
Research on Flipped Classroom Teaching of Communication Principle Experiment on Micro Course and MATLAB

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Abstract: The concept of communication principle course is abstract, complex and systematic. In addition, most students are weak in mathematical foundation, which results in the unsatisfactory effect of experimental teaching. In this paper, MATLAB is introduced into the experiment teaching of communication principle. Students use MATLAB to simulate the theory of communication principle, which to a certain extent increases students' understanding and digestion of communication principle knowledge, and greatly improves students' enthusiasm. At present, students majoring in Computer Science in Wuhan University of science and technology only use MATLAB simulation platform to complete the traditional experiment teaching, which leads to the failure to achieve the purpose of experiment teaching. The rapid development of micro course promotes the innovation of education reform. Flipped classroom reverses the teaching sequence of knowledge transfer and knowledge internalization, which is an innovation of traditional teaching mode. This paper aims at the lack of communication principle experiment box and other hardware experiment environment for computer major students of Wuhan University of science and technology in elective course of communication principle, and they only use MATLAB simulation platform to complete traditional experiment teaching. In the process of teaching reform of communication principle experiment course, this paper makes full use of micro course and MATLAB simulation software, and puts forward the flipped classroom teaching mode of micro course combined with MATLAB communication principle experiment. The teacher combines the theory and experimental content of the experimental course with "PPT + Voice explanation + MATLAB simulation results", and shares them to the students in the form of micro class video before class. From the final effect analysis, this teaching mode effectively enhances students' autonomous ability, cultivates students' interest, and improves students' experimental results.

Keywords: Communication Principle, Micro Course, Flipped Classroom, MATLAB, Experiment

1. Introduction

With the development of cloud computing, big data, network and other concepts, data communication technology has been widely used in various fields and become the main core of modern communication development. Because of the importance of data communication, communication principle has been set up in almost all information majors in Colleges and universities.

In recent years, flipped classroom has been widely concerned by educators. Its basic idea is to turn over the traditional learning process so that learners can complete

independent learning of knowledge points and concepts in extra-curricular time. The classroom has become a place of interaction between teachers and students, which is mainly used to answer questions, report and discuss, so as to achieve better teaching effect.

In recent years, micro class has been highly concerned in schools at all levels, which is a main form of flipped classroom teaching. Micro class is a short teaching process. It is used to teach a certain teaching knowledge point or demonstrate a practical operation skill by means of information technology and streaming media technology under the traditional teaching method. It is used to guide

learners to carry out efficient self-study activities.

At present, many scholars have studied the experiment of communication principle on MATLAB simulation software, wechat platform and flipped classroom teaching mode.

Literature [1] introduces MATLAB software to assist students in experiments. Students can design their own experimental scheme, analyze experimental parameters and results, and write experimental reports. In addition, the introduction of software assisted experiment can also spread students' thinking, so that the experiment is not limited to the verification results, but also can be operated according to students' own ideas.

Literature [2] based on MATLAB GUI, a course assistant teaching system of communication principle is designed, which provides a good platform for teaching and learning of courses, and solves the problems of teachers' poor teaching and students' inability to learn.

Literature [3] puts forward and practices the experimental flipped classroom model based on micro class. Teachers share the theoretical principles and practical contents involved in the experimental course to students in the form of "PPT + Voice explanation + physical display" before class, which effectively solves the problems of students' less opportunities for hands-on experiments, insufficient experimental time and poor experimental results.

In reference [4], the simulation of binary digital modulation is carried out by using the Simulink component of MATLAB software. In the experiment teaching of communication principle, teachers use MATLAB software to join in Simulink system modeling and simulation, cultivate students' practical ability, and enhance the ability to analyze and solve practical problems in communication engineering.

In reference [5], the teaching content reform of communication principle course based on Simulink simulation voice case teaching method is proposed, and the digital transmission example of voice signal is given.

In document [6], three teaching modes are proposed, which are modular verification, self-designed simulation experiment, and design experiment combining hardware platform and hardware description language.

Literature [7] proposes a hierarchical experimental teaching system. In order to improve the quality of teaching, teachers should combine the virtual with the real, and combine the extracurricular and in class.

