on proactive service quality prediction. These predictions help guide a reinforcement learning-based resource controller to achieve optimal resource allocation while avoiding transient quality-of-service violations due to fluctuating workload demands. Nasrulloh et al. [19] pointed out the development of an e-book in EPUB 3.0 format as a learning resource for mixed learning IPA Terpadu. The purpose of this study was to produce an e-book on IPA Terpadu and understand its quality as a mixed learning resource. The e-book, composed of text, images, and videos, can be read on computers or other electronic devices. The development of the e-book consists of three stages: planning, design, and development. Saputro et al. [20] proposed the use of colonial historical sites in Bamibang City as an outdoor learning resource. If students actively participate in learning activities, then all of the students' senses will be engaged. One of the learning activities that can promote active participation is outdoor learning. This research used historical methods supplemented by scientific methods from various fields, such as theology, politics, anthropology, and sociology. The results of the study on colonial historical sites in Bamibang City provided a high school outdoor learning resource.

3 METHODOLOGY

3.1 Study objects

Considering the applicability of the impact of online teaching on the use of learning resources using the interactive learning method, this research focuses on studying online learning courses and design-equivalent group experiments. The experimental group will adopt the interactive learning method to investigate the impact of online teaching on learning resource utilization, while the control group will adopt the traditional reference method [11] and reference method [12]. The effectiveness of the impact of interactive learning methods on resource utilization in online teaching will be fully validated through a comparative analysis.

3.2 Experimental context and tools

To ensure that all subjects can fully and scientifically understand the basic concepts of professional courses, as well as master the basic operations of the corresponding equipment under the impact of online teaching using interactive learning methods on the availability of learning resources, this study provides basic knowledge reading materials. The main equipment required for the experiment is the virtual experiment software and its supporting hardware used by learners.

With the research context and tools as the center and the content collection and teaching objectives as the premise, the platform database is developed to store the collected content in its internal storage. This database has the function of retrieval and use. The interactive objects of this module are students, teachers, and administrators. When entering this module, users must first apply for entry, and then the module will verify their identity. In case of failure to match user resources, the module will automatically exit. After verification, users will enter different interfaces according to their different needs, and the module will provide necessary interfaces accordingly. Different types of synchronous or asynchronous interactive tools can be designed within the module to assist interaction. At the same time, it is closely connected with the teaching progress and generates toolbars for each stage, which facilitates teachers in searching for learning resources, improves students' understanding of knowledge, and provides communication channels for students and teachers. The collected information of students is presented on the platform, which helps teachers design learning plans and fill in knowledge gaps left in the classroom. Teachers fill in teaching content through the database, which is equipped with multimedia courseware. The specific technical details are shown in Table 1.

Table 1. Application of database teaching

Core Method	Classification	Technical Support	Teaching Application
Interactive learning method	Slides	Based on the principles of light reflection and refraction	Display texts, images, and other resources of learning materials, which are more suitable for key and difficult teaching content
	Projector		
	Video recording	The development products of video recorder and phonograph	Enhance teaching quality to impress students
	Electronic courseware	The direct application of multimedia technology	Improve students' interest in learning

The multimedia courseware technology in the database can enhance students' self-learning ability. The students occupy the main position in the database, where valuable teaching activities are arranged for them to ensure that they can search for learning resources at any time during the learning process and enhance their learning efficiency.

