



Research on the teaching of information-based experimental courses taking university physics experimental courses as an example

Nan Wang^{1,*}, Yu Sun¹, Chao Sun²

¹Dept. of Basic Sciences, Dalian Naval Academy, Dalian, 116018, China

²Liaoning Police College, Dalian, 116000, China

*wangn001@163.com

Abstract. With the continuous development of science and technology, computer and Internet technology are constantly applied to teaching. Experimental courses in higher education also need information teaching. College physics experimental courses are the beginning of middle school students entering college to learn experimental courses, which has certain representativeness. Through information technology means such as Mu class platform, Weixin Mini Programs, campus network informatization platform, virtual simulation system, etc., the experiment preparation effect can be improved, classroom teaching means can be enriched, and more scientific and accurate assessment methods can be provided.

Keywords: data; informatization education; university physics experimental.

1 Introduction

With the continuous development of science and technology, computer and Internet technologies are constantly used in teaching. Nowadays, information technology is used in teaching in colleges and universities all over the world, establishing an online course system and forming an online-offline hybrid teaching mode.^[1] Physics experiment is the first practical course for college students to enter the university learning stage, which is the forerunner of science experiment, reflecting the commonality of most science experiments, the university physics experiment course is the beginning of the experimental course for secondary school students to enter the university to learn the experimental course, and the content of the university physics experiment course covers a wide range of experiments, with a wealth of experimental ideas, methods and means. The teaching of physics experiment course plays the role of scientific guidance and laying the cornerstone for the establishment of the basic quality of scientific experiment and the cultivation of innovation consciousness of college students. Traditional university physics laboratory teaching is a teacher-centered offline didactic teaching, usually the teacher or demonstration, students do, teaching methods in a single means

at the same time received time schedules, classroom arrangements, the number of instruments and other factors. With the continuous development of information technology, we can make use of catechism, WeChat applet, virtual simulation experiment system, online teaching evaluation system, etc., to carry out effective teaching reform, fully embody the "degree center", and improve the teaching effect.

2 Informatization Means Applied to Laboratory Teaching

2.1 Internet Catechism Platform

Since 2013, MOOC online learning has become the norm. Taking MOOC as an example, MOOC has cooperated with 811 universities in China, and the top three courses in the rankings, as shown in Table 1, have 151833 participants, 117328 participants and 526645 participants respectively. There are 1916 courses related to physics and 381 courses related to college physics experiments. The teaching resources are very rich. According to the statistics at the beginning of 2023, the number of Mu classes exceeded 60,000, registered users exceeded 400 million, the number of students exceeded 900 million, the number of Mu classes and the number of students ranked first in the world, and the number of high-quality courses continued to grow. Since the establishment of the World Mu Class and Online Education Alliance in 2020, 168 global integrated courses have been opened and 8 English global open courses have been launched, attracting many international learners. Through online Mu class, you can learn anytime and anywhere, learn at different speeds according to your own characteristics, learn repeatedly, and learn rich and extensive resources, which will certainly develop efficiently and continuously. Tables are "float elements" which should be inserted after their first text reference and have specific styles for identification. Do not use images to present tables, or they will be inaccessible to readers using assistive technologies.

Table 1. Number of participants in the top five courses of mooc ranking of Chinese universities

course name	construction unit \ author	number of participants
Python programming language	Beijing Institute of Technology	151845
Introduction to Program Design - C Language	Zhejiang University	117328
Assault Advanced Mathematics/Calculus	Dr.Hou	526645
Advanced C Language Programming	Zhejiang University	33578
Psychology and Life	Nanjing University	136061

2.2 Weixin Mini Programs

Online social networking platforms allow people to exchange information and make connections, and have become an indispensable part of today's society. WeChat, as a social software for mobile devices, continues to grow in China, as shown in Figure 1, according to statistics as of September 2023, the number of combined monthly active accounts of WeChat and Wechat has reached 1.336 billion, which covers almost the

entire population of China, and WeChat mini-programs are also being used by more and more people.