Literature [8] puts forward the "3 + 3" training mode that the course experiment teaching is divided into three levels and the practice teaching is divided into three categories. Teachers should be student-oriented, carry out individualized teaching and cultivate students in various levels and forms.

Document [9] puts forward the advantages of applying micro course and MATLAB to the experiment teaching of communication principle. Taking QPSK modulation and demodulation experiment as an example, the design and implementation of experiment teaching based on micro course and MATLAB are explained in detail.

Literature [10] proposes the method of combining basic experiment and improvement experiment. In the part of basic

experiment, students can lay a solid foundation of communication principle and simulation means, and in the part of improving experiment, students' innovation ability will be highlighted.

In a word, the teaching methods put forward by these scholars can improve students' learning enthusiasm in varying degrees to complete the teaching experiment of communication principle. Based on this point of view, this paper puts forward the flipped classroom teaching mode of combining the micro course with the communication principle experiment of MATLAB. Students make full use of the micro course and MATLAB simulation software, which will greatly improve the enthusiasm of students' autonomous learning, strengthen students' in-depth understanding of the theoretical knowledge of communication principle, and effectively enhance the effect of the experimental teaching of communication principle.

2. The Main Problems in Class

Communication principle is a very important professional foundation of information specialty, which plays an important role in undergraduate teaching. However, this course has a strong theoretical nature, a lot of mathematical formula derivation, and a few elective hours for computer major. Students feel very abstract and difficult to understand when they study. Therefore, it is very important to open a good experimental course. Through the experiment, students can observe the process of signal transmission, modulation and demodulation vividly in the communication process, so as to strengthen the understanding of theoretical knowledge and improve the ability to analyze and solve problems [2].

At present, when students majoring in Computer Science in Wuhan University of science and technology choose the principle of communication, the experiment course is mainly completed by MATLAB simulation software. At present, when students majoring in Computer Science in Wuhan University of science and technology choose the principle of communication, the experiment course is mainly completed by MATLAB simulation software. In the actual teaching process, students are limited by the teaching conditions such as less experimental class hours, limited laboratory opening time, as well as the influence of traditional teaching concepts. The opportunity and efficiency of students' hands-on participation in the experiment are not high, so the experimental teaching effect is not ideal. But from the author's teaching situation for many years, there are several problems in using MATLAB simulation software to complete the communication principle experiment. But from the author's teaching situation for many years, there are several problems in using MATLAB simulation software to complete the communication principle experiment [3].

First of all, there are clear experimental steps and parameter settings in the experimental instruction. Some students do not need to understand the experimental principle at all, as long as they complete the steps, they can see the experimental results. The results are not analyzed, resulting

in the lack of understanding of the principle after the experiment, and the experimental effect is not good.

Secondly, the experimental hours of a single experiment are less and the teaching process is tense. At present, there are two class hours for a single experiment of communication principle, and some students can't finish the experiment on time. When students make up the experiment after class, they often have time conflicts with other experimental classes in the laboratory. At the same time, they lack the guidance of teachers, so the practical teaching effect is not satisfactory.

Thirdly, the experimental explanation of communication principle needs to cover a lot of content, involving not only the theoretical framework, but also the specific platform operation of MATLAB software. They are also influenced by signal analysis, analog and digital circuit knowledge and traditional teaching methods.

Finally, only one PC with MATLAB simulation software can be provided in the laboratory. The evaluation of the experimental effect is not enough, but the utilization rate of PC in the traditional classroom is low.

To sum up, the problems existing in the current experiment teaching of communication principle are not conducive to the analysis and solution of complex engineering problems, and nor to the improvement of experimental ability.

Therefore, it is very important to introduce the idea and practice of flipped classroom into the experiment course of communication principle by using information technology and MATLAB simulation software.

