



Research on Collaborative Learning Behavior Recognition of Online Education Platform Based on Data Mining

Zhi Zhang^(✉)

Technique Center of Modern Education, Jiangxi Science and Technology Normal University,
Nanchang 330013, China
lky02560@tom.com

Abstract. The time sequence information of traditional online education platform collaborative learning behavior recognition method is not comprehensive, resulting in low recognition rate. Therefore, a collaborative learning behavior recognition method of online education platform based on data mining is designed. Monitor the learning behavior through the progress management function, identify the educational characteristics of learners, obtain the timing information of the online education platform, and feed back the information to teachers and students in a visual way, optimize the interactive links of collaborative learning, meet the personalized requirements of learners, investigate the basic database of student scores by using rough set theory, and mine data from the database. In order to identify the collaborative learning behavior of online education platform. Experimental results: the average recognition rates of the online education platform collaborative learning behavior recognition method and the other two recognition methods are 68.142%, 56.310% and 57.988%, which proves that the online education platform collaborative learning behavior recognition method integrated with data mining technology is more reliable.

Keywords: Online education platform · Collaborative learning · Learning motivation · Behavior identification · Learning activities · Interactive links

1 Introduction

With the rapid development of my country's economy and society and the continuous advancement of science and technology, mobile phones, tablet computers and various interactive information tools are gradually changing our production and life styles, and people continue to pursue more information and convenient lifestyles. In the traditional sense, teaching evaluation is an activity that analyzes and evaluates teaching results and teaching process and provides a scientific basis for teaching decision-making. It is a process of evaluating and judging the practical significance of teaching activities. The cumbersome manual teaching, limited teaching time and mechanical teaching methods that exist in traditional teaching are no longer suitable for current needs, and the demand

for information and intelligence in the education field is particularly prominent [1, 2]. Classroom teaching is the main part of school education. Paying attention to students' learning behaviors, communication speech, and learning emotions in classroom situations are issues that cannot be ignored in the process of educational development. With the continuous development of computer vision technology, many companies and teams are combining the "Internet+" way of thinking with big data, cloud computing and other information technologies to intelligently design the teaching methods of teachers and the learning methods of students, Improve the quality of the teaching environment and enhance the effect of classroom teaching. On the one hand, classroom learning behavior research can categorize students' learning behaviors in detail, and through in-depth analysis of various influencing factors of student behaviors, the teaching evaluation can be implemented on objective data. To acquire and analyze student behavior, firstly, it is necessary to use image processing technology to process the video content shot by the classroom surveillance camera, and to detect and recognize the students in the video screen. On the other hand, by collecting the behavior data of students in the classroom, analyzing the learning behavior data of students, forming an evaluation of the students' learning state, forming effective teaching effects are reflected in the data, which is conducive to improving the learning efficiency. The purpose of automatic teaching is realized through face recognition, so as to reduce the time teachers spend on classroom management, increase the teaching and learning time of teachers and students, and help the school to manage students. How to use the current computer vision technology and the related measurement methods of the teaching process to combine, how to measure the learning behavior of students in the classroom, etc., these are the difficulties faced by the current teaching detection work. The research on these issues evaluates the current teaching process The development of it is of great significance. Zhang et al. took CNKI and WOS as data sources and obtained 37 representative literatures highly related to research topics in recent 5 years at home and abroad through key word retrieval, retrospective retrieval and data cleaning. Integration of the information ecology theory and empirical analysis process form the research framework, from information, information, information technology and information environment such as dimension to explore the influence factors of online education platform collaborative learning behavior from aware of interest, interactive driving factors, content, learning orientation known variables identify online education platform collaborative learning behavior. Although the efficiency of this method is very high, the problem of incomplete timing information is not deeply studied, which leads to the decline of recognition rate. Wu et al. coded micro "click stream" and mesoscopic "activity stream" data based on 3D design software, defined verbs and objects suitable for 3D design platform, and obtained the whole-process behavior data of learners in 3D design platform. On this basis, according to the STEAM 3D education learner behavior analysis model, the data of the learning process of the 3D design course of small sample teaching practice are analyzed to complete the cooperative learning behavior. This method has the characteristics of better recognition efficiency, but it lacks the detailed description of time sequence information in the research process. The recognition rate of cooperative learning behavior decreased.