The online teaching platform using the interactive learning method is designed based on interactive learning methods and with NET as the development platform. The specific structure is shown in Figure 1.
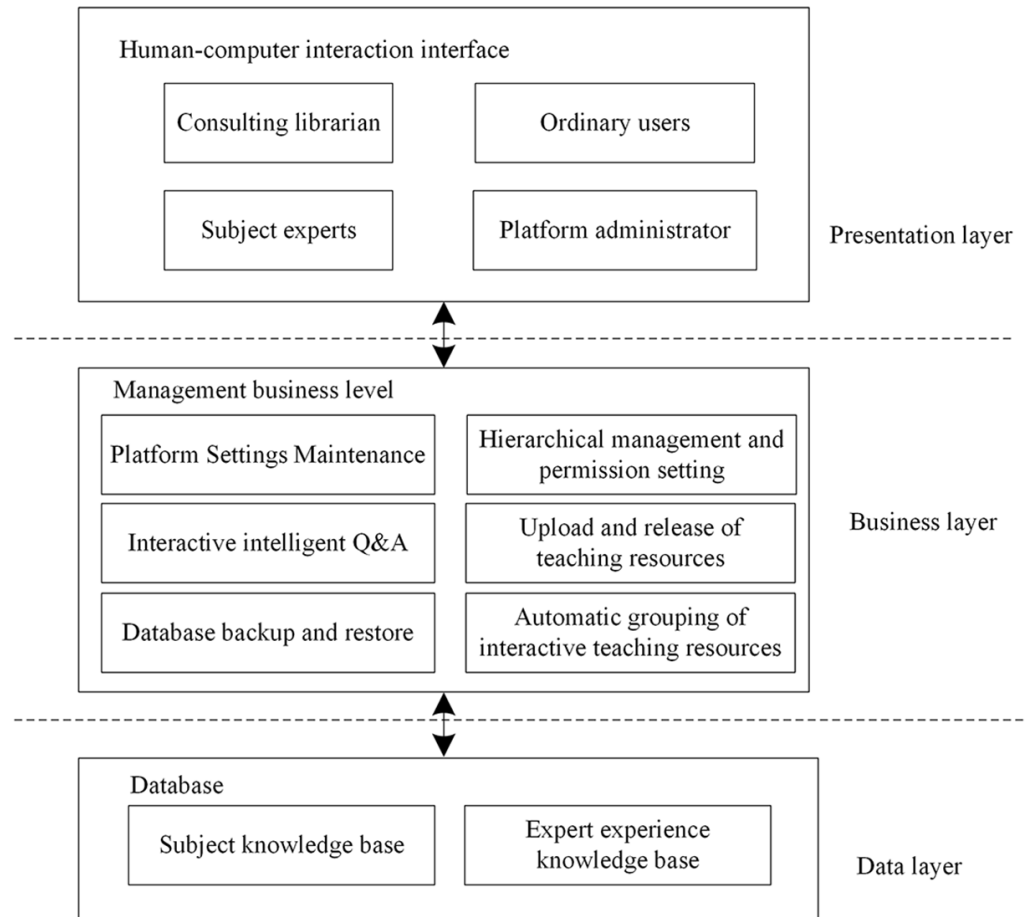

Fig. 1. Online teaching platform using the interactive learning method

In Figure 1, the presentation layer is used to facilitate interaction between users and the entire platform, and users access various platform functions through this layer. This layer can enhance the maintainability of the platform and accelerate the rendering efficiency of resources. The business layer is the core of the platform, which contains several modules, including interactive teaching resources, automatic grouping, and interactive intelligent question-answering modules. The main function of this layer is to provide functional calls for the presentation layer and complete the business of each module. It also speeds up access efficiency by calling the data access layer to access the data layer. The data layer, which is located at the bottom of the platform, is responsible for providing access to the database. It realizes the interaction of the database and has functions of resource collection, querying, insertion, deletion, and modification. The data layer serves the business layer, extracting or modifying resources in the database according to the needs of the business layer.

3.3 Data collection

The questionnaire consists of three parts. The first part is the basic information questionnaire, which is used to collect the age and major of the subjects, whether they have experienced online teaching using interactive learning methods, and other questions. The second part is the questionnaire of learning engagement. The four aspects of the questionnaire are redesigned to create a questionnaire about the influence of learning resource utilization in this study. The third part is the learning ability test using the interactive learning method, with the score given by the teacher after the learner completes the experiment as the evaluation standard.

