2024 Volume 2, Issue 1
Signal and Information Processing
ISSN: 2630-4805

New Exploration of Hybrid First-Class Undergraduate Course Teaching Reform Based on OBE Concept: Taking the Course of Digital Signal Processing as an Example

Dongchu Jiang, Fei He*, Jie Xiong, Wenguo Li, Xiaoxi Liu
School of Information and Electronic Engineering, Hunan City University, Yiyang 413000, Hunan, China

***Corresponding author:** Fei He, hefei@163.com

Abstract:

Based on the OBE concept, this article deeply explores the online and offline hybrid teaching reform of digital signal processing courses. To fulfill the fundamental task of cultivating talent with morality, the teaching team upholds the three basic concepts of "student-centeredness, output orientation, and continuous improvement", integrates ideological and political education into the teaching process, constructs a new student-centered "six-in-one" online and offline hybrid teaching reform model, and proposes a new idea of "2W+2H" hybrid first-class undergraduate course teaching reform based on the OBE concept. The aim is to explore new teaching concepts, models, structures, and evaluations for digital signal processing courses, providing a reference for local application-oriented universities to carry out teaching reforms of first-class undergraduate courses.

Keywords:

OBE concept
Hybrid first-class undergraduate courses
"Six-in-One"

Online publication: June 28, 2024

1. Introduction

Outcome-Based Education (OBE) is an advanced educational philosophy that emphasizes "student-centeredness, output orientation, and continuous improvement." Based on the orientation of university operations and talent cultivation goals, it aims to build first-class undergraduate courses that cater to the needs of cultivating innovative, compound, and application-oriented talents, achieving full coverage of first-class undergraduate course construction across different types of universities [1], and aligning with the "golden course" standards of "two characteristics and one degree" (high-level, innovative, and challenging). In the process of building first-class undergraduate courses, curriculum system construction occupies a central position, aiming to precisely align with and efficiently achieve established talent cultivation standards.

In 2019, the Ministry of Education issued the

]. To strive for world-class universities, the Ministry of Education has proposed the "Double First-Class" construction and the "Double Ten Thousand Plan." Among them, central universities are actively carrying out the construction of world-class universities and disciplines, while local universities are also committed to building first-class undergraduate majors and courses. In the context of engineering education accreditation, many domestic universities have invested significant effort in constructing first-class undergraduate courses, in digital signal processing. Many scholars have conducted in-depth reforms and practices in the context of first-class undergraduate course construction. For example, Wen *et al.* (2020) constructed a talent cultivation model, optimized the curriculum system, and established a hierarchical practical teaching system [3]. Cao *et al.* (2021) proposed a teaching outline design scheme for digital signal processing courses based on engineering education accreditation standards and the OBE concept [4]. In addition, Nie *et al.* (2021) elaborated on the implementation plan of deeply integrated hybrid teaching for digital signal processing courses and analyzed its teaching effectiveness [5]. On the other hand, Wang *et al.* (2020) constructed a progressive hybrid teaching system that improves "theory T + practice G + collaboration C" abilities and carried out teaching activities such as problem-based four-step flipped teaching and project-based inquiry and discussion experimental flipping [6]. These scholars have explored and practiced digital signal processing courses from various aspects such as teaching philosophy, teaching mode, and teaching methods, providing references for future course teaching reforms. However, there are still certain limitations and deficiencies in current research that require further comprehensive and in-depth studies.

In the context of deepening the construction of first-class undergraduate courses, this study explores the hybrid teaching reform of digital signal processing courses based on the OBE concept. From the perspectives of new ideas, new models, new approaches, new structures, and new evaluations, it aims to carry out a student-centered, outcome-oriented, and continuously improving hybrid first-class undergraduate course teaching reform, with the standard of "two characteristics and one degree" (high-level, innovative, and challenging), combined with the school-based characteristics of electronic information majors.