3. Related Teaching Research

3.1. Cognitive Micro Course

Micro lecture is the abbreviation of micro lecture, which is a new teaching resource widely concerned and applied in the field of teaching in recent years. Micro lecture refers to teaching video as the main carrier according to the new curriculum standards and teaching practice requirements. It records the whole process of wonderful teaching and learning activities carried out by teachers around a certain knowledge point such as key point, difficult point, doubtful point or teaching link. The concept of micro course was first put forward by David Penrose, senior teaching designer of San Juan College in 2008. He called micro course knowledge pulse to produce a more focused learning experience. The core content of the micro course is the classroom teaching video of the lesson segment, which also contains the auxiliary teaching resources related to the teaching topic. They create a thematic and semi-structured resource unit application environment with certain organizational forms and presentation methods. Therefore, micro class is different from traditional single resource types such as teaching courseware, teaching examples, teaching reflection, teaching design and so on, because this kind of teaching resource is teacher centered. However, micro course is not completely separated from the traditional type of resources, and it is a new type of teaching resources inherited and developed on its

basis [4].

Micro class is not a class teaching. It is to refine knowledge points and make a teaching video with a playback length of only a few minutes. It has the characteristics of short time, precise content, clear and single learning objectives. It is not only suitable for mobile learning, ubiquitous learning and autonomous learning in the micro era, but also suitable for students to select learning, personalized learning and micro mobile learning on demand for different subject knowledge points. It can not only find out the missing but also strengthen the consolidation of knowledge.

For micro class, we can reach a consensus that it is a kind of new curriculum resources which supports teachers' teaching and students' learning.

3.2. Cognitive Flipped Classroom

In recent years, flipped classroom has become a hot topic in the global education field. Flipped classroom originated from Woodland Park High School in Rockies, Colorado.

Generally speaking, flipped classroom enables students to complete the task of teaching knowledge by themselves through the class teaching video. It is to use classroom time to use classroom learning activities, such as projects, activity topics to help students achieve knowledge internalization. It is a brand-new teaching concept and method, which truly embodies the subjectivity of students' learning and the leadership of teachers, and completely changes the traditional classroom teaching mode [10].

Flipped classroom is a new type of teaching form which transforms the traditional teaching activities and learning process. In the traditional teaching mode, teachers impart knowledge in the classroom, and students grasp and absorb knowledge through practice and practice, so as to complete the internalization of knowledge. Flipped classroom is to reverse these two processes. The teaching link is mastered by students in the form of courseware and video. The internal acquisition of knowledge is the process of finding and solving problems in class, which is the basic form of flipped classroom. Generally speaking, the traditional teaching process usually includes two stages: knowledge transfer and knowledge internalization. Knowledge transfer is completed by the teacher's teaching in the classroom. The internalization of knowledge needs students to complete it through homework, operation or practice after class. In flipped classroom, this form has been subverted. Knowledge transfer is completed after class with the help of information technology. Knowledge internalization is completed in the classroom with the help of teachers and students. This is flipped classroom.

3.3. Cognitive MATLAB

MATLAB has powerful functions in engineering numerical calculation and system simulation, including numerical analysis, simulation modeling, system control and optimization. In the communication toolbox of MATLAB, many simulation functions and modules are provided to

simulate and analyze the communication system. SIMULINK is a block diagram design environment based on MATLAB software, which can complete the modeling, simulation and analysis of dynamic system. It provides a GUI of graphical user interface, which can create a model block diagram by clicking and dragging the mouse, just like drawing a model on straw paper with a pen. Using SIMULINK to build the simulation experiment platform of communication principle is different from solving differential equation and tedious programming. It provides a faster, more flexible, more direct and clear way, which can greatly stimulate the subjective initiative of students, and can discover, test and solve problems in time in the experiment. It improves students' ability of synthesis, design and innovation. According to the current situation of the experimental teaching of communication principles for computer majors in Wuhan University of science and technology, in order to meet the needs of students' experimental teaching and the cultivation of innovative practical ability, and enrich the teaching mode, the MATLAB/SIMULINK software simulation is introduced into the experimental teaching to adjust the content of the communication principle experiment and make every effort to complement their advantages [11].

