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Economic Management Teaching Mode Based on Mobile Learning and Collaborative Learning

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ABSTRACT The continuous development of the IOT technology is rapidly penetrating into all walks of life, which promotes the mobile Internet into a new service system, and mobile teaching methods with the characteristics of flexibility and interactivity are also becoming popular. This kind of learning mode enables students to get rid of the limitation of time and space, and can carry out targeted learning, so that different types of students can reasonably arrange their learning objectives according to their own learning quality. For students majoring in economic management, more and more enterprises require them to have practical ability and cooperation ability. Therefore, it is necessary to focus on cultivating students' cooperation ability and theoretical practice ability in education and teaching. The traditional teaching mode does not meet the needs of the times. It is necessary to study the economic management teaching mode in the new era of Internet of things to promote the reform of education industry. Therefore, it is of great significance to study the economic management teaching mode based on mobile learning and collaborative learning. This paper first introduces the principle and technical support of the IOT, analyzes the reform of economic management teaching mode under the environment of the IOT and the experimental teaching process using the IOT technology and virtual technology. This paper analyzes the current situation of experimental education and the characteristics of the teaching mode based on mobile learning and collaborative learning through the method of literature research, and uses the method of questionnaire survey to investigate the students in the experimental teaching center of economic management in Colleges and universities. The survey results show that in the IOT environment, the experimental teaching mode based on mobile learning and collaborative learning can effectively mobilize students' learning enthusiasm, and can improve students' theoretical and practical ability, cooperative ability and autonomous learning ability to a certain extent.

INDEX TERMS IOT technology, mobile learning, collaborative learning, economic management, teaching mode.

I. INTRODUCTION

Digital, intelligent and networking have become the primary development direction of social development [1]. The IOT is rapidly changing people's lives, especially it promotes the mobile Internet into a new service system, and the mobile teaching method with the characteristics of flexibility and interactivity is gradually popular [2]. At present, the development of microprocessor technology is becoming more and more mature. Students can learn anytime and anywhere through mobile devices [3]. This learning mode enables students to get rid of the limitations of time and space, and can learn targeted. The continuous development of the IOT technology has brought new changes to the teaching mode, including the presentation of the classroom, teaching methods and the interaction between teachers and students [4]. For economic management students, due to the rapid update of economic management information and the requirements of enterprises for practical ability and cooperation ability, students need to master new knowledge in time and exercise their theoretical and practical and team cooperation ability. However, the traditional teaching method of economic management can not meet the needs of students. All of these require us to cultivate students' practical ability and cooperation ability in education and teaching, so as to cultivate economic and management talents who can meet

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the needs of the society. In the environment of the IOT, it is of great significance to study the economic management teaching mode based on mobile learning and collaborative learning [5].

For the IOT technology and the teaching mode of mobile learning and collaborative learning, many foreign scholars have studied it. The computer system research laboratory of Binghamton University has done a lot of work in the application layer design of mobile ad hoc network protocol and sensor network system [6]. Professor Slavin has carried out research on cooperative learning among students in the United States, Canada and other countries [7]. Ultra-lab has designed and developed WAP education sites that can meet the needs of mobile learning for youth learning groups [8]. Pasowu proposed that in the process of education implementation, colleges and universities should pay attention to the cultivation of personalized talents, cultivate students' autonomous learning ability and innovative thinking ideas [9]. Zucker and others put forward the research framework of mobile learning campus to promote the development of mobile learning in schools, communities and countries at all levels [10], [11].

On the domestic, Wang Yang studied the development of mobile learning resources based on mobile client [12]. Deng Zhaohong mainly studies computer intelligence. In his research, he described the application of the IOT, a fusion product, in various fields, especially in the education industry [13]. He pointed out that the application of the IOT in the field of education must bring new reform in Education [14]. Wang Tan believes that the collaborative learning teaching system enables different students to help each other in the process of participating in group cooperation and jointly complete the learning tasks issued by teachers, and teachers can give appropriate rewards and affirmation according to the completion of the Group [15]. Huazhong University of science and technology has created an online virtual experiment system for engineering testing [16]. Students can learn and exchange online testing technology and fault diagnosis technology through the system, and conduct virtual simulation experiment operation with networked computer terminals [17], [18]. Gao Likun and Zhao Hong think that it is important for instructional designers of mobile learning to carry out teaching activities [19].