To simulate the learning ability of the human brain using interactive learning methods, an interactive intelligent question-and-answer module is designed. The knowledge rules can be obtained by using the resource characteristics in the learning database at each layer. The data output from the upper layer are regarded as the input data of the lower layer. The feature space of the initial sample is then changed to shape the joint distribution between questioning and answering to achieve an intelligent question-and-answer service. The structure of an intelligent question-and-answer module using the interactive learning method is shown in Figure 2.
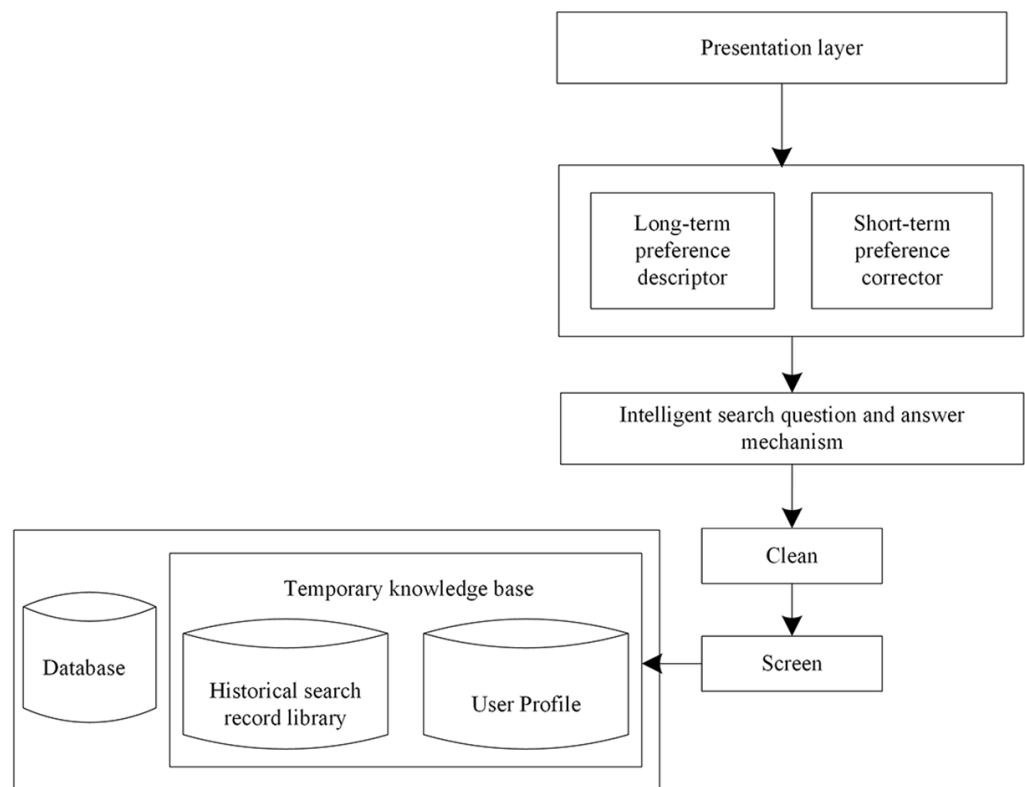

Fig. 2. Structure of an intelligent question-and-answer module using the interactive learning method

This model emphasizes knowledge feedback learning and controls the variable factors of learning algorithm by setting parameter weights. It is suitable for learning differences between new and old users. The training data are obtained by collecting basic information about users in the database.

The active classification of question-and-answer is crucial in the interactive intelligent question-and-answer module. The main method aims to not only clarify the user's request but also understand the subject characteristics of the database so as to provide the user with the query-and-answer retrieval function, reduce retrieval difficulty, and shorten information-filtering time. The specific steps of the impact of online teaching on the utilization of learning resources using the interactive learning method are as follows:

Step 1: Preprocess the text, eliminate insignificant words, process the text by word-segmentation algorithm, and obtain Chinese word vectors by training on a huge database based on word2vec.

Step 2: Encode the vectors obtained from Step 1 in a sequential manner, obtain vectors of the same length, and output them from the hidden layer as the semantic feature vector of the input sentence containing all semantic information.

Step 3: Take the neural network as a decoder, output the decoding result according to the semantic information of each input word, and assemble these words in sequence to obtain the answer to the user's question.