Student behavior recognition is to analyze the head posture and facial expressions of students in the classroom based on the face recognition of the students, to judge

whether the students in the classroom are listening carefully, and to record the student's head-up state, so as to minimize human intervention. Classroom is the core of school education, the evaluation of classroom teaching process is of great significance to the improvement of teaching quality, and the performance of students' learning behavior is an important part of classroom teaching evaluation. In this way, it can help teachers adjust and change their teaching styles in time to achieve more efficient teaching. At the same time, it can also mobilize students' learning enthusiasm and improve learning efficiency. By evaluating the learning behavior of students, forming effective feedback information and teaching orientation can effectively promote classroom teaching and student development. At present, the research materials on the combination of data mining and online education platform collaborative learning behavior recognition are not very rich, and they need to be continuously improved. The time sequence information of the traditional collaborative learning behavior recognition method of online education platform is not comprehensive, resulting in a low recognition rate. This paper aims to solve various problems existing in the traditional method, monitor the learning behavior through the progress management function, identify the educational characteristics of learners, and obtain the time sequence information of online education platform. The collaborative learning behavior of online education platform is identified based on the results of student score data mining.

2 Research on Collaborative Learning Behavior Recognition of Online Education Platform Based on Data Mining

2.1 Identify the Educational Characteristics of Learners

In the online education platform, learners perceive and recognize the educational availability of the platform and realize what specific learning behaviors they can complete by using these technical tools, such as planning their own learning goals through the learning task management function. General characteristics mainly refer to the psychological, physiological and social characteristics of learners, which are inherent in their peers and easy to be understood by teachers. Obtain the courses you want to learn through the platform search engine, and monitor the learning behavior through the progress management function. The main purpose of understanding learners' initial ability is to understand what knowledge and skills learners have before learning new subject content, students' ability to master information technology and their learning attitude towards the learning content. Through the online test module, you can evaluate your learning achievements, summarize and reflect through the online log, and share learning resources with other learners and teachers. The characteristics of learners are analyzed mainly from four aspects: general characteristics, starting ability analysis, learning style and learning motivation, as shown in Fig. 1.

