Exploration of OBE-based Smart Classroom Teaching Mode in Application-oriented Universities

—Taking "Data Structures and Algorithms" as an Example

Chen Zhang*, Xin Zhang, Zhi Cheng, Chunling Hu and Jing Tu

Hefei University, School of Artificial Intelligence and Big Data, Hefei, Anhui Province, 230000, China

*zhangchen0304@163.com

Abstract. With the advancement of educational reform and the development of information technology, application-oriented colleges and universities have an urgent need for an OBE-based smart classroom teaching mode. Taking the "Data Structures and Algorithms" course as an example, this paper explores the OBE-based smart classroom teaching mode in application-oriented colleges and universities. First, it analyzes the current situation and existing problems of the "Data Structures and Algorithms" course, such as weak practical ability and traditional teaching methods. Then, a smart classroom teaching mode driven by students' learning results is constructed, and the course objectives are reset and the teaching process is optimized. The entire teaching process is divided into three stages: before class, in class, and after class. The technical advantages of big data analysis and artificial intelligence-assisted teaching are used to achieve personalized and accurate teaching.

Keywords: Application-oriented Colleges and Universities, OBE, Smart Class-Room, Data Structures and Algorithms.

1 Introduction

1.1 Research Background

With the continuous advancement of educational reform, application-oriented colleges and universities are facing new challenges and opportunities in talent cultivation. In today's society, the demand for applied talents is growing day by day, which requires colleges and universities not only to impart professional knowledge but also to pay more attention to cultivating students' practical abilities and innovative spirits. The OBE (Outcome-Based Education) education model is student-centered and emphasizes students' learning outcomes and ability improvement, which is in line with the talent cultivation goals of application-oriented colleges and universities.

At the same time, with the rapid development of information technology, the smart classroom teaching mode has gradually become a new trend in the field of education.

J. Yin et al. (eds.), *Proceedings of the 4th International Conference on New Media Development and Modernized Education (NMDME 2024)*, Advances in Intelligent Systems Research 188,
https://doi.org/10.2991/978-94-6463-600-0_3

Smart classrooms use advanced information technology means such as big data and artificial intelligence to provide students with personalized learning experiences and improve teaching effectiveness and quality.

At present, in the teaching reform of application-oriented colleges and universities, the demand for OBE and smart classroom teaching modes is becoming increasingly urgent. Many colleges and universities have begun to try to integrate the OBE concept into curriculum teaching and actively explore the application of smart classroom teaching modes. However, in the practice process, there are still some problems and challenges, such as unclear teaching goals and unreasonable instructional design. Therefore, in-depth research on the OBE-based smart classroom teaching mode in application-oriented colleges and universities has important practical significance.

1.2 Current Situation of "Data Structures and Algorithms" Course in Application-Oriented Colleges and Universities

"Data Structures and Algorithms" is a basic core course for computer majors and has very strong theoretical and practicality. The course introduces typical data structures such as linear lists, stacks, queues, arrays, generalized lists, binary trees, trees, graphs, and sets. It mainly describes their logical structures, storage structures, and algorithm implementations and performance analyses of basic operations. On this basis, it introduces the application implementation of these data structures in typical operations such as searching and sorting. At present, this course mainly has the following problems:

Theoretical nature is relatively strong while practical nature is relatively weak. The course of "Data Structures and Algorithms" contains a large number of abstract concepts and complex algorithm principles, such as stacks, queues, linear lists, trees, graphs, etc. It is of certain difficulty for students in application-oriented universities to understand. The daily course content often focuses on the imparting of theoretical knowledge and is not closely integrated with practical applications, resulting in students' lack of interest and motivation in the learning process. With the rapid development of information technology, the field of data structures and algorithms is also constantly being updated and evolving. However, the course content in some application-oriented universities is not updated in a timely manner and is not combined with the current frontiers of science and technology, so it fails to reflect the latest technological developments and application requirements. In addition, in the teaching process, less emphasis is placed on practice, and there are few practical cases combined with the course content, making it impossible to achieve a good combination of theory and practice, leading to students' poor practical abilities.