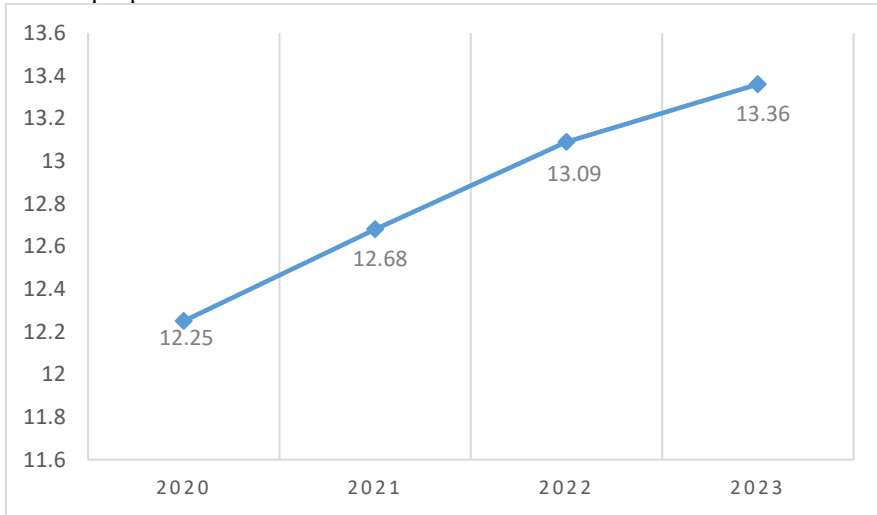


Fig. 1. Monthly active accounts of Wechat users(in billions)

The demand for university physics laboratory course resources based on mobile smart terminals such as cell phones and tablet computers is increasing. At present, the informatization teaching applet based on "Rain Classroom" has become more and more mature. Teachers can push the corresponding mooc resources and exercises to students' cell phones, and students can study the course online and answer questions and ask questions. At the same time, the rain classroom can be used to form teaching data to understand the learning situation of students and form positive feedback.

2.3 Campus network digital information platform

In terms of digital resource conditions, each school has its own network homepage, which makes reasonable use of the network teaching conditions, and the information platform is generally utilized at a high rate. Through the network to realize the pre-course online selection, effectively realized the students according to their own learning interests to choose the content of the university physics experiment, and at the same time solved the problem of difficult scheduling. At the same time, the digital information platform of campus network realizes the management functions such as students' attendance, achievement records and statistical analysis. Scientific management of student learning and scientific learning evaluation.

2.4 2Virtual Simulation Experiment Platform

Simulation of experimental instrument operation and teaching is not subject to time and space constraints, students can log on the platform at any time and any place to learn.

The main boards of the simulation experiment teaching system include user management, teaching experiment resources, online simulation experiments, evaluation of experimental operation, evaluation of experimental data, and so on. According to statistics, such as Peking University, Zhejiang University, China University of Geosciences, University of Science and Technology of China, Dalian Maritime University, Chongqing University and so on have built virtual simulation laboratories, which can support a certain number of virtual simulation experiments, such as Shanghai Jiao Tong University's online teaching platform, integrating the basic service platform, pre-study system, reporting system, course selection system, simulation experiments of various functions, on-line coverage of force, heat, light, Electricity, modern physics, and more than 40 virtual experiments. Moreover, some schools can independently design and develop virtual simulation experiments and win awards. The virtual simulation experiment platform breaks the limitations of time, place and teaching experiment resources, so that students can simulate the real operation in the online virtual scene and master the relevant experimental content. Thus, it provides a basis for blended teaching.