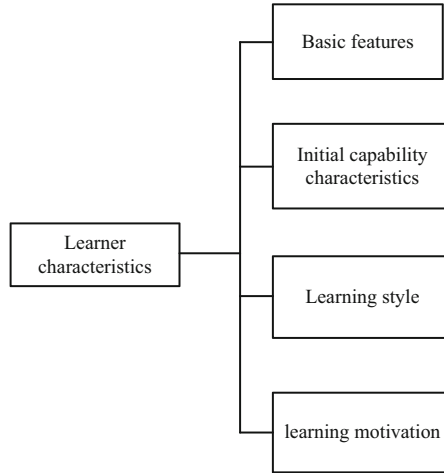


Fig. 1. Schematic diagram of learner characteristics

As can be seen from Fig. 1, learning style mainly refers to the learning style and learning tendency with personality characteristics shown by learners, such as field dependent and field independent style, concrete and abstract style, etc. When learners perceive that they are part of the group and that they are in a community, they will be more willing to actively participate in group and group activities. Mastering learners' learning is helpful to teachers' teaching. Learning motivation refers to the driving force of learners' learning activities, that is, learning motivation. Motivation plays an extremely important role in people's behavior and activities. Mastering learners' learning motivation can make use of students' learning. The existence of social availability makes learners realize that technology gives them the ability to communicate with other learners and teachers, which makes learners have a sense of community and belonging, so as to promote their communication with others and jointly complete curriculum learning and thinking. Learning task design is the focus and core of the whole collaborative learning, which can make learners clear their goals and solve problems. It is important that learners can actively participate in the process of collaborative learning, so as to cultivate learners' ability to apply theoretical knowledge with practical application and solve problems [3]. Learners and other learners form a learning group to help each other, complete the task together, and share learning experience and experience with each other. The design of tasks should be suitable for the characteristics of learners, preferably within the scope of learners' proximity to the development area, otherwise it is easy to attack learners' learning enthusiasm. Learners communicate with teachers. For difficult problems, teachers answer questions for learners. Learners interact with the content, summarize and reflect on the learned content, so as to realize the re creation of knowledge. The completion of the task depends on the network and adopts a cooperative way. At the same time, it also has the opportunity of autonomous learning. The design of learning tasks should be close to learners' life and have a certain real situation, so as to stimulate learners' learning motivation. The results of learning tasks should be easy to generate and submit.

2.2 Obtain Timing Information of Online Education Platform

The design of learning activities and resources is designed and formulated by teachers (or teaching designers) based on the comprehensive analysis of learning content, learning environment and learners' characteristics. It is not only the most important part of collaborative learning, but also the guarantee for the smooth development of collaborative learning. The reasoning of time dimension information is an important means for artificial intelligence to complete the task of behavior recognition. It is a method to connect the target or object logically and sequentially according to the passage of time. In the collaborative learning environment, the original intention of learning activities and resources design is to help students maintain learning progress and enable students to actively participate in the learning process, so as to create a collaborative learning environment and atmosphere. Time series reasoning can enable intelligent species to infer what may happen in the future or strengthen the relationship between things before and after time according to the past and current situation. We solve this problem by using different minimum support and minimum confidence for different classes. We only need the user to specify a total minimum support, and then distribute it to each class according to the class distribution data as follows:

$$l = \frac{\alpha(h)^2}{|h|} - 1 \quad (1)$$

In formula (1), α represents the number of instances in the training data, and h represents the minimum support. Therefore, the design of learning activities and resources must first have a clear purpose. The purpose of this part of the design is to make students' learning closely related to their learning goals, improve students' participation in curriculum learning, and closely link the entire process with learning evaluation to obtain timely feedback. In remote visual surveillance, people can easily distinguish the sequence of two sequence static images at a given time and infer the actions between the contents displayed by the two static images. The design of learning activities and resources in this research is divided into online learning part and classroom learning part in terms of presentation form. Time reasoning is extremely important in behavior recognition, and it provides a lot of help for inference of behavior categories. The online learning part needs to complete the learning of the core content of the course, so it is necessary to strictly plan the learning progress and the distribution of learning resources. Correctly distinguishing the time series is very helpful for behavior recognition. The behavior recognition in the video is the main point that we need to study and explore. Offline classroom learning mainly completes the work of answering questions, discussing, and evaluating. Each part is an important part of learning activities, and there is no distinction between importance and importance. The completion of each part requires the active cooperation of teachers and students. The learning behaviors of students in online courses will be recorded in detail in the learning log database, and visually fed back to teachers and students. It can also compare the learning progress of each student with the current learning progress and supervise students who are lower than the current learning progress, so as to effectively monitor the student's learning.

2.3 Optimize the Interactive Links of Collaborative Learning

Learning objectives are the goal orientation of collaborative learning. Designing appropriate learning objectives can ensure that learners are not “lively” on the surface, but substantive cooperation in learning. The behavioral level of collaborative learning culture mainly refers to students’ learning behavior, which is embodied in the operation of curriculum platform, the arrangement of e-learning time, the use of curriculum forum, online testing and assessment, the participation of offline learning activities, the discussion of classroom learning activities, learning partners, seeking help, etc. The main problems are the low utilization rate of curriculum forum, insufficient participation in classroom learning and discussion activities, lack of learning partners and inability to seek help in time. Therefore, in practice, the following three objectives can be achieved by integrating bloom and Gagne’s classification of learning objectives and combining the specific subject content. Knowledge and skill objectives: what knowledge points or theoretical frameworks learners can apply, what new knowledge they can discover or what new skills they can develop. In addition, there are differences between boys and girls in these aspects, that is, the main deficiency is the lack of human-computer interaction and face-to-face interaction. Method strategy goal: learners can develop strategies for problem solving, learning, cooperation and communication. Attitude experience goal: what kind of attitude and emotional experience learners get through collaborative learning. Some scholars have shown that there is a positive correlation between learners’ learning performance and the degree of social interaction in the context of online open courses. The main process of collaborative learning interaction is shown in Fig. 2:

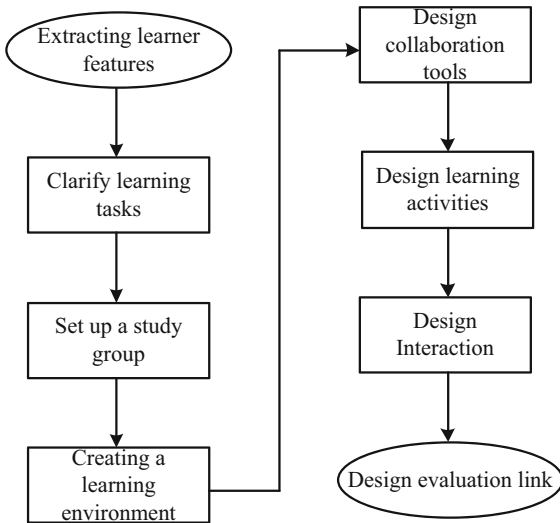


Fig. 2. The main flow chart of the interactive part of collaborative learning

It can be seen from Fig. 2 that learners perceive and recognize the social availability of the platform and realize what social activities they can accomplish with these

technical tools, such as communicating with other learners and teachers through synchronous and asynchronous social tools communicate. Learning resources refer to all relevant elements that learners can use in the learning process, including people, money, materials, and information that can support learning. The socialized learning behavior of high-performing learners goes beyond simple knowledge sharing and interpersonal communication, and there is a deeper level of knowledge interaction and interpersonal communication. Therefore, the key to the construction of collaborative learning cultural behavior level is to strengthen the degree of human-computer interaction and face-to-face interaction of student learning under collaborative learning conditions. The learning resources referred to in this article mainly refer to teachers, peers, teaching materials, network resources, etc. In collaborative learning, the design of these learning resources is not only restricted by the characteristics of learners, learning tasks, and platform conditions, but also learning resources are designed for collaborative learning activities, not for individual learners. On the one hand, it must be restricted from the system level; on the other hand, the human factor must be brought into play. Under the guidance of the concept of “teacher-led-student main body”, the strength of both teachers and students should be brought into play. Therefore, the resource design of learning resources should follow the following principles: it is closely related to collaborative learning activities, and learning resources provide support for collaborative learning. Therefore, the higher the correlation, the greater the help for collaborative learning. Secondly, the collaborative learning environment is complex and changeable, and requires the cooperation of a variety of learning behaviors to complete. Therefore, students should adapt to the open learning environment as soon as possible while also helping students develop good learning habits. The design of resources should be diversified, preferably with pictures, texts and sounds, which can support the development of collaborative learning activities from different angles, meet the individual requirements of learners, and facilitate the retrieval and search of resources. Emphasizes that learner-centered, whether the design and selection of resources are reasonable, the key depends on whether these resources can help learners discover, explore, and solve problems in collaborative learning, actively participate in collaborative activities, and can construct the meaning of knowledge.