On the basis of existing scholars' research, this paper first analyzes the characteristics of IOT technology and key technology algorithm, and then analyzes the reform of economic management teaching mode under the environment of IOT, as well as the experimental teaching process using IOT technology and virtual technology. On this basis, this paper studies the economic management experimental teaching mode based on mobile learning and collaborative learning, and investigates the students of economic management experimental teaching center through questionnaire survey, and studies the teaching effect of economic management experimental teaching mode based on mobile and cooperative learning in the environment of IOT.

II. RESEARCH ON ECONOMIC MANAGEMENT TEACHING MODE UNDER THE ENVIRONMENT OF IOT

A. PRINCIPLES AND CHARACTERISTICS OF IOT

1) PRINCIPLES OF IOT

The IOT is based on the Internet, using sensors, RFID radio frequency technology and communication technology to achieve automatic product identification and information sharing, forming a wide range of networks [20], [21]. The topology of IOT application is shown in Figure 1.
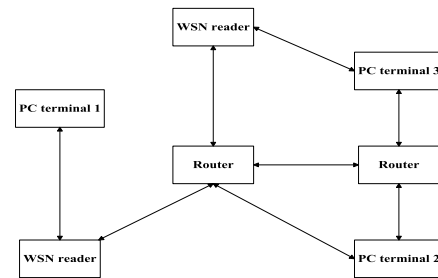

FIGURE 1. Application topology of IOT.

2) CHARACTERISTICS OF IOT

1) Comprehensive perception: there are many types of sensors on the IOT, and each sensor can be said to be an information source, which can capture information of different contents and formats [22]. The IOT through active, passive and other different transmission methods to collect the object data information classification management and analysis, and then accurately transmitted to the data processing system, so as to achieve the IOT era of interconnection [23]. No matter where you are, at any time, you can communicate smoothly.

2) Reliable transmission: use radio frequency identification, sensors, locators and other means to collect and obtain information from objects at any time and place [24], [7]. Sensing includes sensor information collection, collaborative processing, intelligent networking, and even information services to achieve the purpose of control and command. There are clear requirements for security, real-time and resource sharing.

3) Intelligent processing: there are a large number of sensors in the IOT, which collect information according to a certain period frequency, use cloud computing, fuzzy recognition and other intelligent computing technologies to analyze and process the massive data and information and update the database, so as to enhance the insight into the physical world [25], economic and social activities and changes, and realize intelligent decision-making and control.

B. KEY TECHNOLOGIES AND ALGORITHMS OF IOT

1) INTELLIGENT SENSOR TECHNOLOGY

Sensors are produced by data and materialization of information that people cannot clearly perceive, such as temperature, velocity, acceleration of gravity, electromagnetic radiation, PM2.5 value, etc. Sensors can be regarded as the extension of human senses. In the unknown fields and places where human

beings are not suitable to explore, sensors will be an important existence of machines, which plays a role in connecting the outside world and the processor in automatic control [26]. The sensor collects the external input through the sensitive element, converts the signal into another electrical signal which is easy to be identified, recorded and analyzed through the conversion element and conversion circuit, and then processes the signal through various processors [27]. Its working principle is shown in Figure 2.
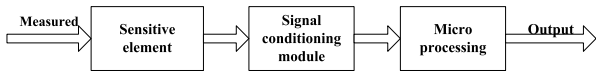

FIGURE 2. Principle block diagram of intelligent sensor.

2) ADAPTIVE FILTERING ALGORITHM BASED ON LMS

Intelligent sensor is to process the signal and extract useful information through the application of software and hardware integrated technology [6]. Modern filters regard the signal and noise as random signals, and their main function is to estimate some characteristics of the signal or the signal itself from the noisy data [28]. Generally, linear phase filter is selected to ensure that the components of different frequencies in the signal fall into the filter passing band [29].The LMS based adaptive filtering algorithm consists of two processes, namely filtering process and adaptive process. For a noisy observation signal, it can be expressed as follows:

$$x(n) = s(n) = v(n) \tag{1}$$

where $x(n)$ is the observed value with noise, $s(n)$ is the true value of the signal, and $v(n)$ is the value of the noise signal.