The theory and technology of analog modulation is the foundation of digital communication, and a considerable number of analog communication equipment is still in use, such as AM and FM broadcasting, ground broadcasting and television, satellite live television, etc. Analog modulation technology is generally divided into amplitude modulation including AM, DSB, SSB and VSB. Angle modulation includes FM and PM. These are the key points of teaching. In the classroom, the teacher simply teaches the modulation principle and model, and the students will find it difficult to understand. If MATLAB simulation modeling is introduced into classroom teaching, it will help students understand and master theoretical knowledge in a more intuitive way. In this paper, the double side band modulation is taken as an example.

In the frequency spectrum of conventional AM signal, the carrier component does not carry information but occupies most of the power. The carrier component is suppressed and the side band part is reserved. Thus, the modulation mode of double side band modulation is obtained to improve the modulation efficiency. The time domain expression of bilateral band signal is: $S_{DSB}=f(t) \cos w_c t$.

The spectrum expression of the corresponding modulated signal is: $S_{DSB}=F(w-w_c)/2+F(w+w_c)/2$.

Where: $F(t)$ is the modulation signal and carrier wave. In the SIMULINK platform, the simulation model of the communication system using double band modulation is built. In this model, both the source and the carrier are sine wave signals. Through the simulation results of the double band modulation, it can be observed that the amplitude envelope of the modulated signal is not exactly the same as the base band signal, and there is a very obvious reverse phase point phenomenon, which is also a significant feature of the double band modulation modulated signal. The carrier used in

demodulation is the same frequency and phase as the modulation carrier, so it is called coherent carrier, and the corresponding demodulation method is called coherent demodulation. In this communication system model, Gaussian white noise is superimposed on the useful signal in the transmission process, and compared with the source waveform of the transmitter, the coherent demodulation method is verified to recover the original signal.

3.4. Flipped Classroom Teaching Mode

The flipped classroom teaching mode based on micro class belongs to a mixed teaching mode. It draws on the advantages of task-based teaching, situation teaching, interactive teaching, cooperative teaching and so on. This kind of efficient teaching mode is characterized by jumping, flexibility and comprehensiveness. This kind of efficient teaching mode is characterized by jumping, flexibility and comprehensiveness. Leaping shows that the teaching mode connects a variety of teaching methods and knowledge. It can quickly change from one teaching method to another. Flexibility is mainly reflected in two aspects: on the one hand, the classroom is more flexible and lively; on the other hand, it enables students to learn the principle of communication flexibly and master the practical skills of communication principle. Comprehensive refers to the flipped classroom teaching mode based on micro courses, which integrates the advantages of various teaching methods, so that students can learn comprehensive knowledge and comprehensively improve their communication principle skills and cultural literacy. Moreover, the flipped classroom teaching mode based on micro class can keep the effective connection of communication principle before, during and after class. It will expand the teaching scope of communication principle and help teachers to understand the specific needs of students before class. It will develop valuable learning resources for students and make the best teaching plan. In class, teachers can use the micro class platform to do a good job in class interaction, guide students to improve the practical skills of communication principles, and enhance students' practical skills of communication principles by arranging typical assignments. After class, teachers can design a micro class network platform for students. The platform shows students excellent works, promotes the sharing of communication principle knowledge resources, helps students solve English learning problems, and constantly improves students' practical ability of communication principle.

With the rapid development of modern information technology, people have too much time wasted, so how can people make full use of the time? The emergence of micro learning solves this problem. Micro learning refers to the process of segmenting the learning content or learning time, so that learners can fragment the learning content. Now, the content of Micro learning is usually a single topic, which presents relevant content around a core knowledge, that is, short, loose, practical and fragmented learning content. Micro course is one of the concrete of micro learning. It is based on subject unit knowledge, supplemented by other teaching

resources. Learners can learn anytime and anywhere across time and space obstacles. For example, the popularity of smart phones can be used for micro class learning, and learners can achieve independent learning only by installing the app of relevant courses. In the process of learning, learners can adjust their knowledge according to their own characteristics, and learn in accordance with their own speed of accepting knowledge. In flipped classroom, with the help of micro class, teachers try to cultivate learners' ability of independent exploration and thinking innovation. Micro class is one of the core teaching resources of flipped classroom, which can effectively close the distance between teachers and students, explore students' learning potential, and greatly strengthen students' internal absorption of knowledge. In flipped classroom, micro class can better show the personalized development of students' learning. It can make students quickly adapt to and master the learning content with the characteristics of short, small, precise and fierce. Finally, it directly affects the teaching effect of flipped classroom, which determines the effectiveness of knowledge transfer in flipped classroom. As the main learning resources of flipped classroom, micro class also promotes its own development and promotion.