2.4 Behavior Recognition Based on Data Mining

Data mining is a process of extracting hidden, unknown but potentially useful information and knowledge from a large number of incomplete, noisy, fuzzy and random data, which is called data mining [4–6]. The performance of students’ learning behavior includes two aspects: one is the status of learning behavior, mainly including the overall atmosphere of competition, debate, cooperation, problem solving, partners, design and role play, discussion, the overall status of listening input and the overall atmosphere of the classroom; The other is the status of non learning behavior, including games, reading novels, arguing, etc. In recent years, the use of statistical technology to calculate students’ scores and data mining technology have been gradually changed to data mining technology [7]. Rough set theory is used to investigate the basic database of students’ scores, extract classification rules, and understand the factors affecting students’ scores [8]. The difficult problem is to solve the problem of weight, including negative weight and positive weight. After a large number of experiments, it is found that it is ideal to

combine the two. The positive weight formula is as follows:

$$p_{\eta} = \frac{g}{\eta} \times T \quad (2)$$

In formula (2), g represents the set of positive items covering the data instance, η represents the set of negative items covering the data instance, and T represents the confidence of the original positive rule. In traditional classroom teaching, teachers can form an effective evaluation of students to a certain extent by observing students' learning behaviors and homework completion. However, it is difficult to form a comprehensive and systematic evaluation system of students' learning behaviors by teachers alone. Classification rules usually include usual grades, classroom efficiency, and after-school study time, etc. These main factors affect the overall score. When there are multiple data with the same score, use the following priority formula to calculate:

$$y = \frac{\sum (\lambda - G)^2}{|Q| + |G|} \quad (3)$$

In formula (3), λ represents the discretization coefficient, G represents the overall score function, and Q represents the allocation index. In the collaborative learning environment under the teaching platform, learners' learning and application of relevant knowledge and the cultivation of learners' comprehensive ability are the core of collaborative learning, so more attention should be paid to problem solving and design learning task design. If a module that can automatically record students' learning behavior can be built in the platform, the problem of incomplete and objective recording of student behavior can be solved. If it is the analysis mode of the classroom question and answer process, it is necessary to extract the event data of raising hands, sitting down, and standing up, and classify each piece of data according to the location field and the time field. By recording students' learning behavior information, more meaningful results can be further dig out, which is of great significance to help teaching staff improve the teaching process. Among them, according to the classification of the time field, it is necessary to extract the time of each question and the time from standing to sitting down which is the closest to the time of the question. This time period is used as the period of each question [9, 10]. Form a study group with other learners in the online community, and help each other to complete a certain task together. The task of design should be open, and the standard of exploration results cannot be "correct" or "incorrect". The problem-solving process is not just to expect learners to master basic theoretical knowledge. If it is the classroom activity analysis mode, it is necessary to extract the event data of bowing and lying on the table, and classify each piece of data according to the location field. Then the classified results are sent to the subroutine of each person's activity analysis and the overall situation analysis of the classroom. Learners complete the in-depth understanding of knowledge, the mastery of learning methods and the improvement of thinking through interactive teaching.

3 Experimental Research

3.1 Set up the Experimental Environment

This experiment is based on PC, Kinect2.0 somatosensory device, Hikvision PTZ camera, student behavior measurement in a small classroom scene. The database used in this article is My Sql, which is realized by the relevant functions integrated with Python. The database is mainly used to save the student’s identity information and head posture information for storage, so as to be able to view the heads of different students in the entire visual process. Frequency information of bowing. Since each Kinect can only identify 6 human skeleton information, if multiple Kinects can be added, it is also suitable for large classroom scenes, but the cost is relatively high. The original data collected in the experiment is processed and identified by the PC and then transmitted and stored in the server database. The parameters selected in this experiment are consistent, ensuring the authenticity and reliability of the experimental results.