3 The application of information technology teaching in university physics experiment courses

3.1 Experiment pre-study session

The pre-course study session of university physics experiment can stimulate students' enthusiasm to do experiments and improve students' self-learning ability. The assessment result of the experimental pre-study session accounts for 10% of the total grade, which stimulates the students' correct attitude of learning pre-study. Among them, the Internet information technology means play an irreplaceable role in pre-study. Before the experiment, the teacher uses the WeChat applet network platform to release the experimental learning tasks and requirements, and uses the catechism video resources, online virtual telepresence platform and other experimental teaching materials. Students according to the learning tasks, independent or collaborative independent learning, familiar with the experimental background, experimental principles, experimental procedures, experimental instruments, experimental safety and precautions. Through the Internet platform, students can carry out knowledge assessment, teachers can answer questions and solve problems or prep knowledge, so that not only can understand the students' prep situation, but also the test results can be used as the experimental prep session grades. At the same time, through the pre-test can also realize the flipped classroom teaching, more classroom time back to the students, the instructor personalized guidance. Students can also be assigned classroom debriefing tasks, combined with the Feynman learning method, to promote learning through lecturing and the continuous development of the degree center. Through statistics, 97.2% of the students preferred to utilize computer and other information means for preclass preliminaries than the traditional method of preliminaries through reading books. And the rate of laboratory pre-study 76.6% increased to 87.4%.

The practical results show that students do well in advance of the experimental preview, effectively improve the efficiency of classroom learning, but also can be more accurate and patient to complete the experiment; students who do not do well in the experimental preview, in the design of the program, experimental discussion and is the process of the actual work is easy to be at a loss, and even damage the experimental apparatus, can not play the initiative of the students, so the reasonable use of information technology teaching means, by providing students interested in the Therefore, it is very important to make reasonable use of informatization teaching means and provide students with interesting teaching resources to motivate students to complete the pre-study in quality and quantity.

3.2 Experiment Teaching

University physics experiment teaching, generally using the 5E teaching method, that is, through the video, demonstration of phenomena, tell the story of scientists and so on to explain the background or history of the experiment "Engage (introduction)" link; focus on the experimental principles, through the establishment of a physical model to analyze, to establish the need to measure the physical quantities of the Explain"; "Explore", which is to debug and manipulate the apparatus according to the requirements of the experiment, to complete the investigation by using the experimental method and to record the experimental data; "Elaborate", which is to refine the ideas and methods of the experiment to achieve the sublimation of the purpose. Elaborate" is to refine the experimental ideas and methods to achieve sublimation; "Evaluate" is to evaluate the experimental process and experimental results.^[2]

3.2.1 Lecture.

In the process of teaching, first of all, the material library is enriched through the catechism resources to organize the "Engage" link. The material library includes experiment-related scientists' life stories such as Milligan, Newton, Einstein, etc.; experiment-related production technology applications; experiment-related latest scientific and technological developments, and so on. Secondly, in the "Explain" section, the "rain classroom" WeChat small program is used to solve the problems of low participation in classroom questions and the inability to provide timely feedback on the students' learning level. The main performance is that in the course of the class, students enter the virtual classroom through the QR code, the teacher uses the small program to send test questions, and students answer online. Through the use of WeChat small program, effectively increase the number of students and the number of participation, and at the same time can quickly grasp the degree of students' understanding of knowledge.^[3] The knowledge that has not been learned to further strengthen the explanation.

3.2.2 Classroom practice and experimental data recording.

As an important part of experimental teaching, the experimental operation can promote the improvement of students' experimental skills, thinking ability, experimental

attitude and other qualities through experimental operation, which is categorized into the "Explore" exploration link. Before the experimental operation, you can use the virtual simulation experimental platform, the first experiments, especially the more dangerous or expensive experiments for pre-operation, by contacting in advance to improve the accuracy of the operation of the experiment. At the same time to each experimental station on the configuration of tablet computers, for the forgotten knowledge points or operational notes, in the traditional teaching process, regardless of whether the knowledge points are simple or complex, need to be instructed by the teacher one by one, thus wasting the time to solve the complex problem in a limited number of events. Currently, students can play back the video of the teacher's explanation of the knowledge points that have been recorded in advance through the tablet computer to achieve the purpose of quickly solving simple personalized problems. Teachers can give guidance to students who need it more by observing their experimental operations. According to the survey statistics, students can solve 63.7% of the problems by watching the explanation video repeatedly.^[4]

At the same time, through the campus network to establish a network account belonging to each student, the operation of the experimental data through the tablet computer into the laboratory report form on the Internet, you can realize the role of anytime and anywhere to call the check and save the data. Through the process of experimental operation and data recording, students can continuously cultivate the rigorous scientific experimental sentiment and the scientific attitude of seeking truth from facts.

