**Open Access Library Journal**
2023, Volume 10, e10491
ISSN Online: 2333-9721
ISSN Print: 2333-9705

# Teaching Reform of Virtual Instrument Technology and Application Course Based on OBE Concept

**Xingzhi Xu**

College of Mechanical and Control Engineering, Guilin University of Technology, Guilin, China
Email: 414246895@qq.com

**How to cite this paper:** Xu, X.Z. (2023) Teaching Reform of Virtual Instrument Technology and Application Course Based on OBE Concept. *Open Access Library Journal*, **10**: e10491.
https://doi.org/10.4236/oalib.1110491

**Received:** July 10, 2023
**Accepted:** July 24, 2023
**Published:** July 31, 2023



## Abstract

Virtual instrument technology is widely used in the field of information engineering. Based on the concept of OBE, this paper carries out the teaching reform of virtual instrument technology and application course, optimizes the teaching content from the training goal, updates the teaching method with students as the center, improves the assessment standard with the evaluation of learning results, and puts forward the measures to ensure continuous improvement. Practice shows that the reform has enhanced students' interest in learning, enhanced their practical ability to analyze and solve problems, and laid a good foundation for further improving the quality of talent training.

## Subject Areas

Mechanical Engineering

## Keywords

Virtual Instruments, OBE, Labview, Teaching Reform

## 1. Introduction

The concept of virtual instrument technology was created by the United States NI (National Instruments) company, which clearly put forward the design concept of "software is instrument", and launched a graphical programming software Labview in 1986. Virtual instrument technology uses the graphical programming software, combined with hardware acquisition card and other equipment to complete the signal acquisition, analysis, processing, output and other content, widely used in engineering testing, aerospace, military science and

technology and electronic information technology-related measurement, control fields. It has strong practicability [1].

In view of the shortcomings in the application process of the virtual instrument system, many teaching workers have put forward teaching reform methods, teaching modes, teaching content and other innovative suggestions. However, in view of the integration of theory and practice in the teaching process, there is still a lack of corresponding research on detailed assessment.

OBE (Outcome-based Education) is a kind of outcome-based education, which is student-centered and focuses on what learning outcomes students can get through the education process. Aiming at the problems of outdated syllabus, insufficient practice links, backward teaching methods, single assessment methods and other problems in the teaching of virtual instrument technology and application course, the course of integrating theory and practice is adopted, and the original course content is reintegrated under the concept of OBE [2] [3]. Improved training objectives, teaching content, experimental teaching, assessment methods, etc., in order to systematically improve the teaching level of virtual instrument courses and enhance the ability of students to adapt to the new situation of industrial enterprises for the skills of graduates.

## 2. Problems in the Teaching of Virtual Instrument Technology Course

The traditional teaching method is "teacher-centered". Students are completely listening in the classroom, watching the teacher demonstrate programming, easy to forget after class, and then open the book control operation, efficiency is not high. If the basic problem of programming is not solved in time, students are more likely to give up. The traditional teaching method neglects the cultivation of students' independent learning ability, practical ability and innovative ability.

In the traditional teaching method, the teaching link of virtual instrument technology and application course is mainly divided into two parts. 1) The content of the experiment is relatively simple and the practice link is lacking. The labview of some knowledge points and professional cases are shown in **Table 1**. The experiment is based on software and can be completed according to the guidance steps. The lack of comprehensive course design fails to fully mobilize students' enthusiasm for learning and carry out practical training, and does not play the role of courses in improving students' comprehensive ability, which affects subsequent graduation design and professional practice. 2) The examination method is based on paper examination. Although attendance, homework and experiments have been counted as the total score of normal participation in the assessment process, they account for a relatively low proportion. Students focus on the final exam paper, ignoring the process of analyzing and solving problems, which is not conducive to making an objective evaluation of students' practical ability and comprehensive quality [4] [5] [6].

At present, many colleges and universities use the experiment box or labview

**Table 1.** Labview some knowledge points and professional cases.

| number | knowledge point | case content |
|---|---|---|
| 1 | for-loop structure | obtain the maximum and minimum values of the collected voltage |
| 2 | while-loop structure | filter processing of acquisition temperature |
| 3 | conditional structure | detect liquid level and alarm processing |
| 4 | sequential structure | calculate the running time of a program |
| 5 | formula node | find a two-dimensional function curve |
| 6 | local variable | design current display program |
| 7 | global variable | implementation of dual-machine communication protocol |
| 8 | waveform chart | design the sequence display program of sine wave, square wave and triangle wave |
| 9 | intensity map | program for designing the relationship between two-dimensional array and screen strength |

Note: The content in the table is quoted from the literature [2].

simulation platform in the practice course of virtual instrument technology. The experimental box has some problems such as slow update speed and fixed module. In addition, most of the experimental contents of the experimental boxes are confirmatory experiments. When the experimental results appear, students will think that the experiment has been completed, so as to stop their learning pace. Practical teaching through simulation software can solve problems such as insufficient hardware resources. However, in practical application, it will be found that there is still a certain gap between simulation software and actual projects, and over-reliance on simulation software will also affect the learning effect. The dso38lab virtual instrument experiment box is shown in **Figure 1**.

