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PAPER

# Design and Implementation of Experiment Online Teaching Platform for Oil and Gas Storage and Transportation Based on WeChat Mini-Program

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**ABSTRACT**

With the emergence of "Internet + higher education," online teaching platforms have become increasingly important, particularly for practical teaching courses. The study of oil and gas storage and transportation is a fundamental and essential course for students in this major. In light of the issues related to limited space, lack of openness, and low student enthusiasm for traditional experimental teaching methods, an online experimental teaching platform for oil and gas storage and transportation was developed. This platform is based on the WeChat mini-program and follows the principles of cross-platform computability, user friendliness, and low investment. Its aim is to explore effective learning models for mobile devices. This study compares and analyzes the differences in classroom effects before and after the implementation of the WeChat learning platform. The study examines the design of the platform, teaching session cases, and the analysis of application effects. The research utilizes questionnaires and statistical data as research methods. The results indicate that the WeChat online teaching platform has significantly improved the enthusiasm and learning outcomes of students in the independent learning of experimental courses. It has received high recognition from both teachers and students and has greatly enhanced the quality of teaching. This has considerable potential for further promotion.

**KEYWORDS**

online teaching platform, experimental teaching, WeChat mini-program, intelligent education, online and offline mixed teaching mode

## 1 INTRODUCTION

With the rapid development of modern technologies such as big data, artificial intelligence, and virtual reality, undergraduate education and talent training in Chinese universities are in need of change [1, 2]. The relevant documents from the Chinese Ministry of Education propose promoting the seamless integration of modern

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information technology and education teaching. This includes the development of a new model called "Internet + higher education" that combines online and offline teaching. The goal is to facilitate the improvement of higher education quality through the use of modern information technology, leading to a transition overtaking [3, 4]. Experimental teaching in higher education is a crucial component for students to integrate theory with practice and elevate their theoretical knowledge. It is also an essential aspect of cultivating students' practical ability, innovation ability, teamwork ability, and capacity to solve complex engineering problems [5–8].

The study of oil and gas storage and transportation is a mandatory foundational course for undergraduate students majoring in oil and gas storage and transportation engineering. This course is crucial as it serves as comprehensive practical training that plays a significant role in developing students' problem-solving skills for complex engineering issues. At present, the course is taught using a traditional teaching method, relying on a self-prepared experimental guide as the primary teaching resource and utilizing the laboratory as the sole teaching location. After the students enter the laboratory, the instructor will explain the theory and demonstrate the experimental procedures to the students. The students will then collect the relevant experimental data, process and analyze it, and write an experimental report based on their hands-on experience. This model is influenced by reduced class time, limited space, and a lack of openness. As a result, students are in a passive learning state with low enthusiasm, poor concentration, and unclear objectives, leading to unsatisfactory learning outcomes [9]. Today, with the rapid development of information technology, the abundance of network resources, and the widespread use of mobile devices, this traditional experimental teaching mode is clearly outdated and does not contribute to the overall enhancement of students' innovative abilities and comprehensive quality [10–12].

The online teaching platform is an effective means to combine online and offline education and promote the quality improvement of higher education [13]. Meanwhile, WeChat is one of the most popular new media platforms in the modern era and is widely used by contemporary college students. It has a popularity rate of almost 100% [14]. In recent years, the WeChat platform has been increasingly introduced into higher education to reform teaching modes and methods. This is due to its advantages, such as convenient operation, timely communication, and the ability to provide rich and accurate content [15]. This platform can be used to assist in experimental teaching, creating an informative, lightweight, and mobile MOOC system [16]. Through this platform, teachers can upload learning resources, and students can access and learn from them anytime and anywhere, making use of fragmented time to acquire the necessary knowledge. This extends the limitations of traditional teaching in terms of space and time [17]. This online and offline teaching mode, which is deeply integrated, can play a dominant role in guiding, inspiring, and monitoring the teaching process. It can also reflect the initiative, enthusiasm, and creativity of students as the main participants in learning. This approach represents a new direction and idea for experimental teaching reform [18, 19]. Given this, we will design an online experimental teaching platform based on WeChat. Our goal is to comprehensively promote the construction of our university's information and experimental teaching platform, explore new modes of experimental teaching, and share the practical experience gained since the platform's inception.