2. A new "six-in-one" online and offline hybrid teaching reform model centered on students

Based on the OBE concept and the "two characteristics and one-degree" standard for first-class undergraduate course construction, the teaching team has constructed a new "six-in-one" online and offline hybrid teaching reform model centered on students (see **Figure 1**). This model integrates various aspects such as online and offline quick quizzes, online and offline interactive discussions, innovative applications combining theory with practice, innovative thinking in academic competitions, ideological and political education throughout, and process evaluation of learning effects. It aims to provide students with a more comprehensive, efficient, and in-depth learning experience. In the implementation process, the teaching team conducts smart teaching with the assistance of "Rain Classroom" and "XuetangX" platforms and applies this model to the hybrid teaching practice of digital signal processing courses. Through analyzing and evaluating the implementation effects, the teaching team has verified that this model not only highly aligns with the "golden course" standard of "two characteristics and one degree" but also effectively meets the cultivation needs of innovative, compound, and application-oriented talents, playing a positive role in improving classroom teaching effectiveness and talent cultivation quality.

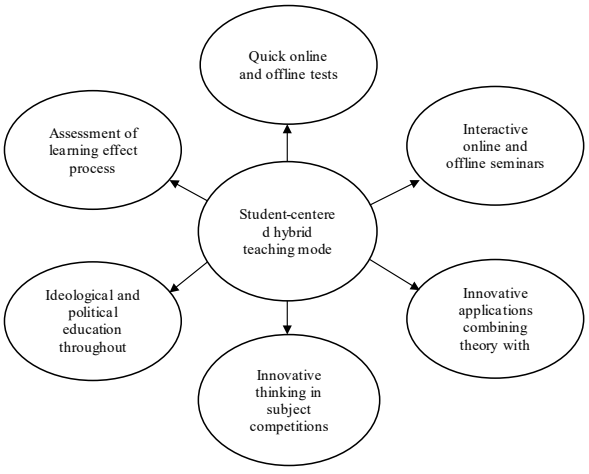

Figure 1. A new model of "six-in-one" online and offline hybrid teaching reform.

3. Based on the OBE concept, a new approach for "2W+2H" hybrid first-class undergraduate course teaching reform

After understanding the construction of online and offline hybrid first-class undergraduate courses, the teaching team proposed a new approach for "2W+2H" hybrid first-class undergraduate course teaching reform based on the OBE concept (see **Figure 2**). Specifically, "Why" refers to the reason for building a student-centered "six-in-one" online and offline hybrid teaching reform model; "What" refers to the positioning and goals of first-class undergraduate courses; "How" refers to how to design the entire course or each lesson in the teaching process; "How good" refers to how to comprehensively evaluate the teaching effect and summarize reflections.