The teaching mode is traditional and the teaching methods are single. At present, the course of "Data Structures and Algorithms" in many application-oriented universities still adopts the traditional classroom lecturing method. Teachers explain theoretical knowledge on the podium while students passively accept it. This teaching mode lacks interactivity and practicality and it is difficult to stimulate students' learning enthusiasm and creativity. In the teaching process, it mainly relies on traditional teaching means such as textbooks and PPTs, lacking diverse teaching resources and tools. The new

generation of information technology has not been fully integrated into the daily teaching. The traditional teaching mode and teaching methods cannot meet the needs of students for personalized learning and autonomous learning.

2 Theoretical Foundations

2.1 OBE Educational Concept and Development History

OBE (Outcome-Based Education), namely outcome-oriented education, is an education concept that is outcome-oriented and student-centered, and it holds a crucial position in today's education field. OBE, that is, outcome-oriented education, is an education concept that is outcome-oriented and student-centered and has a crucial position in today's education field. The core principles of OBE include reverse design and continuous improvement. Reverse design is in contrast to traditional forward design. Forward design is curriculum-oriented and emphasizes the systematicness and completeness of the disciplinary knowledge system[1]. Reverse design starts from needs. Needs determine training objectives, then training objectives determine graduation requirements, then graduation requirements determine the curriculum system, and then determine the learning outcomes and teaching content of each course. In teaching, reverse design must first clarify what the final outcome of students is, and then carefully design the training program and courses in reverse from the final outcome[2]. For example, at the course level, what constitutes a course and what content should be included in the course should be defined by the expected outcomes.

Continuous improvement is another important principle of OBE[3]. Implementing OBE requires a different pedagogy from traditional teaching. It emphasizes positive demonstration, expectation of success, deep engagement, diagnostic assessment, and timely feedback. Teachers should hold the belief that all students can succeed, set high-level learning outcomes, set high-standard evaluations, and provide additional guidance when needed[4]. At the same time, an incentive mechanism that combines challenges and support should be constructed. Through the assessment of learning outcomes, problems can be found in time, and teaching content and methods can be continuously adjusted to achieve the goal of continuous improvement.

2.2 The Meaning and Advantages of Smart Classrooms

As a new teaching mode, smart classrooms have the characteristics of intelligence, personalization, and practicality, providing new ideas and methods for the teaching reform of application-oriented colleges and universities[5]. Smart classrooms refer to the use of advanced information technology means such as big data, artificial intelligence, and the Internet of Things to innovate and upgrade traditional classrooms to achieve a more efficient, personalized and intelligent teaching environment[6]. In smart classrooms, teachers and students can interact and communicate through smart devices such as tablets and smartphones. Teaching resources can be presented digitally for students to learn anytime and anywhere[7]. At the same time, smart classrooms can also understand

students' learning situations and needs through data analysis technology, provide personalized teaching suggestions for teachers, and help teachers better conduct teaching.

Smart classrooms have the advantages of improving teaching effectiveness, realizing personalized teaching, enhancing teaching interactivity, promoting educational equity, and improving teaching management level. Specific as follows:

Improve teaching efficiency: Smart classrooms can realize the rapid sharing and transmission of teaching resources. Teachers can use tools such as electronic whiteboards and online teaching platforms to display teaching content to students more vividly and intuitively, improving students' learning interest and participation. Students can learn anytime and anywhere through smart devices and arrange their learning progress independently to improve learning efficiency.

Realize personalized teaching: Smart classrooms can understand students' learning situations and needs through data analysis technology and provide personalized teaching suggestions for teachers. Teachers can formulate personalized teaching plans according to the actual situation of students to meet the learning needs of different students. Students can also choose learning resources and learning methods suitable for themselves according to their own learning progress and ability to realize personalized learning.