## 2 LITERATURE REVIEW

WeChat, a mobile application launched by Tencent in 2011, offers free instant messaging services that allow users to exchange voice messages, video clips, photos,

and text messages over the Internet [20]. Due to its powerful features and user convenience, WeChat has rapidly gained popularity in China. In particular, it has been widely adopted by college students and, therefore, provides a new platform for mobile teaching [14]. The WeChat mini-program was officially launched on January 9, 2017. It is a cost-effective application that operates seamlessly within the WeChat environment without requiring any downloads or installations. This versatile application encompasses various functionalities in diverse domains such as education, entertainment, food, transportation, and office work [21]. The WeChat mini-program is currently the most widely used and technologically advanced scenario tool, boasting powerful capabilities through its integration with the WeChat platform. As a hyperlink tool in mobile scenarios, it provides a more convenient and efficient platform for mobile learning [22].

In recent years, many scholars have started researching the application of WeChat platforms in education, primarily in the field of theoretical teaching. Peng et al. [23] pointed out that previous research on teaching models primarily focused on traditional teaching methods. However, in today's context, it is essential to utilize mobile teaching platforms to integrate teaching resources, offer personalized real-time guidance, and enhance teacher-student interaction channels. This approach aims to address the challenges encountered during the learning process. Li and Chen [24] argue that the teaching platform based on the WeChat mini-program not only enriches teaching resources, expands students' knowledge, and broadens their horizons, but also frees them from the constraints of textbooks. Additionally, it caters to the needs of students at different levels, stimulates teachers' enthusiasm for teaching, ignites students' interest in learning, and revitalizes the classroom. The interactive and one-on-one question-answering teaching methods provided by the platform are more conducive to personalized instruction by teachers. Han et al. [25] indicated that the acquisition of personalized learning resources, the collection of learning data, and the interaction of extracurricular learning processes in the flipped classroom can be realized through the use of new information technology platforms. This allows for the maintenance of a "teacher-led, student-subject" approach and facilitates a smooth transition from the traditional classroom to the flipped classroom, ultimately improving the effectiveness of teaching and learning. According to Lu et al. [26], there has been a growing demand for mobile learning as a result of the ongoing advancements in mobile communication technology, network technology, and the continuous update of learning concepts. In contrast to traditional forms of classroom teaching, the development of mobile learning is not limited by time and space. Learners can access learning resources whenever and wherever they want. Jing et al. [27] proposed that teaching activities based on WeChat are conducive to improving students' academic performance, cultivating students' good learning habits, and allowing them to review the course's learning content at any time, thereby reducing the teaching pressure on teachers.

However, due to the specific nature of the experimental course, it is essential to use experimental equipment and ensure active hands-on participation by students. This requires the student to have prior knowledge of the laboratory environment and experimental conditions. Otherwise, students will consistently remain in a passive state of learning, which can result in diminished enthusiasm, poor academic performance, and limited development of innovative thinking and practical skills. In recent years, several scholars have conducted research and exploration on online teaching platforms and teaching models for experimental instruction. Cheng et al. [28] established a WeChat public platform for organic chemistry experiments and utilized it for supplementary teaching. Through practical applications,

it was found that the platform was well-received by students, and the quality of teaching improved significantly. Cai et al. [29] established a WeChat public platform for basic chemistry experiments, catering to the comprehensive needs of teaching and learning at all stages, including before, during, and after basic chemistry experimental instruction. Additionally, it addresses the requirements of teachers and students for daily learning and communication while enhancing the quality of teaching basic chemistry experiments. Han et al. [30] established a WeChat public platform to implement a novel experimental teaching mode. They used the experimental course "Metallurgical Process Water Model" as an example. This mode allows students to independently select topics, design experimental plans, automatically form groups, and engage in self-practice for three water model experiments: ladle water, tundish water, and mold water. Empirical evidence has demonstrated that the implementation of this innovative pedagogical approach effectively stimulates students' enthusiasm and initiative, fosters a collaborative group dynamic, and cultivates their comprehensive abilities and innovative qualities.

In general, the application and research of the WeChat platform in experimental teaching practice in Chinese universities are still in their early stages [20]. In particular, the utilization of the WeChat platform in professional experiments related to oil and gas storage and transportation is currently insufficient. This study aims to address the research gap by establishing an online teaching platform on WeChat for conducting such experiments. The platform consists of three main function modules and 12 sub-function modules. It provides a wide range of teaching materials, including instructional videos and courseware, to meet the needs of experimental teaching and enhance teacher-student communication. Through questionnaire surveys and statistical analysis, we will compare and analyze the learning behaviors and effectiveness of students before and after implementing the WeChat learning platform. This stay aims to enhance the quality of experimental teaching.