3.5. Teaching Platform of Micro Course

This paper will build a micro course learning resource based on wechat platform. On the basis of wechat platform, teachers can upload the principle of this experiment before each experiment, explain the principle of the experiment briefly, and guide students how to write code in MATLAB environment. After the experiment, the students explain the code in detail and show the simulation results. The students verify the experiment principle according to the simulation results, and attach the complete MATLAB code. These preschool and post school contents can be made into wechat videos and uploaded to wechat platform. Students only need to open wechat via mobile phone at any time, and spend a short time to understand the experiment content before class, consolidate the experiment principle after class, and teachers can also answer the questions raised by students in time. Through the new mode of wechat platform and micro video, students' enthusiasm for learning can be better aroused, and the communication between teachers and students can also be increased.

4. Design of Flipped Classroom Teaching

4.1. Classification of Experiment Types

In view of the problems faced by the experiment of communication principle, the reform of experiment teaching content is imminent. The reform of the experiment teaching content of communication principle is based on students and individualized teaching. The experimental contents are divided into three types: confirmatory experiment, design experiment and comprehensive experiment. The difficulty of the experiment is improved step by step. Confirmatory

experiment is a kind of experiment to verify the knowledge in class, so as to consolidate the knowledge. The design experiment is an experiment based on the confirmatory experiment to increase the content of improvement, so as to solve the new problems through the learned knowledge and achieve the purpose of drawing inferences from one example to another. Comprehensive experiment is a systematic experiment composed of multiple knowledge points. It will stimulate students' innovation ability and improve students' practical ability. It will lay a good foundation for students to engage in related work or deeper scientific research after graduation. Therefore, the following will take the digital modulation and demodulation experiment as an example to explore how to build three types of experiments [12].

Confirmatory experiment is to verify the basic theoretical knowledge of communication principle through experiment, which emphasizes to prove the knowledge content through demonstration. The content of the confirmatory experiment is to be able to observe the waveform characteristics of 2FSK, 2ASK and 2PSK modulation signals in the existing experiments. It will understand the characteristics of intermediate signals in the process of modulation and demodulation. It will achieve the purpose of understanding the principle of modulation and demodulation. Students can achieve two goals through experiments: the first choice is to combine classroom teaching, observe the experimental results, analyze the experimental phenomena, and consolidate the theoretical knowledge learned in the classroom; The second is to lay a solid foundation for the next design experiment. The confirmatory experiment usually adopts the teaching mode of informing, verifying and using. Students can verify the scientific principles they have mastered through their own experiments, which can be said to be very fixed.

The content of the design experiment is to design the modulation and demodulation methods of FSK, ask and PSK signals, which requires students to have a higher understanding of the theoretical knowledge. The design experiment can be carried out on the SIMULINK platform. SIMULINK is a visual simulation platform in MATLAB simulation software, which provides an integrated environment of system modeling, simulation and comprehensive analysis. In this environment, modular mode is used to allow users to use the block diagram to build the system, and directly and clearly see the simulation results. Through the design experiment, students can not only deepen the understanding of knowledge, but also improve the ability of programming. At the same time, students have a deeper understanding of how to use in class knowledge to solve problems.

In recent years, many colleges and universities have begun to pay attention to the cultivation of students' practical operation ability, innovation ability and thinking ability, especially in science colleges and universities. For the experiment of communication principle, the comprehensive experiment content is to realize the modulation and demodulation of FSK, ASK and PSK on the software or

hardware platform. Comprehensive experiments can also be carried out on the SIMULINK platform or the embedded platform. To complete the comprehensive experiment, the students must write the program and simulate on the basis of fully mastering the theoretical knowledge. This will greatly mobilize students' creativity and subjective initiative, promote students to think independently, and comprehensively use the learned methods and innovative methods to improve students' practical ability.