Enhance teaching interactivity: Smart classrooms can realize interaction and communication between teachers and students through smart devices, such as online questioning, group discussions, voting, etc. This interactive way can enhance students' participation and learning interest and improve teaching effectiveness. Teachers can also understand students' learning situations and needs through interaction and adjust teaching strategies in time to improve teaching quality.

3 Application of "OBE + Smart Classroom" in the "Data Structures and Algorithms" Course

3.1 Course Objectives

Based on the OBE (Outcome-Based Education) concept, it is of vital importance to clarify the specific learning outcomes that students should achieve in the context of smart classrooms. The knowledge objectives should be closely integrated with the practical ability objectives. In terms of knowledge objectives, students are required to master the logical and physical structures of various data structures such as linear lists, stacks, queues, arrays, generalized lists, trees, and graphs, as well as the implementation principles of related algorithms. In terms of practical ability objectives, emphasis should be placed on cultivating students' ability to solve practical problems by applying the relevant knowledge of the learned data structures. While mastering theoretical knowledge, students should possess relatively strong practical hands-on abilities.

3.2 Design of Teaching Links Based on "OBE + Smart Classroom"

(1) Design of independent learning before class

In the "Data Structures and Algorithms" course, the hybrid smart teaching mode can be borrowed to guide students to preview using online resources before class. For example, teachers can post preview tasks on the course platform, including watching teaching videos, reading relevant materials, etc., and students can conduct independent learning according to their own learning progress and needs. Teachers can also use Chaoxing Learning APP to detect students' preview situation, understand students' learning difficulties and problems, so as to explain them targeted in classroom teaching.

(2) Interaction and practice in class

Enhance students' participation and practical ability through “case-driven + group discussion” and other methods. In classroom teaching, teachers can combine cases and put forward some targeted questions according to the situation of preview before class to guide students to think and discuss. For example, when it comes to the shortest path of graphs, teachers can ask about the popular tourist destination Harbin this year. How can we reach Harbin from Hefei? How to choose the shortest path among several paths? At the same time, preach the traditional Chinese virtue of respecting parents. Through this case, let students discuss in groups and then send representatives to speak. Through group discussions, students can exchange learning experiences with each other and deepen their understanding and mastery of knowledge. At the same time, teachers can also use the interactive functions of smart classrooms, such as online voting and answering quickly, to increase the interactivity of the classroom. In addition, in classroom teaching, practical links can also be added to allow students to consolidate the learned knowledge through programming practice. Through practical links, students can combine theoretical knowledge with practical applications and improve their programming ability and problem-solving ability.

(3) Personalized guidance after class

Through testing students' situation in class (mastery of knowledge points, learning interest, cooperation consciousness, learning ability), analyze the practical effect and process control, and conduct timely summary and reflection. After-class personalized tutoring takes into account students' differences and pushes independent learning content. First of all, teachers no longer assign unified homework, but issue targeted homework tasks based on each student's preview before class and classroom learning situation, and intelligently push personalized review materials based on the information technology platform; secondly, after students complete their homework, they can submit their homework to the teacher in time through the platform according to their own progress. Objective questions can get immediate automatic correction and feedback. For subjective homework questions, teachers can record micro-lessons for correcting homework for each student's homework situation and push them to this student or more students in time for personalized tutoring.

Take the shortest path of graphs as an example to design the teaching process of a smart classroom based on OBE, which is shown as Table 1.

Table 1. The intelligent classroom teaching process based on OBE takes the shortest path of graphs as an example.