## 3 METHODOLOGY

### 3.1 Construction objectives of the WeChat online teaching platform

Under the context of developing new engineering disciplines and considering the practical challenges faced during the experimental teaching of oil and gas storage and transportation engineering at Xi'an Shiyou University, we aim to fully leverage the benefits of the WeChat platform. By integrating classroom teaching, mobile learning, and flipped classroom approaches, we will establish an online experimental teaching platform on WeChat. This platform will provide comprehensive support for professional experimental teaching. The platform provides a space for teachers and students to communicate, analyze, discuss, and strengthen the interaction, continuous communication, and resource sharing of experimental teaching information [31, 32]. In addition, the construction of this platform aims to bridge the gap between the laboratory, faculty, and students. It aims to strengthen the awareness of teachers and students about the need to actively participate in laboratory management. The platform also aims to achieve a comprehensive combination of teacher-led and student-led teaching, exploring a hybrid teaching mode that integrates online and offline components. The goal is to improve the quality and

effectiveness of experimental teaching and promote the development of students' independent learning abilities and collaborative innovation.

## 3.2 Basic architecture of the platform

The WeChat-based online experiment teaching platform is built on the WeChat mini-program as its fundamental architecture, consisting of two main components: the view layer (View) and the logic layer (App Service). The view layer is responsible for rendering the page structure, while the app service layer handles logic processing, data requests, and interface calls. They run on two threads. The view layer uses WebView for rendering, while the logic layer uses JSCore for execution. The view layer and the logic layer communicate through the WeixinJsBridage of the system layer. The logic layer notifies the view layer of data changes, which triggers page updates. The view layer then notifies the logic layer of the triggered events for business processing. The specific architecture is shown in Figure 1.

The overall architecture of the online experimental teaching platform is mainly divided into three parts: the WeChat mini-program, the WeChat server, and the data management center. The overall architecture diagram is shown in Figure 2. The client part of the WeChat mini-program primarily utilizes the multipurpose infrastructure for network applications (MINA) framework of the applet. This framework includes the Weixin markup language (WXML), Weixin style sheets (WXSS), and JavaScript. It also provides a range of rich components to facilitate client interface design and function implementation. The client of the WeChat mini-program directly interacts with both the administrator and student users. The WeChat server is a data transfer station, primarily responsible for forwarding user requests to the data center. It utilizes the server platform of Xi'an Shiyou University. The platform parses the user-request data pushed from the WeChat server. It selects the appropriate logical processing modules for processing based on the data type and content. The processed data is then encapsulated, encrypted, and forwarded to the WeChat client through the WeChat server.

