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Improved Instructional Design of Analog Electronic Technology Course

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Abstract: *For the training requirements of application-oriented talents, aiming at the problems such as the difficulty of analog electronic technology courses, single teaching methods and poor ideological and political system of courses, four innovative ideas and implementation methods are proposed that are "project-based" teaching content design based on OBE(Outcomes-based Education) concept, exploration of online and offline mixed teaching mode based on BOPPPS(Bridge-in, Objective, Pre-assessment, Participation, Post-assessment, Summary), introduction of curriculum ideology and politics based on hierarchical positioning, and optimization of assessment methods to promote continuous improvement of course in this paper, which the pain points of course teaching are effectively solved. The practice shows that the above measures improve the teaching effect and talent training quality to a certain extent, and provide reference for the curriculum construction of related engineering majors.*

Keywords: *OBE; BOPPPS; Assessment; Improvement; "Project-based" teaching*

1. Background and Significance

In 2018, the Ministry of Education issued the "Education Informatization 2.0 Action Plan", which pointed out that: "Education informatization has the unique advantages of breaking through the limitations of time and space, rapid replication and propagation, and rich means. It will become an effective means to promote education equity and improve the quality of education. Leading the modernization of education with education informatization is a strategic choice for China's education reform and development in the new era, and is of great significance for building an education power and a human resource power." In the same year, the Ministry of Education issued the Notice on Implementing the Spirit of the National Undergraduate Education Conference in the New Era, proposing that universities should reform various courses to create "golden courses" with high order, innovation and challenge. In 2020, the Ministry of Education issued the Guidance Program for the Construction of Ideological and Political Education in College Curriculum, which pointed out that comprehensively promoting the construction of ideological and political education in college curriculum is a strategic measure to implement the fundamental task of moral education and cultivating talents, and is a key move to improve the quality of talent training.

The course of "analog electronic technology" [1] is a core course for students majoring in electronic information engineering, communication engineering, automation and measurement and control in institutions of higher learning. It is a basic course of enlightening technology that opens the electrical science and leads students to deepen the electrical world. Its importance is self-evident. However, for a long time, because the course research object is abstracted from the engineering practice model, theoretical and engineering application background is strong, and it involves more mathematical knowledge, so the learning difficulty is large, the failure rate is high, which is called "magic electricity" [2] by students. How to combine the requirements of the Education Informatization 2.0 Action Plan, build analog electronic technology courses with gold course standards, explore the ideological and political introduction of science and engineering courses, and promote the all-round development of students, has become an important issue that must be faced in the curriculum reform of colleges and universities.

Our university is an applied undergraduate university with distinctive features and famous quality. Adhering to the talent training concept of "paying attention to general knowledge and integrating into the industry", it has been approved as a typical model university for professional certification by the

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Ministry of Education. In the process of professional certification and teaching reform, it adheres to the OBE concept and continuously improves the quality of talent training. Based on the actual situation of our university, combined with the characteristics and teaching objectives of analog electronic technology course, the course team carries out targeted classroom teaching reform and practice [3].

2. Course "Pain Point" Problem

In terms of classroom teaching, the traditional teaching mode of "teachers talking and students listening" lacks information teaching means, the interaction between teachers and students is poor, and students lack initiative and enthusiasm. The data of teaching activities can not be obtained in time, which makes it impossible to find teaching problems in real time, adjust teaching plans and implement accurate academic assistance. In terms of experimental teaching, the course experiment is mainly based on principle verification experiment. Due to the limited space of professional laboratory, the relatively tight experimental equipment resources, and the great limitations of experimental time and place, students lack opportunities for high-level engineering practice training, and the cultivation of engineering practice ability is insufficient. It is impossible to achieve the combination of theory and practice, consolidate and deepen the understanding of theoretical knowledge. In recent years, the course teaching team has tried to carry out teaching reform in combination with the actual situation of our school, and has achieved certain results, but there are still several problems, among which the outstanding problems are as follows:

Problem 1: The course theoretical knowledge points are too many, the calculation and analysis are tedious, the key points are not easy to grasp, the learning difficulty is large, and the failure rate is high.