The output signals of the adaptive filter are as follows:

$$y(n) = \sum_{i=0}^{N-1} w_i(n)x(n-i) \tag{2}$$

The objective function MSE is expressed as:

$$F(e(n)) = \xi(n) = E(e^2(n)) = E(d^2(n) - 2d(n)y(n) + y^2(n)) \tag{3}$$

The input signal is filtered to get the output signal:

$$y(n) = \sum_{i=0}^{N-1} w_i(n)x(n-i) = \mathrm{w}^T(n)x(n) \tag{4}$$

where $x(n) = [x(n), x(n-1), \ldots, x(n-N+1)]^T$, $w(n) = [w_0(n), w_1(n), \ldots, w_{N-1}(n)]^T$, For a fixed filter, Let $Q = E[d(n)x(n)]$ be the cross-correlation vector between the input signal and the desired signal, and $F = E[x(n)x^T(n)]$ is the auto-correlation matrix of the input signal.Then the objective function can be simplified as follows:

$$E(e^2(n)) = \xi(n) = E[d^2(n)] - 2w^T Q + w^T F w \tag{5}$$

The gradient vector of vector w is obtained as follows:

$$g_w = \frac{\partial \xi}{\partial w} = \left[\frac{\partial \xi}{\partial w_0} \frac{\partial \xi}{\partial w_1} \ldots \frac{\partial \xi}{\partial w_{N-1}} \right] = -2Q + 2Fw \tag{6}$$

Given the value of vector Q and matrix F, let $g_w = 0$ obtain the vector:

$$w = F^{-1}Q \tag{7}$$

3) RFID RADIO FREQUENCY TECHNOLOGY

Radio frequency identification (RFID) technology is a technology that uses radio frequency signal to realize no contact information transmission through spatial coupling, and achieves the purpose of identification through the information transmitted [30]. It has the characteristics of fast scanning, small size, diversified shape, ability and durability, reusable, penetrating and barrier free reading, large capacity of data memory, high security and confidentiality. The main advantage of RFID system is no contact identification and fast reading speed, which can be used for interactive business such as process tracking [31].

4) EMBEDDED SYSTEM TECHNOLOGY

Embedded system also includes hardware and software. After decades of continuous evolution and development, intelligent terminal products characterized by embedded system can be seen everywhere in people's daily life, such as MP3, mobile phone and so on. These portable terminal products provide great convenience for people's daily life.

C. VIRTUAL REALITY TECHNOLOGY

With the development of information technology, people can control computer instructions through the computer screen mouse and keyboard [32]. But with the development of virtual reality technology, the experimenter can use virtual reality equipment to carry out human-computer interaction more conveniently and quickly [33]. Through the virtual technology to simulate the interaction between human and real experimental environment, can greatly enhance the sense of reality in the experimental process, more integrated into the experimental environment, fully understand the various experimental links. It solves the problem that it is difficult for the experimenter to intervene in the experimental process in time before the computer simulation experiment stage, and provides great convenience for the experimental teaching in the future. The framework of virtual reality system is shown in Figure 3.
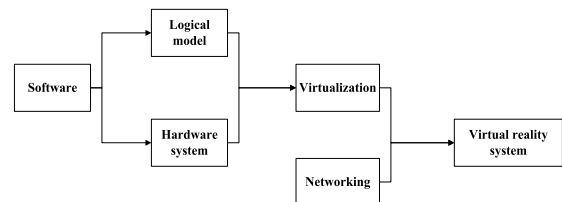

FIGURE 3. Virtual reality system framework.