## 3. Teaching Practice of Integration of Theory and Practice Based on OBE Concept

### 3.1. Clear Learning Goals and Optimize Teaching Content

In combination with professional characteristics, from the graduation requirements and employment needs, clear learning objectives, so that students can complete the acquisition, analysis and processing of signals through the study of virtual instrument technology courses, the output and display of results, so that students have engineering awareness, and cultivate students' ability to analyze and solve practical problems as well as teamwork and communication skills [7]. The teaching content is divided into two parts. One is software design, which mainly includes basic program design and signal processing. Courses include program structure, basic data types, variables, file operation, graphic display, program debugging, sub-VI design, signal generation, time domain and frequency domain analysis, digital filter, serial communication and network communication.

Figure 1. DSO38Lab virtual instrument experiment box. Note: This image is from the dedicated equipment of the Virtual Instrument Laboratory.

The second is Hardware acquisition, including: data acquisition, bus interface technology. According to the course content and learning effect, the 32-hour theoretical course is mainly arranged to teach software design, and the last 2 hours is to teach hardware acquisition, followed by the experimental course based on hardware acquisition card, and a one-week course design is arranged before the end of the semester. The content of serial communication between the host computer and the single chip microcomputer will be carried out by self-study in the course design. In the design of the hardware case of virtual instrument, the knowledge points related to analog electronics and digital electronics are introduced, so that students can carry out circuit analysis simultaneously during the experiment, and achieve the purpose of complementing each other between courses. The case of virtual instrument technology combined with analog electronics and digital electronics is shown in Table 2.

### 3.2. Enhance Students' Awareness of Active Learning and Strengthen Students' Learning Subject Consciousness

The teacher began with the introduction of the engineering projects completed by using virtual instrument technology, the winning works of the National Virtual Instrument Competition, and the training works of college students' innovation and entrepreneurship, and then introduced the graduation design topics that students could choose from far and near, and then implemented the knowledge points that the course needs to learn from large to small, so that students could intuitively realize the practicability of the course and understand the design of the teaching content At the same time, it provides an effective introduction of network and reference teaching materials resources to pave the way for subsequent course learning [8].

The theoretical classes are taught in the laboratory in a combination of teaching and practice. The teacher teaches the key points of programming and demonstrates the operation results of example problems. The students complete

**Table 2.** The case of virtual instrument technology combined with analog electronics and digital electronics.

| number | analog electronic case | digital electronic case |
|---|---|---|
| 1 | diode characteristics and analysis | basic logic gates test |
| 2 | analysis of single tube basic amplifier circuit | decoder function test |
| 3 | field effect tube amplifier circuit | comparator function test |
| 4 | resistance-capacitance coupling multistage amplification and feedback | seven-segment code latch test |
| 5 | differential Amplification | 555 timer test |
| 6 | integrated op amp design | trigger function test |

Note: The content in the table is quoted from the literature [2].

basic exercises in class and the teacher records the completion of classroom exercises. The original relaxed state of listening in class is transformed into a state of pressure where results need to be tested and the students are urged to "do". "Learning", timely completion of each lesson needs to master the core content. In the course of teaching, different teaching methods are used for different contents, and heuristic and comparative methods are used for basic programming content. For example, the loop structure, mainly through the while loop and students are not unfamiliar with these two loop structures. They have been in contact with them in the previous text language programming class. Teachers can ask, these two are cycles, what parameters or conditions are required to complete the cycle, so that students can think from the reference of previous knowledge, and the corresponding programming is in the graphic language labview after introducing the implementation method, it is proposed to use the cycle to achieve accumulation or calculate factorial how to achieve, leading to the introduction of the use of shift register, and then ask students to complete an accumulation design, from understanding to realization, the teaching rhythm is compact, which helps to digest the basic knowledge in time and solve the main problems. After-class expansion and in-depth learning should be carried out on the basis of class. For this part of content, it is necessary not only to avoid blind selection by students, but also to take into account the different understanding speed of each student.