4.2. Flipped Classroom Teaching on Micro Course

The flipped classroom teaching mode based on micro course is to turn the traditional teaching mode. With the help of micro course teaching resources based on Internet, it reestablishes teaching activity structure framework and activity program. In the traditional teaching mode, the theory course of communication principle corresponds to the process of knowledge transfer, while the experiment course corresponds to the process of knowledge internalization. In the flipped classroom teaching mode based on micro course, teachers adjust the teaching organization structure and teaching allocation time inside and outside the classroom. It transfers the initiative from the teacher to the students, and forms the reversal of the order and way of teachers' and students' activities. Finally, micro course realizes the reverse process of teaching and learning, teachers and students, in class and out of class. Specifically speaking, teachers' activities and students' activities include three activity procedures, which are before class, in class and after class. Before class, the teacher will make the knowledge points that were taught in class into micro course, and pass them to the students through the network experiment teaching platform. The students can learn independently according to their needs, and at the same time, they can consult the materials and discuss with each other. In class, teachers don't need to spend a lot of time on class teaching. They can provide individualized practical guidance, organize and guide students to conduct centralized or group experiments, cooperate to discuss and correct understanding. After class, teachers urge students by answering questions and evaluating homework. At the same time, students need to complete the corresponding independent planning of learning content, which can achieve the effect of knowledge consolidation [3].

In the teaching of communication principle experiment course, the flipped classroom teaching mode based on micro Class Autonomous Learning and personality guidance is adopted. It effectively stimulates students' enthusiasm for learning, improves classroom efficiency and develops students' practical ability. It realizes the innovation of curriculum education mode and provides a good reference for flipped classroom teaching. The flipped classroom can be realized by micro class making, courseware publishing and sharing, students' self-study, group analysis and discussion, classroom teaching and personal guidance. It transforms the traditional teaching mode of time-consuming and inefficient in the experiment class of communication principle into the modern learning and training mode of spontaneous and

independent. Therefore, in the past, teachers taught the relevant theoretical knowledge of the experimental content before organizing the steps of experimental operation. This will lead to a complete change in the phenomenon that students are short of time, thinking space and hands-on ability. In this mode, before class teachers send the theoretical principles and practical contents involved in the experimental course to students in the form of micro class video combining PPT, voice explanation and MATLAB simulation. Its content includes not only the basic concepts, system block diagram and other theoretical knowledge, but also the specific time operation links corresponding to the real object. In this way, students are encouraged to use their spare time to study independently and discuss in groups. In the classroom experiment, students complete the experiment content independently and invite teachers to help solve specific problems. In this way, students are encouraged to use their spare time to study independently and discuss in groups. In the classroom experiment, students complete the experiment content independently and invite teachers to help solve specific problems. At the same time, teachers find common and individual problems in classroom practice, and then carry out targeted guidance, and optimize the curriculum teaching plan. Therefore, students' learning attitude will change from "you want me to learn" to "I want to learn". The teaching role of teachers has changed from a professor to a promoter and a director, and the overall teaching effect has been greatly improved.

5. Implementation of Flipped Classroom

5.1. Teaching Design

Teacher design includes three aspects: learning task list, making micro lessons and making corresponding micro exercises [8].

According to the overall teaching goal of the experiment, the course is divided into corresponding micro units. It is to determine the micro unit according to the experimental content divided by the former communication principle experimental teaching type.

The task list of autonomous learning is designed. Autonomous learning task list is the task list that students need to complete before classroom teaching. The task list mainly includes learning guide, such as learning theme, achievement goal, learning method proposal and classroom learning form publication. The learning task is to grasp the whole, the key and difficult points, and other knowledge points and create the necessary collaborative exploration situation. Problem design is the transformation of key and difficult points, other information into problems and constructive learning resources. Learning and practice are helpful information such as exercise questions, necessary tips, and designated space for doing exercises. Problem file refers to recording questions and putting forward suggestions on teachers' classroom guidance. Learning reflection is the process of solving problems, practicing statistics, existing

problems and improving ideas. Students can make their own learning plan according to the task list and complete the learning tasks before class. If students can complete the learning tasks before class with quality and quantity according to the learning task list, the teacher can effectively implement classroom teaching [13].