D. REFORM OF ECONOMIC MANAGEMENT TEACHING MODE UNDER THE ENVIRONMENT OF IOT

The rapid development of the IOT is constantly changing people's daily life, but also promoting the continuous reform

of teaching mode in the education industry [34]. From the traditional blackboard teaching to the popular mobile teaching mode, this portable and interactive mobile teaching method enables students to get rid of the limitation of time and space, and can choose targeted teaching resources and platforms according to their actual situation, so as to improve the learning effect of students. With the continuous maturity of IOT technology and virtual technology, the concept of virtual classroom is gradually rooted in the hearts of the people, which brings great convenience to some classes that need practical teaching [35]. The economic management teaching mode also follows the pace of the times to join the reform.

The traditional teaching mode of economic management focuses on the teaching of theoretical knowledge, but does not fully carry out practical teaching. Students do not get practical training, and the application of theoretical knowledge is not proficient, which leads to similar problems in practical work, and they do not know how to deal with them and lack practical ability. For students majoring in economic management, more and more enterprises require them to have practical ability and cooperation ability. Therefore, it is necessary to focus on cultivating students' cooperation ability and theoretical practice ability in education and teaching. In this regard, we can combine the theoretical knowledge of teaching materials with modern information technology and means, and use modern information technology to provide the most up-to-date economic management information for classroom and teaching experiments [36]. In order to create a specific practice scene for students, the experimental teaching mode implemented by many majors at present has built a simulated small society for students by using IOT technology and virtual technology, created a simulated economic management environment and space, fully trained students' application and innovation of economic management knowledge, so as to improve their comprehensive practical ability [37], [38].

E. EXPERIMENTAL TEACHING MODE OF ECONOMIC MANAGEMENT BASED ON MOBILE LEARNING AND COLLABORATIVE LEARNING

In the virtual classroom created by IOT and virtual technology, teachers first release experimental tasks, and then group students according to their actual learning ability, so that students can complete the experiment through group cooperation, and evaluate the experimental results. Students can access the experimental teaching resources at any time after class through the mobile Internet. If they encounter problems that are difficult to solve in class, they can exchange and discuss with each other through mobile app after class. Those who have good experience can share it. We can learn from each other and cooperate to complete the whole experiment. The framework of the economic management experimental teaching mode based on mobile learning and collaborative learning is shown in Figure 4.
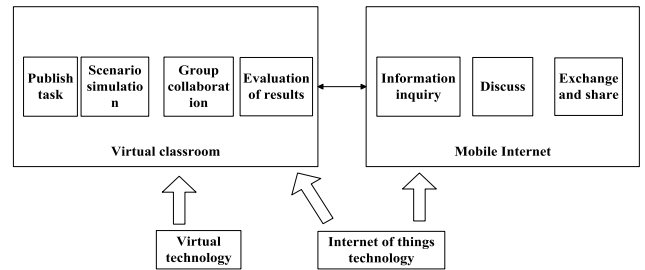

FIGURE 4. Framework of experimental teaching mode of economic management.

F. CHARACTERISTICS OF TEACHING MODE BASED ON MOBILE AND COLLABORATIVE LEARNING

1) COMPREHENSIVE, COLLABORATIVE AND INTERACTIVE

Economic management major is a comprehensive major. The students of this major should not only master the theoretical knowledge of economic management, but also have enough practical ability to solve the problems encountered in practical work. Compared with the theoretical class hours, the current economic management experimental class hours are less, but each experimental link involves a lot of theoretical knowledge points, the experiment can comprehensively investigate the learning effect of students. Economic and management experiments are generally used to solve the problems encountered in the actual operation and management of enterprises, involving many aspects, and the experiments need the assistance of many people [39], [40]. The experimental teaching mode based on mobile learning and collaborative learning can effectively let students carry out teaching experiments.

2) MEET THE NEEDS OF PERSONALIZED LEARNING

Based on the differences in the quality and knowledge understanding ability of each student, the modern education concept tends to emphasize personalized learning. If the same teaching content, method and progress are adopted in the experimental teaching process, the difference of students' comprehensive ability will lead to different learning progress of students in the group. Based on mobile learning, students can choose teaching materials suitable for themselves according to their learning ability and learning characteristics. This learning method is not limited by time and region, and can be carried out anytime and anywhere, which meets the requirements of personalized learning. Through the mobile Internet, we can discuss and communicate with other group members on mobile devices and app, and cooperate to complete the experimental goal. This teaching method can effectively improve students' autonomous learning and cooperation ability.