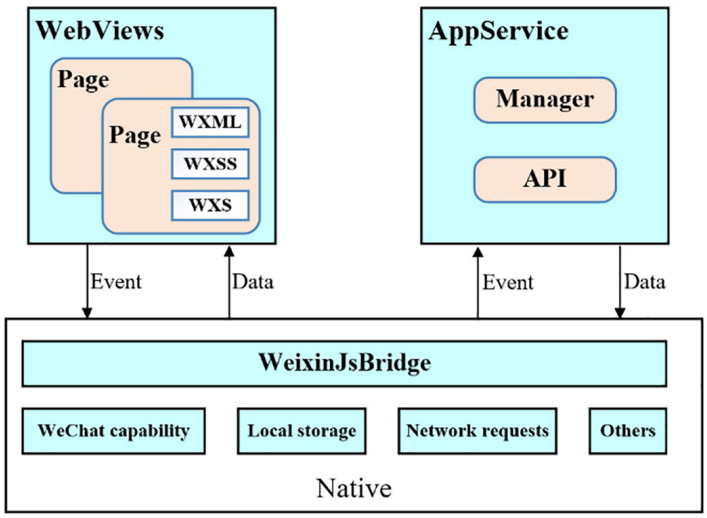


**Fig. 1.** The basic architecture of the WeChat mini-program

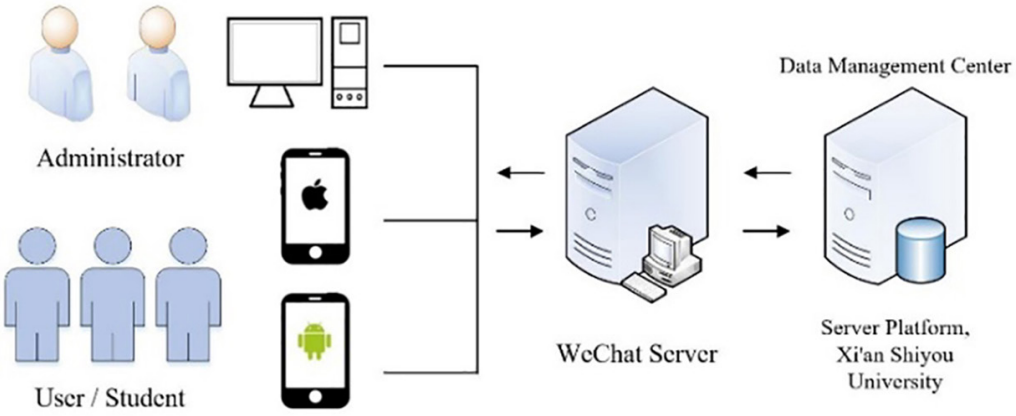


**Fig. 2.** Architecture diagram of WeChat online experimental teaching platform

## 3.3 Functional design of the platform

At present, the experimental course in oil and gas storage and transportation offers 36 experimental projects, totaling 105 credit hours. Students can choose the experiments they are interested in from the nine module experiments, for a total of 48 credit hours. The course is assessed through attendance, lab preparation, lab operation, experiment reports, and other assignments. Through the online experimental teaching platform, students can access videos, experimental equipment, and instructions for pre-testing, as well as write pre-testing reports. After entering the lab, the teacher provides a brief explanation of the experimental project, and the students work in groups to perform practical operations and record the raw data. After the class, they are required to write a formal report.

The functional design of the WeChat platform needs to align with the characteristics of experimental teaching. This includes not only incorporating the current stage's content of experimental teaching to meet the teaching mode but also providing richer information, more three-dimensional content, a simple and clear interface, and convenience for teachers and students to operate and experience. The basic modules include "Experiment Center," "Laboratory Experiment," and "Virtual Simulation Experiment." The module structure is shown in Figure 3.

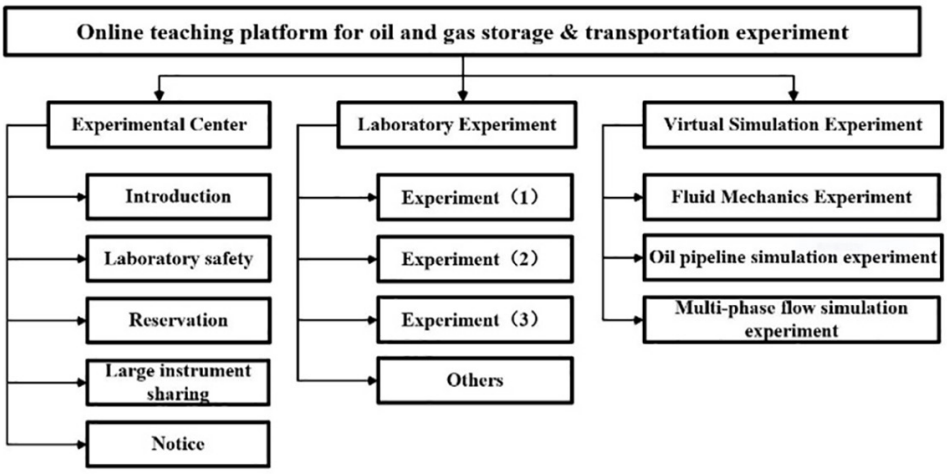


**Fig. 3.** The functional module architecture of the online experimental teaching platform

1. **Experimental Center**

It includes five sub-functional modules: introduction to the experimental center, laboratory safety, reservation, reservation of large instruments, and notice. This document primarily provides an overview of the current state of the experimental center, including its development history, teacher information, safety management, safe operation, and other relevant details. The purpose is to facilitate teachers and students in understanding of the laboratory's development status. At the same time, open reservations are made for regular experimental projects, graduation design, innovation, and entrepreneurship, such as the "Challenge Cup" and "Internet+," as well as for large instruments and equipment. This allows students to conveniently engage in innovative science and technology experiments. Relevant laboratory notices are released to promote learning and communication between teachers and students, as well as to facilitate real-time interaction between them.