3.2 Analysis of Experimental Results

The experiment selects the PCA-based online education platform collaborative learning behavior recognition method and the SVM-based online education platform collaborative learning behavior recognition method, and compares the experiments with the online education platform collaborative learning behavior recognition method in the article. The recognition rates of the three online education platform collaborative learning behavior recognition methods under different minimum support conditions were tested respectively. The experimental results are shown in Table 1, 2, 3 and 4:

Table 1. Minimum support 20 recognition rate (%)

Number of experiments	PCA-based online education platform collaborative learning behavior recognition method	SVM-based online education platform collaborative learning behavior recognition method	Online education platform collaborative learning behavior recognition method in the article
10	85.647	86.487	96.118
20	88.261	83.614	98.515
30	84.632	82.520	97.662
40	85.799	86.144	98.667
50	84.155	85.219	97.335
60	86.332	83.117	94.582
70	85.166	82.505	93.707
80	85.616	82.119	96.825

(continued)

Table 1. (continued)

Number of experiments	PCA-based online education platform collaborative learning behavior recognition method	SVM-based online education platform collaborative learning behavior recognition method	Online education platform collaborative learning behavior recognition method in the article
90	84.213	83.006	98.366
100	83.641	82.519	95.884

Table 2. Minimum support 30 recognition rate (%)

Number of experiments	PCA-based online education platform collaborative learning behavior recognition method	SVM-based online education platform collaborative learning behavior recognition method	Online education platform collaborative learning behavior recognition method in the article
10	65.948	64.588	73.644
20	66.717	66.327	72.505
30	65.311	69.522	73.164
40	69.518	67.346	75.648
50	64.315	68.512	71.098
60	63.228	68.912	73.005
70	64.187	69.577	73.469
80	66.332	66.344	74.156
90	67.558	68.203	75.606
100	62.313	69.457	73.987

According to Table 1, the average recognition rate of the online education platform collaborative learning behavior recognition method and the other two recognition methods are: 96.766%, 85.346%, 83.725%; According to Table 2, the online education platform collaborative learning behavior in the article Recognition method, and the average recognition rate of the other two recognition methods: 73.628%, 65.543%, 67.879%; according to Table 3, we can see that the online education platform collaborative learning behavior recognition method in the article, and the other two recognition methods are the average recognition rate They are: 57.220%, 45.434%, 45.401%; according to Table 4, we can see that the online education platform collaborative learning behavior recognition method in the article has an average recognition rate of 44.953%, 28.092%, and 34.946% with the other two recognition methods. The performance of collaborative learning behavior recognition method of online education platform is better.

Table 3. Minimum support 40 recognition rate (%)

Number of experiments	PCA-based online education platform collaborative learning behavior recognition method	SVM-based online education platform collaborative learning behavior recognition method	Online education platform collaborative learning behavior recognition method in the article
10	45.321	44.618	56.314
20	44.602	43.205	56.847
30	43.873	44.887	57.265
40	46.188	43.625	58.316
50	45.121	45.986	55.124
60	46.908	44.221	56.928
70	45.877	45.606	57.335
80	44.330	46.187	58.209
90	46.312	47.552	59.471
100	45.807	48.121	56.387

Table 4. Minimum support 50 recognition rate (%)

Number of experiments	PCA-based online education platform collaborative learning behavior recognition method	SVM-based online education platform collaborative learning behavior recognition method	Online education platform collaborative learning behavior recognition method in the article
10	26.847	32.647	42.659
20	29.145	37.558	41.577
30	28.335	36.124	40.336
40	29.647	35.874	46.578
50	31.215	36.215	44.315
60	30.008	35.184	45.697
70	24.367	34.515	47.502
80	26.588	33.609	48.223
90	27.854	34.518	45.718
100	26.914	33.215	46.922

4 Conclusion

The time sequence information of the traditional online education platform collaborative learning behavior recognition method is not comprehensive, resulting in a low recognition rate. This paper takes solving a variety of problems existing in the traditional methods as the research goal, monitors the learning behavior through the progress management function, identifies the educational characteristics of learners, obtains the time sequence information of the online education platform, and identifies the online education platform collaborative learning behavior in combination with the student score data mining results. In the future, under the guidance of the theories of collaborative learning and data mining, it is necessary to analyze the possibility and advantages of the combination of online education platform and collaborative learning, design collaborative learning teaching design, which consists of learner feature analysis, learning task design and other links, so as to design a targeted learning plan, ensure the diversification of students' learning modes, and promote the further development of modern education modes.

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