3) COLLECTIVE SYNERGY

In the learning process based on mobile learning and collaborative learning, the cooperative group has a clear experimental task, and this experimental goal needs the cooperation of members in the group to complete [41]. In the process of

experimental teaching, the team members need to maintain a good cooperative attitude, have the determination to advance and retreat, have good resources to share, encounter problems that one person can not solve, can ask for help from group members, all work together. Some studies have shown that in the context of collaborative learning under the Internet environment, interpersonal relationships often affect the learning effect of collaborative learning, and students in groups with good group atmosphere tend to be more motivated. Therefore, the emphasis on collective synergy is an important feature in the process of mobile and collaborative learning.

4) EMPHASIZE THAT TEACHERS AND STUDENTS ARE EQUAL COOPERATORS

In the teaching process, the interaction between teachers and students in class and after class communication is a very important way to promote learning. Classroom interaction can effectively solve problems in class teaching, teachers can timely understand students' understanding degree, after class interaction can not only promote the friendship between teachers and students, but also consolidate students' knowledge weakness; students can help understand teaching knowledge and improve learning enthusiasm through interaction [42]. In the traditional teaching mode, in addition to the experimental class there will be some interaction, other theoretical class and teacher interaction is not much, this situation is not conducive to the growth of students' learning. After class, very few students ask the teacher for knowledge and explanation. In this teaching method based on mobile and collaborative learning, students can actively ask questions to teachers through the mobile Internet after class, without being affected by the classroom environment and location. Teachers can also directly see the weak points of students' knowledge through online evaluation, which is more convenient for teaching implementation and improve the overall teaching effect.

III. EXPERIMENTAL RESEARCH ON ECONOMIC MANAGEMENT TEACHING MODE BASED ON MOBILE LEARNING AND COLLABORATIVE LEARNING
A. RESEARCH OBJECT
The research object of this survey comes from the students of the economic management experimental teaching center of a university. A total of 220 questionnaires were distributed and 162 valid questionnaires were collected.

B. SURVEY METHODS
(1) Literature method: refer to the relevant research on the education mode based on IOT technology and the relevant literature of economic management teaching mode. On the basis of the existing scholars, this paper first analyzes the characteristics of the IOT technology and key technology algorithms, and then analyzes the reform of economic management teaching mode under the environment of the IOT, and the experimental teaching process using

the IOT technology and virtual technology. On this basis, this paper studies the economic management experimental teaching mode based on mobile learning and collaborative learning.

(2) Questionnaire survey method: a standard questionnaire is set up in advance, and valid questionnaires are distributed to the investigated objects. In this paper, the subjects are students from the experimental teaching center of economic management in a university. Through the statistical analysis of the collected effective questionnaire data, we can understand the real situation or seek opinions from the investigated objects.

C. QUESTIONNAIRE DESIGN
For the students of economic management experimental teaching center, this questionnaire mainly solicits opinions from the following aspects: compared with the traditional teaching mode, the evaluation of classroom atmosphere, group cooperation form and mobile learning mode of experimental teaching mode based on mobile and cooperative learning in the environment of IOT; students' interest in this experimental teaching mode Whether the cooperative ability, autonomous learning ability and theoretical practice ability of students are effectively improved under the economic management experimental teaching mode based on mobile and cooperative learning; whether they are more willing to carry out experimental teaching compared with the traditional theoretical teaching mode.

IV. EXPERIMENTAL RESEARCH AND ANALYSIS OF ECONOMIC MANAGEMENT TEACHING MODE BASED ON MOBILE LEARNING AND COLLABORATIVE LEARNING
162 valid questionnaires were collected in this survey, of which 46% were male, 74 were female, and 88 were female. This paper makes statistical analysis on the evaluation of classroom atmosphere, group cooperation form and mobile learning mode of experimental teaching mode based on mobile and collaborative learning in the environment of IOT by students of economic management experimental teaching center. The data are shown in Table 1.

TABLE 1. Students' evaluation of experimental teaching mode.