2. **Laboratory experiments**

The sub-functional module includes professional experiments in oil and gas storage and transportation, such as (1), (2), (3), and other related experiments. This platform is used to introduce teaching videos, teaching PPT, instruments and equipment, operation procedures, safety precautions, and other materials related to the experimental courses taken by students studying oil and gas storage and transportation at our university. The purpose is to facilitate offline learning and enhance students' interest in the experimental classes.

3. **Virtual simulation experiment**

It includes three sub-functional modules: the fluid mechanics simulation experiment, the oil pipeline simulation experiment, and the multi-phase flow simulation experiment. It primarily provides virtual-simulation experiments for the course, allowing students to engage in hands-on practice without being limited by time and space. This enables them to experience a realistic experimental environment.

## 3.4 Specific implementation of WeChat mini-program client

1. **Create a WeChat mini-program client project**

To get started, log in to the WeChat public platform at https://mp.weixin.qq.com/ and create a mini-program account. Once the registration is complete, you can find the mini-program AppID in the "Development Settings" option. Open the WeChat web developer tools and enter the project name, directory, and AppID in the "New applet project" dialog box to create a default WeChat mini-program. The directory contains the pages directory for storing "pages" and the "utils" directory for storing shared application logic libraries. It also includes the mini-program's startup entry file "app.js," the global configuration file "app.json," the global style file "app.wxss," and the project configuration file "project.config.json." Each page file subdirectory contains a .js page script that implements the page's business logic, a. json page configuration file to configure the current page's effect, a.wxml page template structure file to build the interface, and a.wxss style sheet file to beautify the interface. The online experiment teaching platform mainly consists of four pages: login, study, messages, and me. These four pages all belong to the tabBar class page. When creating a project, you need to add the wxml file of these four pages to the tabBar configuration item in the app.json global configuration file.

### 2. Login page

The users can log in after entering their name, student number, and password on the page, as shown in Figure 4a. After logging in, you can click on "Study," "Messages," or "Me" at the bottom of the page to switch to other interfaces. Otherwise, the wx.showModal() function will be called to display a warning message.