In this experiment, 300 students from Dazhou Vocational and Technical College, Chengdu Textile College, and Dazhou Vocational College of Chinese Medicine were selected as experimental subjects. Since there was little difference in the learning ability and acceptance ability for freshmen, 100 freshmen from each school were selected from different majors. Among all the students, there were 150 boys and 150 girls. Before the experiment, each student received a printout of the experiment description and filled in their corresponding gender, number, and group. To ensure the objectivity and authenticity of the experimental results, the purpose of the experiment was kept confidential, and the experimental subjects were required to promise to participate until the end of the experiment. Each student needed to participate in the experiment only once; that is, they needed to answer all the questions in only one questionnaire.

4   RESULTS

The 300 students were divided into Group A, Group B, and Group C, and all groups were tested by the proposed method, the reference method [11], [12]. Independent course knowledge points were selected that were more suitable for individual learning. Moreover, 10 knowledge questions were chosen to test the practical application and conceptual understanding of the experimental subjects, and the time to complete each task and the accuracy of the answers were recorded. Results are shown in Table 2. Each task had a specific indicator for correct implementation.

Table 2. Statistics table of tasks

Tasks	Group A	Group B	Group C
1	Watch teaching videos of knowledge content	Read teaching materials of knowledge content	Self-study teaching content of knowledge content
2	Online teaching using interactive learning method	Self-study on the teaching system platform	Self-study with traditional course PPT
3	10 questions	10 questions	10 questions

During the test, students in Groups A, B, and C were required to be in the same quiet environment to ensure the stability of the environment and focus their attention. Any unclear parts were explained to them to minimize task interference, and the test was administered when they were familiarized with their respective tasks. During the test, the staff recorded the test time for each participant from beginning to end, and the test was announced as completed once the last participant finished their task. The data of a total of 300 students were obtained.

After the task setting was complete, data were collected from 300 participants. The learning time required by three groups of students to complete a module task and their utilization of the proposed methods were calculated, and the results are shown in Figure 3.
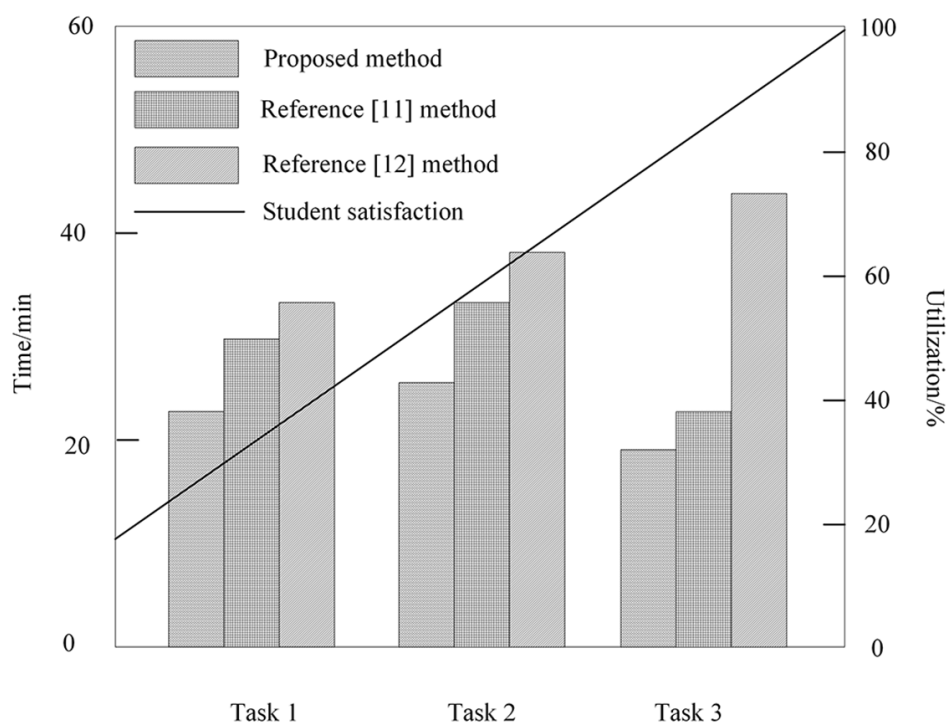

Fig. 3. Comparison results of study time for three groups of students and the utilization of the proposed methods

Figure 3 shows that the proposed method can effectively save students' learning time, improve their learning efficiency, and increase their utilization of the proposed method. The time required to complete a module task using the proposed method is the shortest, followed by the reference [11] method. The longest learning time is required by the reference [12] method. The large differences among the three methods indicated that using the proposed method can help students improve their learning efficiency and increase their utilization of the proposed method. Through the cloud platform, teaching data can be uploaded, and students can obtain more learning resources through the teaching platform. They can also interact with teachers at will to solve knowledge problems. Therefore, the students are more satisfied with the proposed method.