Teachers need to make specific plans, put forward clear after-class learning requirements in each class, play the role of online teaching platform, provide rich learning materials, and combine actual cases with the cooperation of in-class teaching, the curriculum will implement the cultivation of students' exploration and innovation ability. Students need to consult recommended books, watch micro-class videos, complete homework combined with discussion, and summarize the problems learned in class and encountered after class and their solutions. The course team will arrange teachers on duty every week to answer questions and communicate with students online and offline to assist students in learning after class and thinking positively. Set up a professional pocket lab and

configure my DAQ acquisition card can carry out experiments such as software instrument measurement, audio signal processing, analog signal and digital signal acquisition and output, to meet the experimental needs of students for the whole process of signal acquisition, processing and output, and jointly establish a comprehensive open laboratory combined with sensors and microcontrollers, so as to facilitate students to improve and optimize on the basis of existing experiments in class And competition works, try to explore, innovative design. According to the content they are interested in, students will work in groups of 3 to further discuss and research, form preliminary ideas, communicate with teachers, clarify the design plan, complete the design in the comprehensive course design week, write the design report, make PPT to explain the design process and show the results. In this way, students can continue to think after class, make full use of the experimental platform, enhance students' sense of achievement in learning in the process of solving problems, and help enhance the motivation for independent learning and form a good learning atmosphere. The NI vision camera acquisition and onnx inference are shown in Figure 2 and Figure 3.

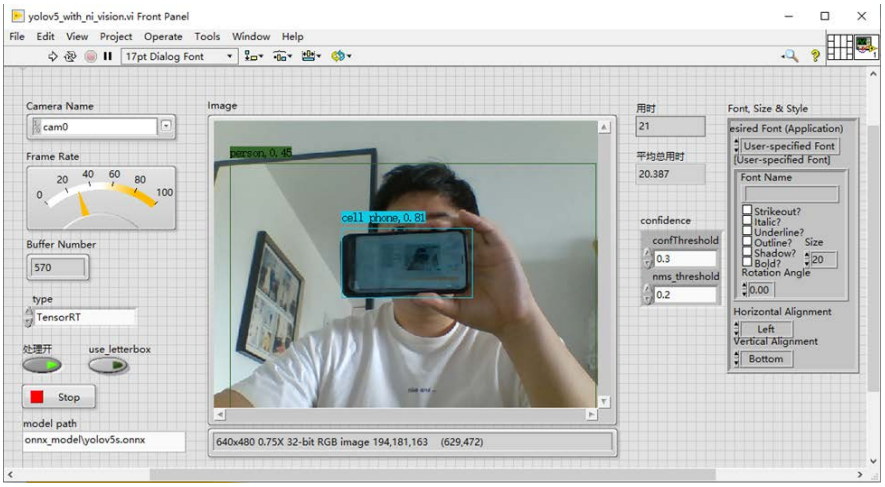


Figure 2. NI vision camera acquisition and onnx inference interface. Note: This image is from the development project of the Virtual Instrument Competition for College students.

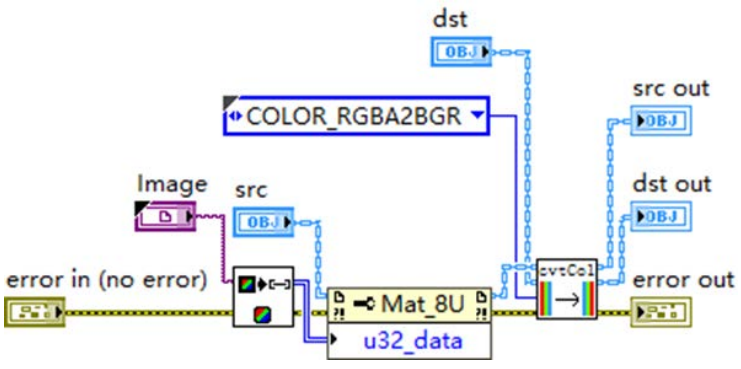


Figure 3. Block diagram of NI vision camera acquisition and onnx inference. Note: This image is from the development project of the Virtual Instrument Competition for College students.

### 3.3. Based Learning Effect and Improve Course Assessment Standards

To improve the assessment methods and evaluation standards based on the OBE concept, it is necessary to reflect the practical ability and comprehensive level of students and encourage innovation, play a positive impact on students' learning enthusiasm and enthusiasm, pay attention to process and diversification, pay attention to individuation and differentiation, and adopt the combination of process assessment and final examination.

Daily performance includes classroom learning performance and the completion of after-school exercises, involving class attendance, classroom discipline, classroom exercises, after-school extended learning and homework submission, hands-on operation of experimental classes and the writing of experimental reports. It not only depends on whether students finish within the prescribed time, but also focuses on how to solve problems encountered in the learning process, whether they can think positively and summarize in time, so as to encourage students to continue carrying out effective learning. The practical results are mainly aimed at the course design, results-oriented, and evaluate the practical learning process. According to the graduation design defense process and the scoring requirements of virtual instrument competition, we will hire experienced engineers and course team teachers to participate in the review, not only to examine the quality of design documents, design ability and work demonstration effect, but also to examine the practicality and creativity of the program, students' teamwork, communication, and encourage students to think and propose problems from the actual needs High analytical and practical ability to solve engineering problems.