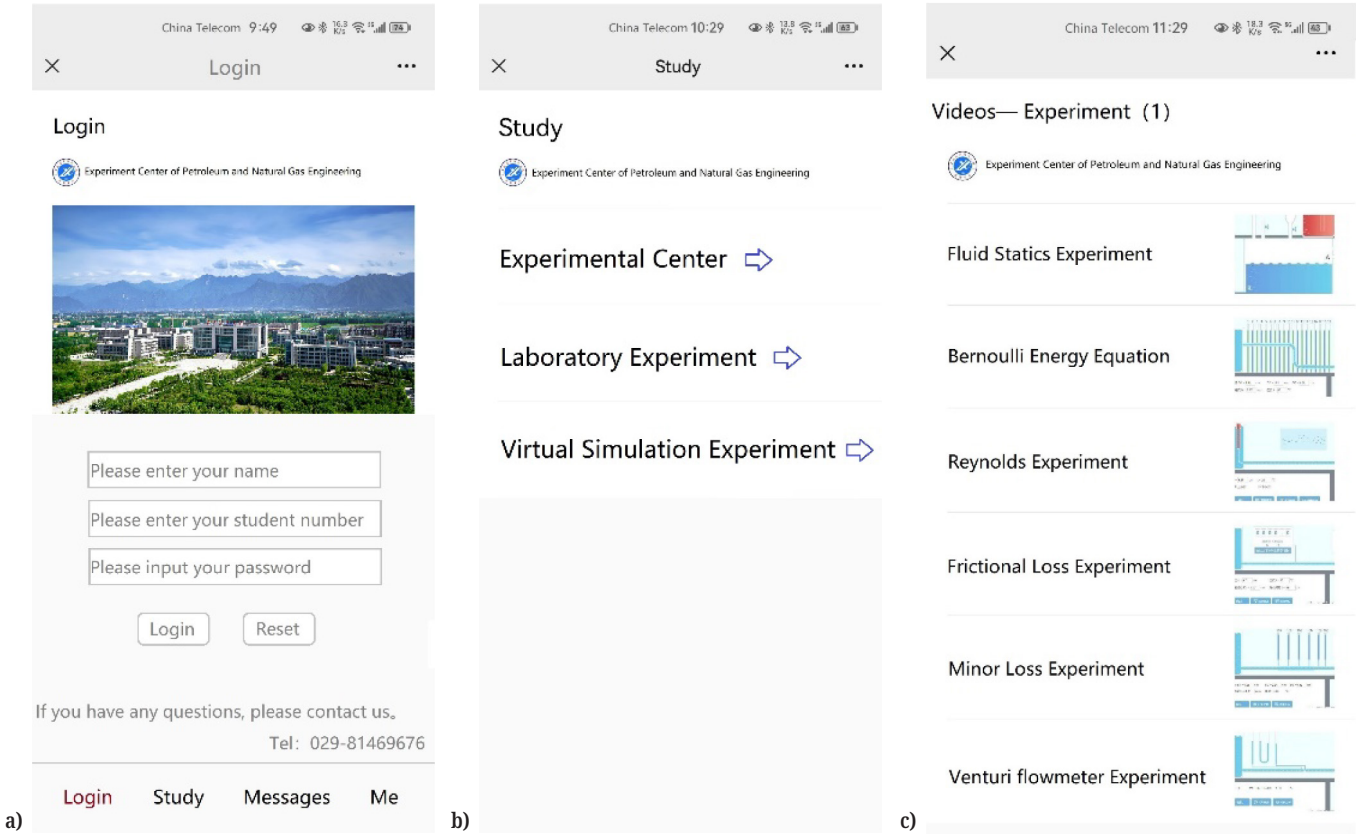


**Fig. 4.** Login page and Learning page

### 3. Learning page

After accessing the learning page depicted in Figure 4b and c, you will find three modules: an experiment center, a laboratory experiment, and a virtual simulation experiment. Students can access the appropriate module for their learning needs. They can watch instructional videos on various topics, including instruments and equipment, operating procedures, and more. Additionally, they have the option to make reservations for different experiments and engage in interactions with teachers.

## 3.5 Design and implementation of the backend database

The student login information and access to teaching materials are stored in a database on the server platform of Xi'an Shiyou University. This database allows for real-time data and file storage. The application database built by the server platform can store multiple different types of data, such as String, Number, Boolean, Date, File, Array, Object, etc. The developers can create a database and download the

corresponding version of the SDK to integrate it into the utils folder of the WeChat mini-program project. After initializing the code, you can perform various operations on the database, such as adding, deleting, changing, and querying, similar to a local database, through the WeChat server.

# 4 APPLICATION PRACTICE ANALYSIS AND DISCUSSION

## 4.1 Platform application data

After the platform was built, the teachers of oil and gas storage and transportation engineering and the teachers of the experimental center at our university did a trial. It was then gradually improved based on the feedback received from the teachers. Next, it was implemented for a class of 34 undergraduate students in the oil and gas storage and transportation engineering program in 2018. Further improvements were made based on the feedback received from the students. Finally, all students in the major were made aware of this platform through the use of a quick response (QR) code. Up to now, the public platform has been open and running for teachers and students for nearly 19 months, with over 1,200 registered users. It has been utilized by students from all three grades, covering a wide range of users. According to the background statistics of the online teaching platform, the average monthly number of active users is 381, which accounts for 31.8%.

In the platform's application process, students can easily access and learn the course materials provided by the teacher. They can engage in various learning activities through the interactive menu designed for this purpose. During the learning process, students can access the corresponding menu based on their learning needs. They can open video, photos, or courseware, and other materials related to the experimental projects for independent learning. This allows them to become familiar with the principles, experimental instruments, hands-on processes, background knowledge, and other relevant content. As a result, when they enter the laboratory, they will not feel unfamiliar and will no longer be at a loss when carrying out experimental operations. The statistics in the background indicate that the video has been played in total with an average of 7.2 plays per person. The courseware has been consulted approximately 8.4 times per person, and the per capita number of clicks on the submenus of the laboratory experiment and virtual simulation experiment have been clicked on more than 3.3 times per person. These numbers demonstrate that the expected goal has been achieved, and it shows that students have a certain level of independent learning and are more engaged in active learning before class.

In addition, some students have made reservations for experiments on the platform based on their availability and the laboratory's opening hours. To access the reservation platform, click on "Experiment Center" and then select "Open Reservation." From there, choose the experiment item and enter the reservation interface. Select the desired experiment time and provide your name, class, student number, and phone number. Once you have completed these steps, you will be able to successfully make a reservation. Through analyzing the data, teachers will review students' applications and subsequently inform them of the scheduled experiment time. They will also remind students to arrive at the lab punctually. In addition, students can reserve laboratory instruments and equipment according to their needs when they are working on their graduation design, participating in innovation and entrepreneurship projects or competitions, such as the "Internet +" design competition,

or conducting other innovative experiments in science and technology. Since the platform has been implemented, every student in the class has made reservations for experimental projects before class, achieving a 100% coverage rate. However, the number of reservations for innovative experimental projects such as graduation design, innovation and entrepreneurship, and "Internet+" is low. The reason for this is that students typically do not have a need for innovative experimental projects and do not require the use of laboratory instruments and equipment. Instead, they usually wait until the competition begins to have a specific demand.