Students from the three schools were selected as experimental subjects, and their interest in online teaching using the interactive learning method was recorded before and after the application of the method in this study. The results are shown in Figure 4.
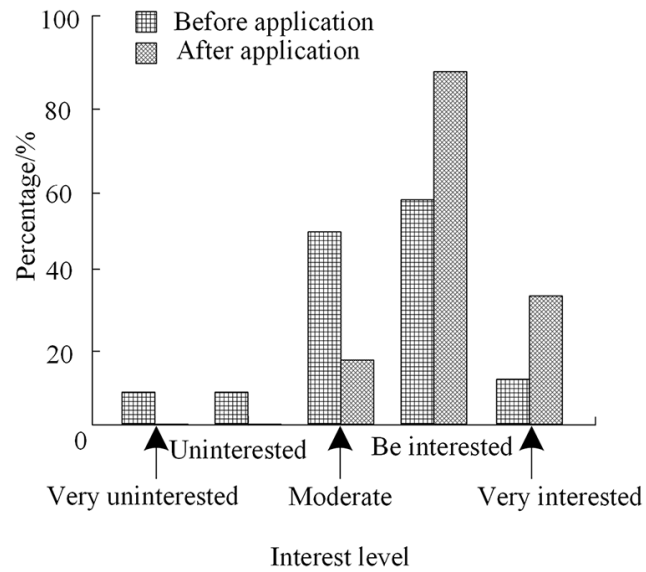
Fig. 4. Statistic of interests in online teaching using interactive learning method

Figure 4 illustrates that the application of the method in this study is beneficial for improving students' interest in online teaching using the interactive learning method. After the application of this method, the proportion of students who were not interested or not at all interested in online teaching using the interactive learning method reduced to 0%. The decrease in interest among students with a moderate interest in the teaching method is more significant, while the proportion of students who were interested or very interested in this teaching method increases significantly.

The experiment showed that the application of this platform could effectively improve the learning interest of students in online teaching using interactive learning methods. A total of 100 students with different learning abilities were randomly selected from the 300 students in the experiment and were evenly divided into two groups: the experimental group and the control group. Before the experiment, there was a small gap in the overall learning ability of students between the two groups. Students in the experimental group were divided using the method in this paper, while the students in the control group were randomly assigned to groups. The results of learning ability between the two groups of students after applying the proposed method for one semester are shown in Figure 5.
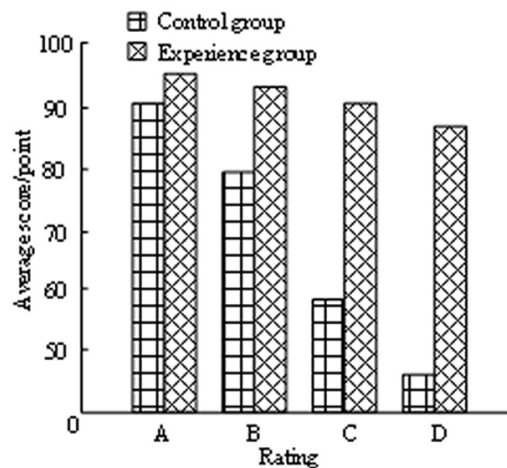

Fig. 5. Comparison of results of learning ability between the two groups of students

In Figure 5, the average score of the experimental group is higher than 85 points, while that of the control group is relatively lower, indicating that the application of the proposed method to group students is beneficial for improving their learning outcomes and increasing their academic performance. The proposed method can clarify the learning situation of students, implement accurate and reasonable grouping, set different learning objectives, and improve their learning ability.