	Great	Good	Normal	Bad
Classroom atmosphere	49%	37%	12%	2%
Form of group cooperation	44%	43%	11%	2%
Mobile learning mode	48%	46%	6%	0%

As can be seen from table 1, 49% of the students think that the classroom atmosphere of this teaching mode is very good, 37% of the students think it is good, and only 14% of the students think that the classroom atmosphere effect of this teaching method is generally not good, which shows that most students have a high enthusiasm for the experimental teaching method, can actively participate in the experimental classroom, activate the classroom atmosphere, and cooperate with the group 44% of the students think that the learning

method of group division and cooperation is very good, 43% think it is better, only 13% of the students think it is general and bad, which shows that most students are adapted to this cooperative learning mode and agree with it. From the students' evaluation of mobile learning methods, most of the students hold a positive attitude, and think that this way of communication and learning through mobile Internet software after class is very good, which facilitates the communication between teachers and students.
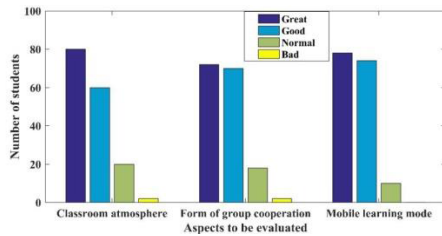

FIGURE 5. Students' evaluation of the experimental teaching mode.

As can be seen from Figure 5, most of the students think that the classroom atmosphere of the experimental teaching mode is very good, and they approve of the learning mode of group cooperation and mutual communication and learning through mobile devices. Only a few students think that this teaching mode is not good. This shows that most of the students of economics and management have a good attitude towards the teaching of mobile and cooperative learning based on the IOT The model can adapt quickly and have a certain enthusiasm for learning [43].

According to the questionnaire collected, the students of different genders are interested in the experimental teaching mode, as shown in Figure 6. It can be seen from Figure 6 that there is no significant difference in the degree of interest of male and female students in the teaching mode, which indicates that there is no single audience phenomenon in this teaching mode. Most of the students are interested in this mobile and collaborative experimental teaching mode A small number of students are not interested in this way of learning. It shows that the experimental teaching mode based on mobile and cooperative learning can attract students' attention and arouse their interest in autonomous learning to a certain extent.
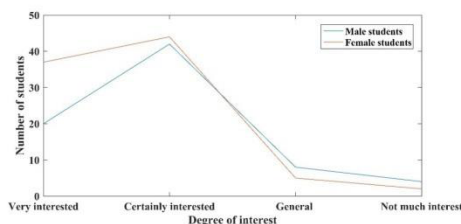

FIGURE 6. Different gender students' interest in experimental teaching mode.

This paper makes a statistical analysis on whether the experimental teaching mode based on mobile and cooperative

TABLE 2. Students' views on whether the experimental teaching mode can effectively improve all aspects of ability.

	Great improvement effect	Certain improvement effect	The effect is not obvious	Almost no effect
Practical ability	46	98	18	0
Cooperation ability	70	82	10	0
Autonomous Learning Ability	57	73	29	3

learning can effectively improve students' practical ability, cooperative ability and autonomous learning ability of students in economic management experimental teaching center. The data are shown in Table 2

As can be seen from table 2, 46 people think that this teaching mode has a great effect on improving their practical ability, 98 students think that it has a certain effect on the improvement of their practical ability, only 18 people think that this experimental teaching mode does not significantly improve their practical ability, which indicates that most students have been integrated into the experimental link and can be truly realized through the scene simulation experiment From the perspective of cooperation ability improvement, 70 people think that the experimental teaching mode based on cooperation and mobile can greatly improve their cooperation ability, 82 people think that it can improve their cooperation ability to a certain extent, only 10 people think that the effect of this teaching mode on the improvement of cooperation ability is not obvious, which indicates that this way of group cooperative learning is right Economic and management students are more suitable, but we should pay attention to the situation of some students. Students who think that there is no effect may not have effectively participated in the experimental teaching. From the perspective of autonomous learning ability, 30 people think that the improvement of autonomous learning ability is not obvious, which shows that the experimental teaching mode based on the IOT environment can cultivate students' autonomous learning ability The effect is not particularly good and needs to be improved.