To prevent laboratory safety accidents, students are required to independently acquire safety knowledge before entering the laboratory. In the context of lab safety, students can access safety education documents, related knowledge, and videos by clicking on "Experiment Center" → "Laboratory Safety." However, since the platform has been operational, the "Laboratory Safety" submenu has been clicked an average of 2.5 times per user. This has met the expected goal. However, there is currently no assessment link available to evaluate students' understanding of safety education. This is an area that needs improvement in the next phase of development for the teaching platform.

## 4.2 Evaluation effect of teachers and students

In order to evaluate the effectiveness of the public platform for teachers and students, a questionnaire survey was conducted to gather feedback from 650 users (630 students and 20 teachers) over a period of nearly 19 months. The results showed that 100% of the teachers believed that the online laboratory teaching platform helped improve students' learning enthusiasm and stimulated their interest in learning. They were also willing to participate in the operation and management of the platform to enhance students' learning outcomes. Furthermore, they were willing to provide their own experimental teaching materials or collect materials for students' learning. 100% of the students believed that the online laboratory teaching platform had enhanced their interest in learning laboratory courses. Additionally, 82.1% of the students found it helpful, while the remaining 17.9% had a positive opinion about it. Furthermore, all students (100%) utilized teaching materials such as videos and PPTs before class. Only a small percentage (3%) considered pre-studying a waste of time. Moreover, 97.3% of students reported that watching the materials improved their understanding of experimental instruments and operational procedures, as well as their proficiency in conducting experiments. The remaining 2.7% of the students believed that the teachers should provide more detailed explanations of the experimental apparatus and operation steps during class. On the other hand, 96.8% of the students expressed their desire for the online teaching platform to be utilized in other experimental classes, as they believed it would enhance their interest and learning outcomes.

To compare the learning effects, the authors analyzed the results of laboratory classes for undergraduate students majoring in oil and gas storage and transportation engineering in 2018. The study included 114 students and compared their performance in the two semesters before and after using the public platform, as depicted in Figure 5. It can be seen that the majority of the students' grades were concentrated in the excellent and good ranges. After using the platform for learning, the percentage of students who achieved an excellent grade increased from 2.6% to 7.0%. The percentage of students who achieved a good grade also increased from 75.4% to 81.6%. Overall, there was a 10.6% increase in the percentage of

students who achieved either an excellent or good grade. These results indicate that the learning effect has improved compared to before.

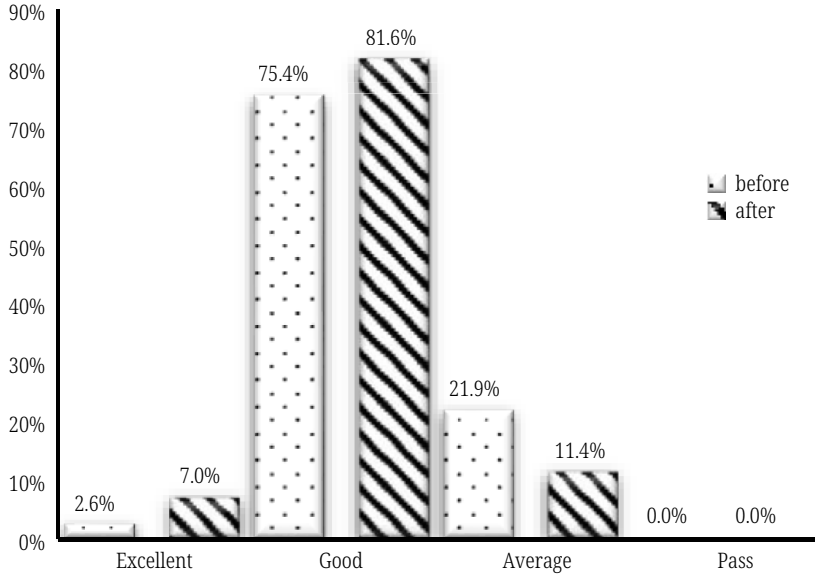


**Fig. 5.** The comparison of students' performance in lab classes before and after using the online teaching platform

The evaluation results above demonstrate that the WeChat-based online laboratory teaching platform, for its support in laboratory teaching, is highly regarded by both teachers and students for its support in laboratory teaching. This platform not only enhances students' learning enthusiasm and stimulates classroom engagement, but also significantly improves their learning outcomes. The students highly evaluate the platform for its effectiveness in knowledge acquisition and skill enhancement. Teachers have also noticed that students are more confident and engaged in the lab, leading to improved enthusiasm for learning and increased classroom vitality.