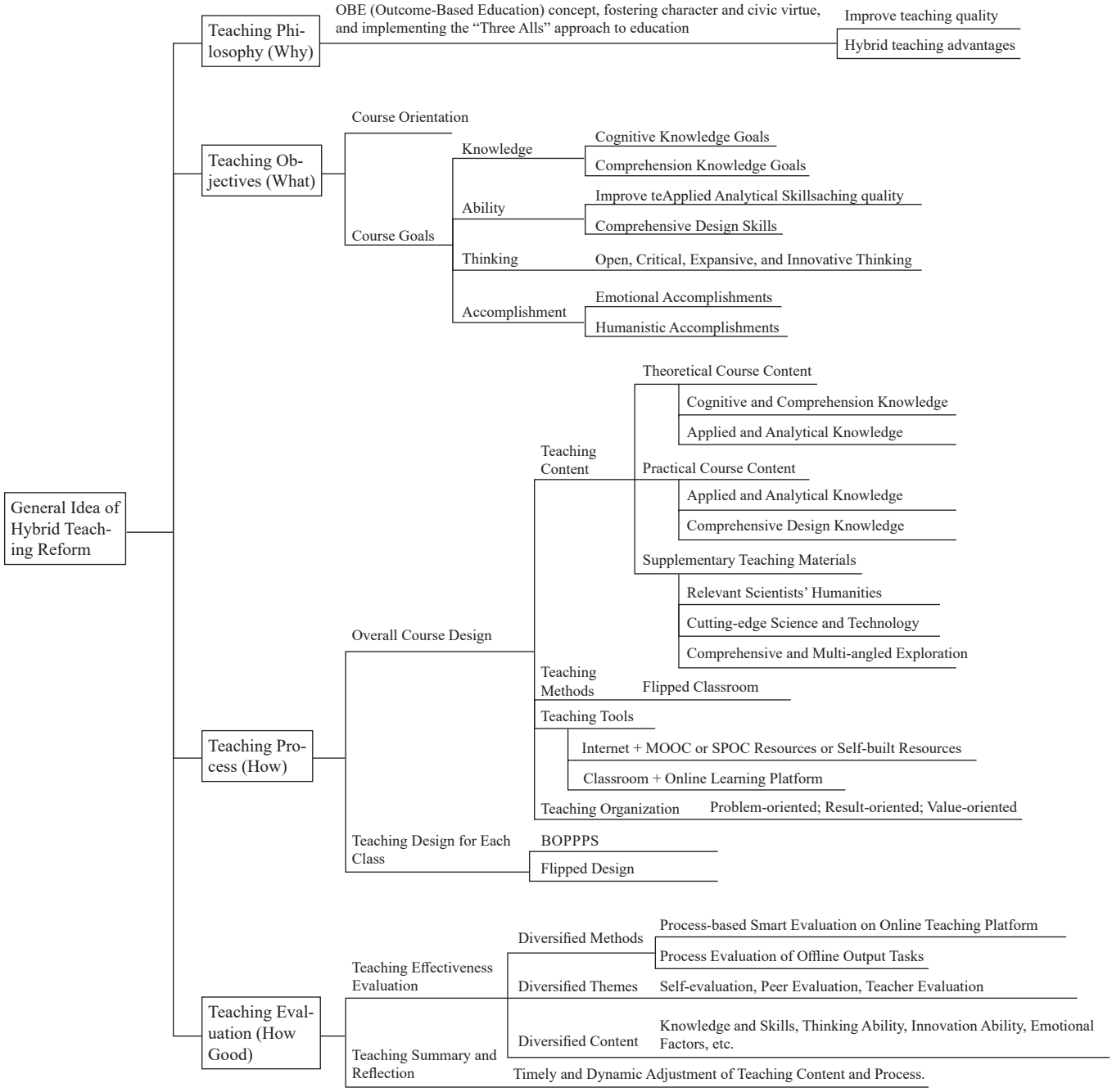

Figure 2. New ideas for teaching reform of "2W+2H" hybrid first-class undergraduate courses.

4. A new architecture of teaching content system based on the four dimensions of "knowledge-ability-thinking-value"

According to the construction requirements of first-class undergraduate courses, the digital signal processing course adopts an online and offline hybrid teaching mode, emphasizing advanced teaching objectives, innovative teaching content, and challenging course learning. To this end, the teaching team has constructed a new architecture of teaching content system based on the four dimensions of "knowledge-ability-thinking-value" (see **Figure 3**), aiming to comprehensively improve students' comprehensive quality and adaptability.

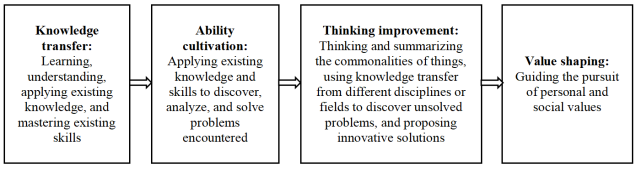

Figure 3. The new framework of the "Knowledge-Ability-Thinking-Value" four-dimensional integrated teaching content system.