The final exam adopts the form of paper answer, which consists of two types of questions: indefinite choice and short answer. The simulation test of Labview assistant development engineer certification is selected to check whether students have a broad and comprehensive understanding of the core features and functions of the development system, and can use this knowledge to develop, debug, and maintain small program modules. The short answer is to test whether students can analyze practical engineering problems and put forward feasible plans. The selection of topics covers the main points of all parts of the course as far as possible, and the achievement degree of the course teaching objectives is tested from the breadth and practicality of knowledge mastery.

## 4. Enhance the Collaborative Development of Teachers and Students and Ensure the Continuous Improvement of Curriculum Teaching

OBE teaching reform requires students to be the center, first of all, teachers need to maintain an active state of learning, improve their ideological consciousness, teaching ability and professional level, so that moral education and knowledge education can go in the same direction. Through ideological and political study

seminars, teachers can enhance their understanding of the thought of socialism with Chinese characteristics in the new era, dig deep into the ideological and political elements contained in the curriculum, and stimulate students' consciousness of learning. By participating in online and offline teaching conferences and course observation, teachers can update teaching methods and teaching resources, adapt to students' learning habits, and make students willing to learn. Pay attention to the industry development and enterprise needs of this major, revise the teaching content and practical training requirements, and enhance the adaptability of students' practical development [9].

Only when teachers do the above work well can they have a better dialogue with students and transform their work into the results of students. Teachers should pay timely attention to students' feedback information, test the learning effect, answer students' questions, understand students' needs, inspire the spirit of exploration and innovation, and follow up the practice process, so as to know which aspects have been understood and absorbed by students and which aspects have not achieved ideal results, accumulate experience, and improve teaching work according to students' specific conditions. Enhance the students' sense of learning and the degree of achievement of the teaching objectives of the course, encourage both teachers and students to make progress together, and promote the sustainable development of teaching.

## 5. Conclusion

Improving the quality of professional personnel training needs to be implemented in the course of curriculum reform. Based on the concept of OBE, this paper carries out teaching reform of virtual instrument technology courses, respects students' main learning status, takes learning output as the orientation, timely solves basic problems in the combination of classroom teaching and practice, and urges and guarantees the orderly development of after-school extended learning and practical training. The reform encourages students to think positively and be diligent in practice, improves their learning initiative, enriches their learning life, and improves their participation in internal and external discipline competitions and awards, and achieves good results. In the future teaching reform, students will be guided to exercise their hands-on ability and problem-solving ability through project-based teaching methods, while enhancing students' interest in learning and subjective initiative.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

## References

[1] Hui, Y., Xu, Z.G. and Hu, G.B. (2020) Electronic Information Professional Course Teaching Reform Based on Virtual Instrument Technology. *Journal of Integrated Circuit*, **1**, 122-124.

[2] Zhang, Y.L. (2020) Reconstruction of Teaching Syllabus Based on OBE Concept. *Journal of Jiangsu University of Science and Technology*, **20**, 90-95.

[3] Tian, F. (2023) A Research of the Course "Taishan Cultural Communication with the World" under Blended Learning Model and Outcome-Based Education Concept. *Open Journal of Applied Sciences*, **13**, 529-537. https://doi.org/10.4236/ojapps.2023.134042

[4] Xie, Q., Chen, F. and Xu, W. (2016) Exploration and Practice of Teaching Reform of "Virtual Instrument Technology" Course. *Journal of Higher Education*, **9,** 161-163.

[5] Zhao, J.C., Liu, G.Y. and Wei, Y. (2021) Based on Hybrid Virtual Instrument Design Course Exploration and Practice of Teaching Model. *Journal of Horizon of Science and Technology*, **35**, 38-39.

[6] Huang, F. and Lei, F.F. (2017) Research on Teaching Reform of Virtual Instrument Technology Course. *Modernization of Education*, **4**, 77-80.

[7] Fu, S.L., Wang, Y. and Huang, H.Y. (2020) Teaching Model Reform of Virtual Instrument Technology Course under the Background of Curriculum "Three Degrees" Construction. *The Internet of Things Technology*, **10**, 115-117.

[8] Yuan, M., Rong, Z. and Bao, J. (2022) Data Driven "First-Class Virtual Instrument Technology" Course Construction Exploration. *Science and Technology and Innovation*, **3**, 4-6.

[9] Bao, J. (2022) Teaching Analysis and Design of Virtual Instrument Technology Online and Offline Hybrid Course. *Science Tribune*, **4,** 127-129.