In order to further analyze the difference of the teaching effect of the experimental teaching mode based on mobile learning and collaborative learning on students of different genders in the IOT environment, the collected questionnaires are statistically analyzed, as shown in Figure 7.
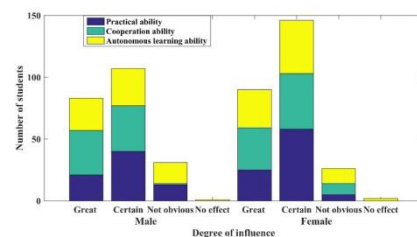

FIGURE 7. Views of male and female students on experimental teaching effect.

It can be seen from Figure 7 that there is no obvious difference between male and female students on the effect of

this teaching mode. Most male students and female students think that this teaching method can improve their theoretical and practical ability, cooperation ability and autonomous learning ability to a certain extent. Only a small number of students think that this teaching method has no effect and has little effect on their own ability The experimental teaching methods based on mobile and cooperative learning can improve the comprehensive ability of students majoring in economics and management to a certain extent, including the combination of theory and practice, and the promotion of students' autonomous learning ability and cooperation ability through mobile learning and group cooperative learning.

The statistical analysis of the data is shown in Figure 8 on whether the students of economic management are more willing to carry out the experimental teaching than the traditional teaching mode.
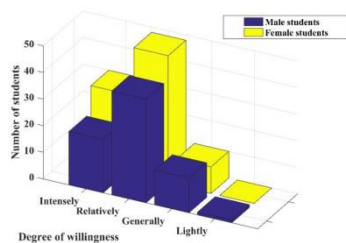

FIGURE 8. Students' willingness to carry out experimental teaching mode.

It can be seen from figure 8 that most of the male students have strong willingness to carry out the experimental teaching mode, and less than one fifth of the male students have no intention to carry out the experimental teaching, and the difference between the male and female students is not very obvious. It shows that, compared with the traditional teaching mode, the experimental teaching is more able to grasp the students' interest and make the students more interested More integrated into the classroom, most of them are more willing to carry out this experimental teaching mode based on mobile and collaborative learning in the IOT environment [44].

V. CONCLUSION

When studying the teaching mode of economic management in the IOT environment, this paper first introduces the principles and characteristics of the IOT, as well as the key technologies of the IOT, sensor technology and related algorithms, radio frequency technology and embedded technology, and analyzes the reform of economic management teaching mode in the environment of IOT. Due to the continuous development of computer technology, the speed of information update in economic management is also accelerating. Enterprises require more and more economic management talents to have the practical ability and team cooperation ability to solve practical problems. The traditional teaching mode of economic management pays too much attention to theoretical teaching and ignores the cultivation of students' practical ability. This teaching mode can no longer meet

the actual needs of the society for economic management talents. This paper puts forward the economic management experimental teaching mode based on mobile learning and collaborative learning. Through the application of Internet of things technology and virtual technology, in order to improve the teaching effect of experimental teaching, and analyzes the characteristics of this experimental teaching mode based on mobile learning and collaborative learning.

In this paper, a questionnaire survey is used to investigate and analyze the students in the experimental teaching center of economic management in Colleges and universities. The survey results show that in the environment of IOT, the experimental teaching mode based on mobile learning and collaborative learning can arouse the interest of most students, mobilize the enthusiasm of students to a certain extent, and create a good classroom atmosphere. Compared with the traditional theory classroom, the combination of mobile learning and collaborative learning can improve students' personalized learning. When they encounter problems, they can communicate with each other after class through mobile Internet, and jointly finish the experimental teaching. Compared with the traditional theory classroom, most students are more willing to carry out experimental teaching, and this teaching method can improve the students' theoretical practice ability, cooperation ability and autonomous learning ability to a certain extent.

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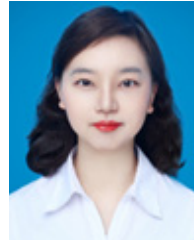
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