Problem 2: The classroom teaching means are single, the modern information technology is not integrated enough, the teaching mode is relatively solidified, and the students' participation in teaching activities is poor. The integration of theory and practice is insufficient, the experiments are mostly principle verification experiments, and the comprehensive application experiments and innovative design experiments are insufficient.

Problem 3: The course teaching objectives are mainly based on the understanding, mastery and application of professional knowledge, and the introduction of ideological and political education is lacking systematicness.

These problems make it difficult to meet the requirements of new engineering construction and industrial development. In order to continuously improve the quality of professional talent training, strengthen students' professional ability and professional quality, the course team carries out the reform [4] of teaching content, teaching methods and ideological and political education in accordance with the requirements of engineering professional certification OBE, closely around the course teaching objectives, and carry out the reform of teaching content, teaching methods and ideological and political education.

3. Course Teaching Reform

3.1. Design of "Project-oriented" Teaching Content Based on OBE Concept

The course of "Analog Electronic Technology" mainly introduces about diodes, transistors, FETs, basic amplifier circuits, integrated operational amplifier circuits, power amplifier circuits and DC power supply, etc., which is carried out mainly by devices, circuits and applications, with the characteristics of "many concepts, many symbols, many principles and little practice". The course concept is abstract and obscure, there are many theoretical knowledge points, the working principle is not easy to understand, the calculation and analysis are complicated, there are many mathematical knowledge involved, the key points are not easy to grasp, the learning is difficult and the failure rate is high. Based on the OBE concept and the results-oriented principle, the teachers of the course team dig deeply into the logical relationship behind the knowledge points of analog electronic technology, reconstruct the knowledge structure [5][6], and build a knowledge structure oriented by the core function of analog electronic circuits, as shown in Figure 1.

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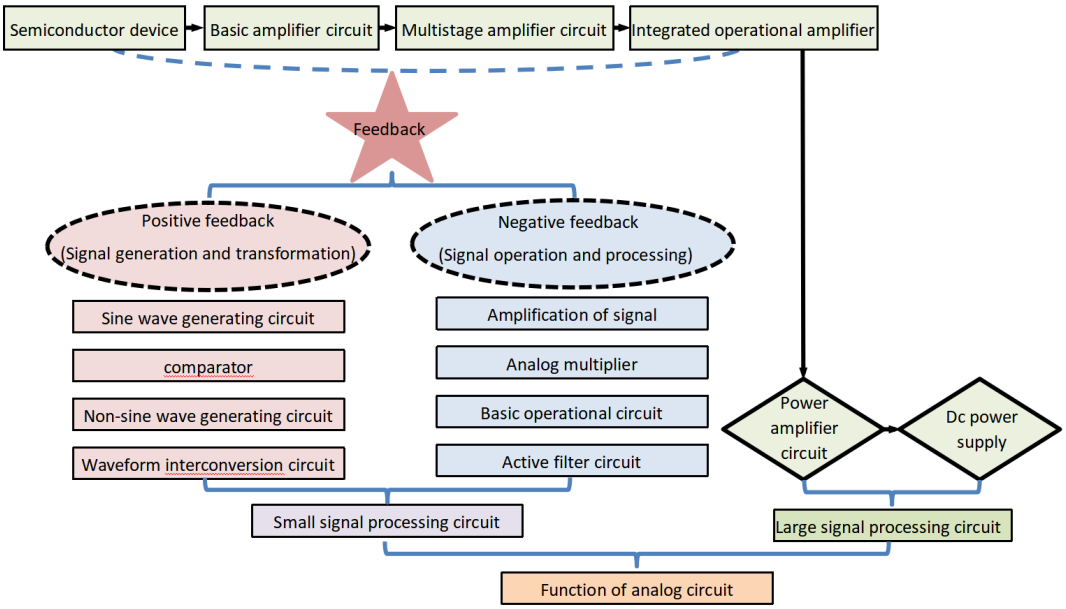

Figure 1: Knowledge structure oriented on the core function of analog electronic circuits.