Based on the new teaching content system architecture integrating "knowledge, ability, thinking, and value," the teaching team continues to innovate teaching methods and carefully designs teaching activities, paying special attention to the cultivation of students' knowledge acquisition, ability improvement, and innovative thinking, and striving to achieve a comprehensive innovative design. The teaching activity process is designed according to three aspects: (1) pre-class online teaching links, (2) in-class offline flipping links, and (3) post-class online consolidation links. The entire teaching activity is based on pre-class online independent learning, with classroom teaching activities as the key and after-class expansion applications as a supplement. They are connected and promote each other, forming a complete closed loop of online and offline interactive learning. In the teaching process, the teaching team continuously demonstrates the rationality of the integrated design of teaching content and continuously improves and refines it based on student feedback on learning evaluation. Based on this, the teaching team has carefully designed the online and offline hybrid teaching implementation process for digital signal processing courses (see **Figure 4**).

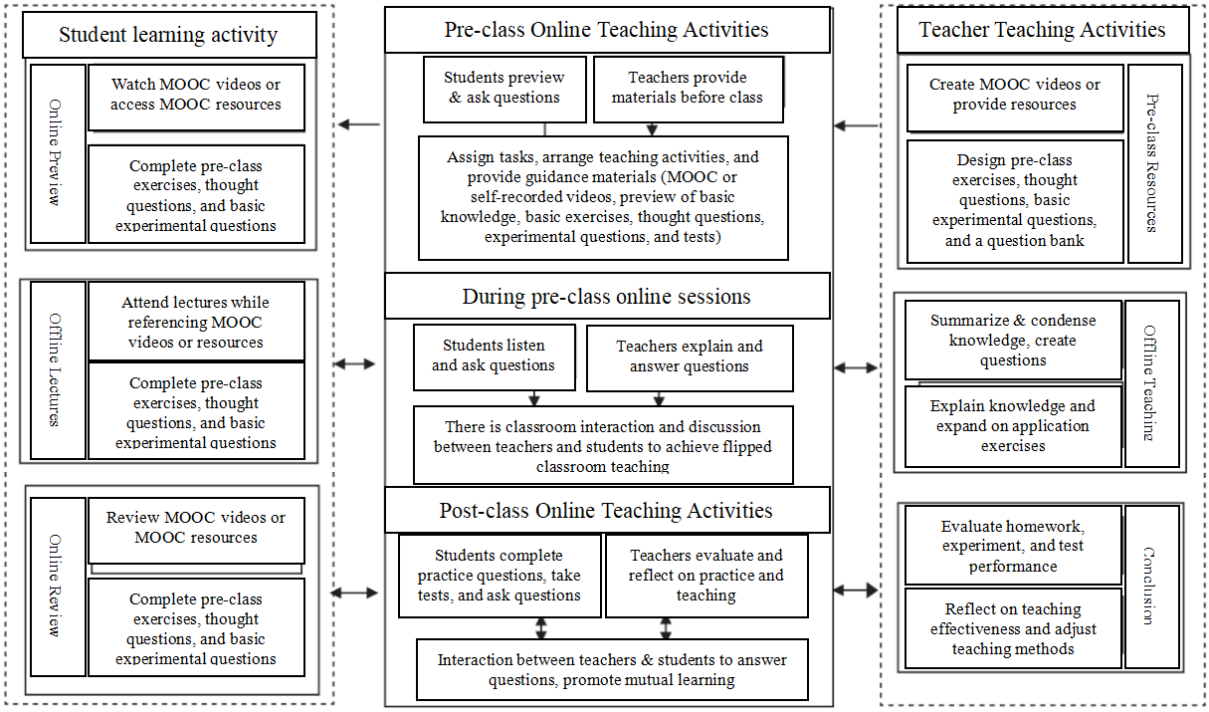

Figure 4. The implementation process of online and offline hybrid teaching for digital signal processing courses.

5. A new evaluation of the teaching effectiveness of hybrid first-class undergraduate courses based on OBE+ diversification

According to the construction requirements of first-class undergraduate courses, the evaluation of the teaching effect of digital signal processing courses needs to construct a new model - the teaching effect evaluation model of hybrid first-class undergraduate courses based on OBE+ diversification (see **Figure 5**). This model combines process evaluation with summative evaluation and integrates online and offline evaluation to achieve a comprehensive evaluation. This evaluation model emphasizes the diversification of evaluation subjects, including teachers, students, and platforms; the diversification of evaluation methods, that is, adopting appropriate evaluation methods and reasonable evaluation proportions according to different teaching activities; and the multidimensionality of evaluation content, covering basic knowledge, engineering abilities, and value shaping. This not only focuses on the learner's learning outcomes but also emphasizes an in-depth evaluation of the learning process to promote continuous optimization and improvement of teaching quality.