The manufacturing steps of each micro unit are as follows: Firstly, the teaching content should be clear, that is, the knowledge points and key and difficult points of the corresponding micro units should be clearly grasped. Secondly, arrange teaching materials and collect multimedia materials. Thirdly, time designs. The duration of micro class should be controlled within 10 minutes, which is in line with the characteristics of students' short attention time. In the process of autonomous learning, the time is too long, and it is easy to get bored. Fourthly, the design of teaching process structure mainly includes the quick introduction of topics to attract students, clear teaching clues, quick conclusion, a micro teaching resource environment and refined teaching language. Finally, the micro class is made. According to the characteristics of the communication principle experiment course, the micro class is made by using the recording software TechSmith Camtasia studio 9.0.5. The introduction of MATLAB can effectively supplement and improve the traditional experiments. The double side band modulation is taken as an example. In the experiment, the base band signal is the recorded voice signal, and the wavread function in MATLAB is used to read the recorded voice signal. The relationship between the modulated signal and base band signal can be seen more intuitively from the recorded output frequency chart. By adjusting the relevant parameters such as carrier frequency, the base band signal spectrum can be moved to the appropriate operating frequency range. It helps students understand abstract concepts such as spectrum shifting. The whole experiment process has greatly trained the students' comprehensive thinking ability and innovation ability, greatly improved the experimental teaching effect, and enhanced the students' enthusiasm in the experimental class.

The corresponding micro exercise design is made for each micro unit. According to the teaching objectives and key and difficult points of each micro unit, the micro exercises matching with the micro course should be prepared, and the number and difficulty of exercises should be appropriate. Because this is the content of students' self-study before class, the quantity should not be too much, the difficulty must be moderate, but there will be some challenges, in order to stimulate students' interest in learning [14].

5.2. Students' Micro Class Learning Before Class

According to the content of the communication principle experiment course, the micro unit is determined. In fact, each micro lesson includes two steps: watching micro lessons and doing micro exercises. The specific operation is reflected in the learning process of each micro course. The specific operation is reflected in the learning process of each micro course. First of all, teachers should give each student a task

list of independent learning. According to the requirements of the autonomous learning task list, students arrange time and place to watch the video of the micro class according to their own situation, and the length of watching time is also determined according to their own learning situation. Students should pay more attention to the important and difficult points or not mastered content, but less to the difficult or mastered content.

In watching the micro class, students can record the confused knowledge points on the learning task list, as well as the harvest and learning experience, so as to facilitate the communication with students and teachers in the classroom. After watching the micro class, students should also complete the class micro exercises according to the requirements of the autonomous learning task list, so as to consolidate the learning effect of watching the micro class. Similarly, the problems found in micro exercises should be recorded on the learning task list in time. In general, the teacher will announce the classroom learning form on the autonomous learning task list. Therefore, after the completion of micro class and micro practice, students should make some corresponding preparations for the follow-up classroom teaching.

5.3. Classroom Teaching Implementation

According to the characteristics of communication principle experiment course, classroom teaching is basically completed in the computer room. Students in the computer room have more time to do exercises by themselves to enhance their practical operation ability. Firstly, teachers should answer questions about the practical problems reflected in watching micro class and doing micro exercises before class, demonstrate and solve the operational problems on the spot. Then, according to the knowledge goal of micro unit, students organize independent or cooperative activities to complete exercises, and carry out collaborative inquiry, display and exchange results and other classroom activities. For example, in the learning of numerical modulation unit, the classroom activities organized at the beginning and middle stage is mainly to complete computer practice and explore problems. In the later stage, because the target knowledge of numerical modulation unit has been basically mastered, some projects can be arranged for classroom activities such as achievement display and exchange. In the flipped classroom, the identity of a teacher changes from a lecturer to a student's designer, organizer, helper and guide. And the students become active learners from passive receivers, and give full play to their initiative. Teachers have more opportunities to guide students one-on-one in class, so as to improve the learning effect.