Before class	Task released on Chaoxing Learning Platform: In transportation networks, questions like these are often raised: Is there a road connecting place A and place B? In cases where there are multiple routes, which one is the shortest?	Students watch videos to complete pre-class preview. Teachers adjust teaching contents, key points and difficult points according to students' feedback.
During class	Course introduction: transportation network problems.	Integrate ideological and political elements of the course. Take parents on a trip to reflect the traditional virtues of the Chinese nation.
	Body explanation: 1, Problem abstraction: In multiple paths from point A (source point) to point B (destination point) in a weighted directed graph, find a path with the minimum sum of edge weights, that is, the shortest path. 2, Shortest path algorithms (1) Single-source shortest path – Dijkstra (2) Shortest path between any two points - Floyd 3, Example explanation	Case-driven and group discussion to cultivate students' logical thinking, teamwork ability and language expression ability. Further adjust the teaching content according to students' feedback.
	Summary: Concepts and processes of Dijkstra and Floyd.	Summarize the problems reflected by students during the class.
After class.	Push homework and self-study content on Chaoxing Learning Platform.	Cultivate students' self-learning ability.

The Chaoxing Learning APP platform can integrate various types of teaching resources, including courseware, teaching videos, reference materials. It can also release learning tasks such as homework and exams, which is convenient for students to complete and submit online. It can also statistics students' learning situations and answering situations, etc., so that teachers can effectively grasp students' knowledge mastery and make timely adjustments to teaching key and difficult points. In addition, it provides a variety of interactive functions such as sign-in, discussion areas, Q&A, and group collaboration, etc., to cultivate students' teamwork ability.

4 Summary

This paper takes the "Data Structures and Algorithms" course as an example to explore the intelligent classroom teaching model based on OBE in application-oriented colleges. First of all, clarify the teaching objectives of the "Data Structures and Algorithms" course in application-oriented colleges. Its teaching objectives should closely revolve around the knowledge, abilities and quality requirements of software enterprises for talents. Master the logical structure, storage structure and flexible application

of linear lists, trees, graphs, hashing, etc. to solve practical problems and cultivate students to have a solid theoretical foundation and practical ability.

Secondly, construct an intelligent classroom teaching model based on OBE. Centering on students and guided by students' learning results, taking advantage of the technical advantages of intelligent classrooms, teaching is carried out in the ways of "case-driven + group discussion" before, during and after class. With the help of student learning data in Chaoxing Learning Platform, analyze students' learning behaviors to realize the personalization and precision of the teaching process.

Acknowledgment

This work was supported by the Teaching research project of Anhui Quality Engineering under Grant 2022jyxm1335, 2022jyxm1326, 2022jyxm1338, 2023jyxm0558, 2021xsxxkc261 and from the Anhui New Era Education Quality Engineering Project (Graduate Education) under Grant 2022xxsfkc050, 2022zyxwjxalk200.

References

1. Xu, S.F. (2021) Reverse design of the talent training program for international business majors based on the OBE concept. Times Education: Mid-term (11):0183-0184.
2. Kalaiselvi B , Sabarish R .(2023) Contribution by Supervised Learners on Outcome Based Education in Revised Education Policy using Machine Algorithms.Knowledge Transactions on, Applied Machine Learning(6):20.
3. Du, Z.J., Zhao G.Y. (2022) Reverse design of the talent training program for physical education majors based on the OBE concept. Contemporary Sports Technology12(2):120-123.
4. Thirumoorthy K , Muneeswaran K(2023). An application of text mining techniques and outcome based education: student recruitment system.Journal of ambient intelligence and humanized computing14(3): 1359-1371.
5. Xie, Q.Q, Zhang R.Y.2024High-quality development of intelligent classrooms for ideological and political courses in colleges and universities: value implications, problems and challenges, and realization mechanisms.
6. Zhu, S., Yang, S., Li, J.Y, et al. (2024)Evaluation paradigm of core literacy of courses in intelligent classroom situations. Open Education Research30(1):83-88.
7. Cheng, J. (2023)Research on college English teaching strategies from the perspective of intelligent classrooms. Innovation and Entrepreneurship Theory Research and Practice (5):58-60.