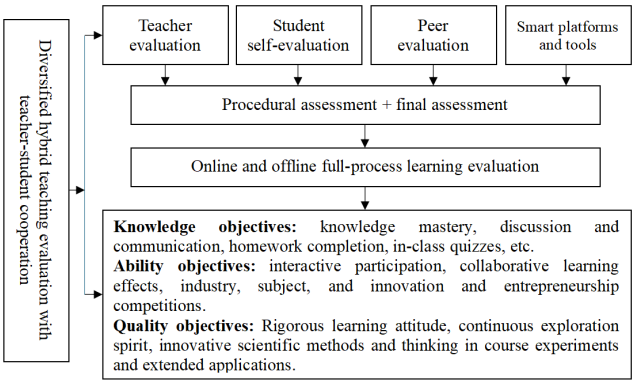

Figure 5. Evaluation model for teaching effectiveness of hybrid first-class undergraduate courses based on OBE+ diversification.

5. Conclusion

Under the guidance of innovative educational concepts and continuous innovation in teaching models, the teaching team has constructed a new model of "six-in-one" online and offline hybrid teaching reform centered on students and proposed a new approach for "2W+2H" hybrid first-class undergraduate course teaching reform based on the OBE concept. Relying on the subject advantages of electronic information engineering, combined with the construction requirements of first-class undergraduate courses in digital signal processing, the teaching team makes full use of the "Rain Classroom" and school online platform, strictly follows the "golden course" standard of "two genders and one degree," and conducts in-depth research and exploration of the teaching philosophy, teaching mode, teaching ideas, teaching system, and teaching evaluation of hybrid first-class undergraduate courses based on "Internet + Education," which has important practical significance for promoting the construction of "double first-class."

Funding

Hunan Provincial Teaching Reform Research Project of General Higher Education Institutions (Project No.: HNJG-2022-0257); Construction Achievements of the First-Class Undergraduate Course "Digital Signal Processing" in Hunan Province (Project No.: Xiangjiaotong [2021] No. 28); Hunan Provincial College Students' Innovation and Entrepreneurship Training Program (Project No.: Xiangjiaotong [2022] No. 174)

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ministry of Education of the People's Republic of China, 2019, Implementation Opinions on the Construction of First-Class Undergraduate Courses by the Ministry of Education, viewed February 10, 2024, http://www.moe.gov.cn/srcsite/A08/s7056/201910/t20191031_406269.html

[2] Ministry of Education of the People's Republic of China, 2019, Notice of the General Office of the Ministry of Education on Carrying Out the Identification of National First-Class Undergraduate Courses for Offline, Online-Offline Hybrid, and Social Practice in 2019, viewed February 10, 2024, http://www.moe.gov.cn/srcsite/A08/s7056/201911/t20191122_409347.html

[3] Wen R, Huang E, Yi M, et al., 2020, Research on OBE-Oriented "Digital Signal Processing" Practical Teaching in the Context of New Engineering. Journal of Nanchang Normal University, 41(6): 24–26.

[4] Cao Y, Wang D, Zhou C, et al., 2021, Design of Syllabus Based on Engineering Education Certification and OBE Concept: Taking Digital Signal Processing Course as an Example. University Education, 2021(3): 88–90.

[5] Nie X, Zhu L, Zhou T, 2021, Exploration of "Digital Signal Processing" Teaching Mode in the Context of New Engineering. Education Teaching Forum, 2021(7): 97–100.

[6] Wang Y, Zhang X, Zhang L, et al., 2020, Exploration and Practice of Progressive Hybrid Teaching Mode with "Digital Signal Processing" Course as an Example. Experimental Technology and Management, 37(12): 244–249.