3.2.3 Classroom Sublimation and Evaluation.

At the same time, according to the experimental operation and learning process, students can summarize the experimental ideas and methods, use the Internet to query and verify, and submit their own ideas to facilitate the teacher in the students or students and students to communicate with each other for the program, so as to realize the "Elaborate (exquisite). Finally, through the computer system to assist the teacher to carry out the usual performance "Evaluate"^[5].

3.3 Post-course Laboratory Assessment

University physics laboratory grades are divided into three major parts: preliminaries, classroom performance and report grades and final examination grades. The final examination of the experimental course generally includes theoretical knowledge assessment, experimental operation assessment, experimental summary report and other forms. Theoretical knowledge assessment is a written examination, mainly examining the experimental principles, experimental methods, experimental applications and data processing. Experimental operation is a random lottery to choose experimental projects, in the specified time to complete the experimental operation and experimental data recording.^[6] The final examination accounts for 30% of the total grade. The final examination session is an assessment of students' comprehensive experimental quality and a test of teaching effectiveness. The research on experimental evaluation shows a diver-

sified trend. It is embodied in the informationization of evaluation means, the development of evaluation purpose and the diversification of evaluation itself. First of all, computers can be used to calculate students' pre-test scores and usual formative assessment scores through the proportion setting. The final examination can use the virtual experiment platform of university physics experiment to conduct online examination, use the tablet computer and other electronic devices to help the offline practical examination, and complete the final high examination by submitting the paper on the campus network platform for mutual evaluation by teachers and students. Finally, the examination results are automatically synthesized through a computer program.^[7]

4 Summary

With the continuous development of science and technology, computer and Internet technology is constantly applied to teaching. The experimental courses in higher education also need informatization teaching. University physics laboratory course is the beginning of the secondary school students to enter the university to learn the laboratory course, has a certain degree of representativeness. Through the practice in recent years, it is concluded that the use of information technology means such as catechism platform, WeChat applet, campus network information technology platform, virtual simulation system and other information technology means in the teaching process can improve the effect of experimental preview, enrich the means of classroom teaching, and provide a more scientific and accurate way of assessment, and so on. It can develop students' good learning and recording habits, and cultivate students' scientific literacy as well as their lifelong learning ability.

References

1. Bazhenova S A. Approaches to improving the training of teachers working under the International Baccalaureate programs in the field of education informatization[J].RUDN Journal of Informatization in Education, 2020.DOI:10.22363/2312-8631-2020-17-2-123-133.
2. Annemarie L. HornSelena J. LaydenJane RoitschOlga Karadimou.Providing performance-based feedback to teachers in real-time using Bug-in-Ear technology[J].Coaching: An International Journal of Theory, Research and Practice, 2021, 14(1).
3. Bass I, Bonawitz E, Hawthorne-Madell D, et al. The effects of information utility and teachers' knowledge on evaluations of under-informative pedagogy across development[J].Cognition, 2022, 222:104999-.DOI:10.1016/j.cognition.2021.104999.
4. Nurym N, Zhunisbekova G S, Akramova A pedagogical possibilities of information technologies in training students[J]. 2020.DOI:10.51889/2020-2.1728-7901.43.
5. Demin W, Guang X, Feichao W, et al. Opportunities and Challenges for Teaching Reform in Colleges and Universities Under the Background of Informatization[J].Journal of Qilu Normal University, 2014.
6. Han M.Integration of information-based teaching and quality education: ways to achieve and evaluation systems[J]. 2023.
7. Zhe X, Xuemei W, Shiwei C, et al.Discussion on Information-based Teaching about Professional Course of Military Academy[C]//0[2024-01-22].

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