5 MANAGERIAL IMPLICATIONS

5.1 Online interaction teaching mode for enhancing learning

The biggest problem in online learning is the lack of supervision of students, which hinders the improvement of students' enthusiasm for interactive online learning. This is a problem that needs to be addressed. A new online interactive teaching model can be developed to solve this problem. First, teachers should strictly control students' learning. In the process of teaching, teachers should keep the camera on at all times so they can clearly observe every move of every student. If there is any careless behavior, teachers can correct or even criticize it in a timely manner. In online teaching using the interactive learning method, the authority of teachers is key to ensuring that students learn seriously. Second, interactive activities such as questioning and answering should be added during teaching, and the number of questions answered by students should be quantified. Implementing the interactive teaching mode can stimulate students' attention, enabling them to be fully focused on listening to teachers and actively communicating with teachers in the classroom. On the other hand, this method can change the one-way transmission of "teachers speak actively, and students learn passively." Specifically, it can improve students' sense of achievement, confidence, and active participation in interactive online learning as well as encourage students to learn independently in class, thus forming a network education mode of "student demonstration, teacher guidance." The teaching mode can not only improve the interest of teaching but also solve the problem of teachers explaining too much and poor audio and video demonstration effects.

5.2 Develop a systematic online teaching plan

The online learning mode uses an intelligent teaching terminal in classrooms, allowing teachers and students to be immersed in a virtual teaching environment. Teachers should recognize that the students' experience in the online classroom is completely different from that in a traditional classroom. Currently, the problems in online teaching are that teachers cannot adapt to online teaching well nor guide students effectively; this is because teachers lack a scientific and systematic teaching plan. To carry out online education smoothly and efficiently, teachers should break away from the traditional offline teaching and thinking mode and organize a set of scientific online teaching plans based on the characteristics of online learning. Specific teaching objectives and tasks should be formulated according to the online education system of the school, specific teaching requirements of online courses, and specific characteristics of the course content. The specific online teaching process includes teachers' lectures, case introductions, monitoring interactions with classmates, grading of students, homework assignments, completion of each teaching

task, and so on. Based on these, teachers should have a certain understanding of each teaching task so as to avoid improper operation and detachment from teaching. The Teaching Affairs Office, Supervision Office, and Supervision and Evaluation Office should ensure that teachers strictly abide by the teaching plan and not teach arbitrarily, due to separation from management, so as to ensure the standardization of teaching.

5.3 Support the online teaching platform

The teaching level of teachers directly affects the efficiency of online teaching platforms using the interactive learning method. Regardless of whether teaching is conducted online or offline, regular training should be provided to improve the skills of teachers. They should be guided on how to record and upload learning resources and become proficient in operating online teaching platforms. Through systematic training, teachers can clarify the key points of teaching, improve the overall teaching quality, and ensure the effective use of learning resources for students with a lively teaching process.

The technical department of the school should improve the overall level of their hardware, strengthen the construction of network security, and provide basic equipment support for the operation of the platform. Based on its own educational philosophy and development strategy, the school must also promote the application scope of the online teaching platform using the interactive learning method. The school can use online courses as a pilot to gradually spread the application to all subjects. The online teaching platform using the interactive learning method is constructed to make up for the shortcomings of the traditional teaching mode. Students' learning is not restricted by time and space, and students' enthusiasm for independent learning will be stimulated to promote the reform of the in-school teaching mode.

6 CONCLUSION

The advent of the information age has changed the traditional way of communication between teachers and students, and the teaching mode is quietly changing as well. Teachers no longer have to achieve teaching goals only by explaining knowledge but also through various learning methods and means. Students no longer focus only on learning knowledge and skills as they did in the past but treat the learning process as an experiential process. This study puts forward the impact of online teaching using the interactive learning method for the utilization of learning resources and draws the following conclusions:

(1) The proposed method can effectively save students' learning time, improve learning efficiency, and increase students' utilization of the proposed method.

(2) After the application of this method, students' interest in online teaching using the interactive learning method is improved. The proportion of students who are not interested in online teaching using interactive learning methods is reduced to 0%. After the application of this platform, students' interest in online teaching using the interactive learning method can be effectively improved.

(3) The average scores of the experimental group are all higher than 85 points. The application of the proposed method to the group is conducive to improving the learning outcome of students and improving their academic performance.

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