5.4. Task Design After Class

First of all, after class students summarize the learning content, complete the experimental report and take part in the online test. Teachers continue to answer questions, correct reports and evaluate test results. The students summarize the

experiment contents and complete the experiment report. Students also need to complete the experimental data, results analysis, experimental summary part. Experiment summary requires students to summarize learning difficulties and problems so that teachers can understand students' learning situation as much as possible. Teachers arrange online test according to the teaching schedule of MATLAB simulation communication principle experiment, and students take part in the online test. An important teaching purpose of MATLAB simulation communication principle experiment is to master the basic idea of communication principle theory, and use MATLAB / SIMULINK application method. After the completion of classroom teaching, students are required to complete the application design homework, train students' ability to apply MATLAB/SIMULINK to solve the theoretical and practical problems of communication principles, and cultivate students' ability to learn and understand the theoretical knowledge and engineering practice of communication principles independently [15].

Secondly, teachers should analyze and summarize the data in the implementation of the curriculum, and constantly improve teaching. In the process of teaching, teachers should pay attention to the problems in the summary of students' test and experiment reports, and give feedback and guidance to students. The school network teaching platform can generate independent learning trajectory data reflecting students' natural situation. Teachers can understand students' learning state, efficiency and effect through data analysis. According to this, teachers should adjust and arrange teaching activities reasonably and improve teaching methods constantly.

Thirdly, the teacher carries on the comprehensive examination to the student achievement. The objective evaluation of performance can play a very good role in promoting students' learning motivation. The evaluation of the experimental results of MATLAB simulation communication principle is not only the evaluation of the design, operation and results of students' problem-solving, but also the most direct and objective effective way to assess students' learning ability and learning effect. The experimental results of MATLAB simulation communication principle are based on online test, homework submitted in class, the quality of experimental report and normal performance. In the course of performance evaluation of communication principle experiment course, the total score includes three aspects: homework submitted in class accounts for 20% of the total score, online test accounts for 30%, and the completion quality of experiment report accounts for 50%. In this way, students' achievements are evaluated comprehensively, fairly and objectively.

Finally, the effect analysis, the flipped classroom teaching mode is used in MATLAB simulation communication principle experiment. From the implementation of the situation, students are basically able to complete the class autonomous learning, to achieve the purpose of saving classroom time. In class, students are able to actively carry out experiments. In view of the experimental content, various

solutions and methods are put forward, and students realize personalized learning, Teachers answer questions and solve questions according to different guidance needs of different students, and realize individualized guidance [16].

The network teaching platform provides conditions for the implementation of flipped classroom. Teachers get better learning trajectory data from the network platform, and control the implementation of teaching activities more accurately. Online test plays a role in consolidating the learned knowledge, strengthening the practical ability exercise and evaluating the students' performance. The improvement of students' learning ability and practical ability in flipped classroom also makes students gain more sense of achievement and self-confidence

6. Conclusion

The experiment of communication principle is realized by MATLAB/SIMULINK software, which can show the change of signal state, reflect the physical concept and help students to understand the book knowledge of communication principle. In addition, through the design of simulation parameters and the compilation of program code, students can master the communication simulation method of MATLAB/SIMULINK software and train their thinking ability. Micro class and flipped class, as the representative of the new generation of teaching resources and teaching mode, have brought far-reaching influence to the education and teaching cause of the whole society. At present, the application of Internet micro course teaching resources in the experiment teaching of communication principles in Colleges and universities has just been fully launched.

This paper takes the communication principle experiment as the application demonstration, combining with the characteristics of the course itself and the actual needs. It integrates information technology, education technology and communication principle experiment teaching deeply, and discusses the application of flipped classroom teaching mode based on micro course in this course. This kind of experimental course education mode, the education idea will further information, digitization. The flipped classroom teaching mode is under the guidance of teachers' overall control. Students change from passive recipients to active learners, and reflect their own main role. The method of independent learning and collaborative inquiry advocated by flipped classroom is in line with human cognitive law, and can meet the needs of individualized teaching and training. Flipped classroom provides a new way and new thinking for the practical teaching of higher education, which is worthy of further study and discussion.

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