## 4.3 Continuous improvement of platform operation

Since the platform has been implemented, although certain achievements have been made, there are still a few students who are not actively participating in the classroom. These students need to be encouraged to focus on their studies and guided patiently during experimental operations. At the same time, some students hope that the teacher will provide further explanations on the design method and process of the experimental scheme, as well as other teaching materials that are not available on the platform. They also express their own opinions on the issues that arise during the experimental process. This indicates that there are still many students who have a strong thirst for knowledge and a desire to learn. In the teaching process, teachers need to instruct students based on their individual abilities. This involves not only attending to students who may struggle with the material but also encouraging those who may be less challenged to explore and innovate actively.

At present, the teaching materials provided on the platform are still limited to the regular experimental teaching items required by the syllabus and are less involved

in the design and innovation of experimental items. The next step is to increase the number of experimental activities in order to enhance students' creative awareness and foster innovative thinking. At the same time, it is necessary to enhance the display and introduction of instruments and equipment in the laboratory. This will facilitate students in developing new functions of experimental instruments, designing and conducting valuable innovative experiments in scientific research, utilizing the existing laboratory conditions, and improving their ability for independent innovation.

## 5 CONCLUSIONS

The online experimental teaching platform for oil and gas storage and transportation, based on WeChat, as designed and built in this article, is a result of integrating experimental teaching with the mobile Internet. This platform was developed under the guidance of the Chinese Ministry of Education and in response to the construction of new engineering disciplines. It serves as an effective tool to facilitate the reform of the teaching mode by integrating online and offline components, thereby expanding traditional experimental teaching's spatial and temporal boundaries. It has practical significance in promoting the reform of experimental teaching and the improvement of teaching quality.

The use of this platform to support experimental teaching has addressed the limitations of traditional methods. By publishing learning resources on public platforms, teachers enable students to access them at any time via mobile devices. This allows for advanced inspection of laboratory environments and equipment, as well as a more intuitive understanding of experimental courses. The platform boasts simple operations and fast content delivery speeds, and it is no longer restricted by temporal constraints. Students have the opportunity to engage in continuous communication and discussion with both teachers and classmates, enabling them to seek guidance or clarification on specific laboratory procedures or experimental equipment at any time. Within the experimental classroom setting, students have the opportunity to access operation videos and supplementary resources available on the learning platform. This allows them to enhance their proficiency in conducting experiments and processing data, even if they encounter difficulties comprehending the teacher's explanations. In nearly two years of operation and practice, the platform has received unanimous praise from teachers and students. The students' enthusiasm for learning has significantly increased, and the effectiveness of their learning has been enhanced. At the same time, the platform has bridged the psychological and spatial gap between the laboratory, teachers, and students. It has also enhanced the awareness of teachers and students to actively participate in laboratory management and operation. Furthermore, it has expanded the range of interactive and continuous communication of information between teachers and students, thus achieving the intended construction goal of the platform. Despite the aforementioned benefits, future research should also pay attention to the following aspects: Firstly, it is necessary to further explore the reform of the flipped classroom teaching mode in combination with the platform. This will transfer the initiative of learning to a greater extent from teachers to students, providing students with a practical guidance mode for experimental teaching design. This transformation of the original experimental classroom will result in a better teaching effect and provide a basis for cultivating and promoting students' independent learning ability and innovation consciousness [27, 28]. Secondly, the supervision and assessment

of the pre-class preview process should not rely solely on the platform's statistics regarding video viewing times and material reading times. It is necessary to continue developing platform functions to enhance the effectiveness of pre-class previews. Otherwise, it will be difficult to facilitate effective discussions in the experimental classroom. Finally, this paper focuses on the experimental teaching of oil and gas storage and transportation engineering majors. The findings in this study need to be further researched to determine their suitability for experimental teaching in other engineering majors.

## 6 ACKNOWLEDGMENT

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