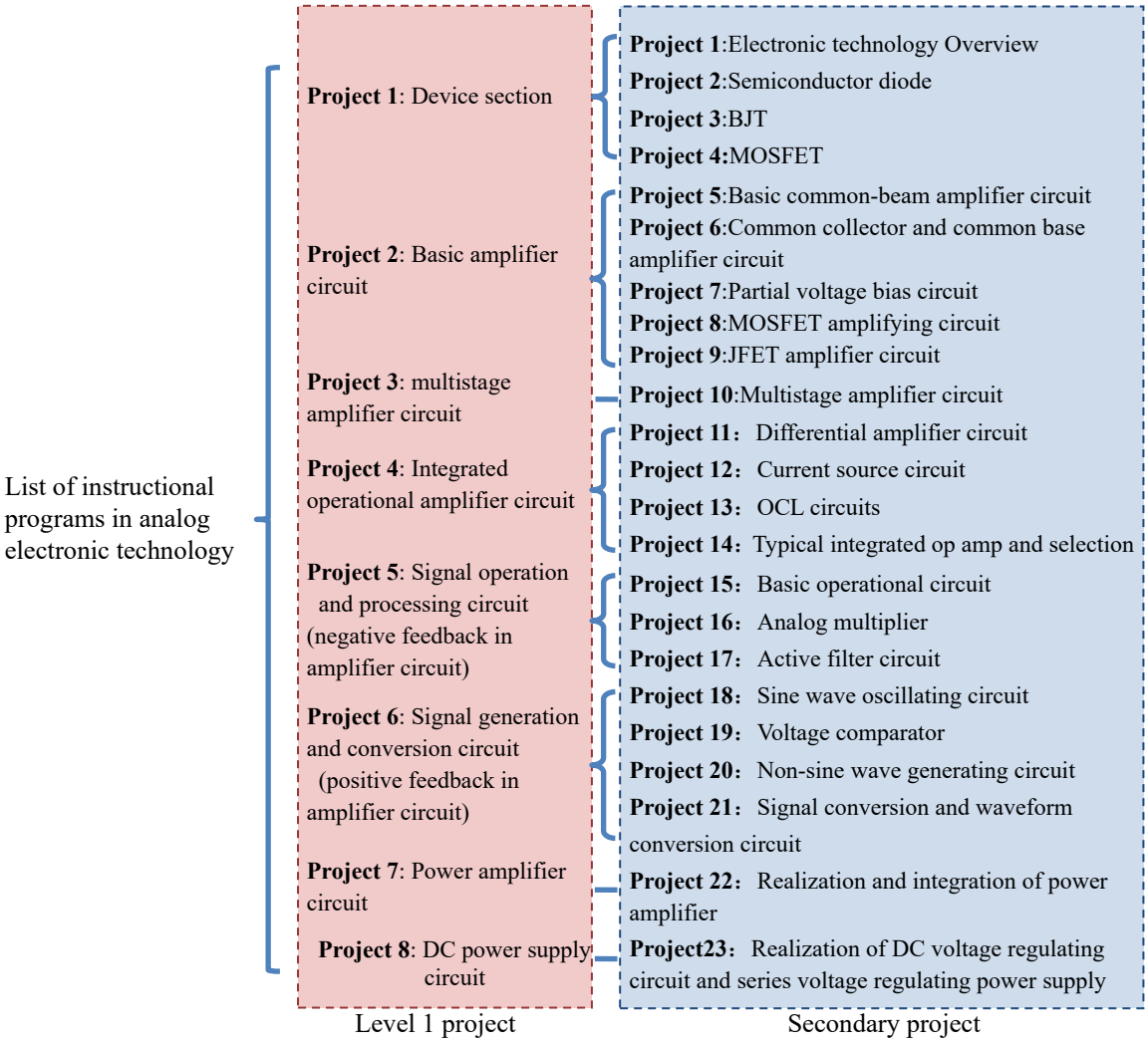

Figure 2: Objective-oriented teaching project setting scheme.

According to the function of analog circuits shown in Figure 1, a goal-oriented project-based teaching setting scheme [5] of analog electronic technology is designed, as shown in Figure 2. The

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following points are explained in Figure 2.

Setup of first-level projects: 8 items of first-level projects. The classification method of the project is divided into 8 first-level projects, each of which represents part of the functions of analog electronic technology, including devices, basic amplification circuits, multistage amplification circuits, integrated operation amplification circuits, signal calculation and processing circuits, signal generation and transformation circuits, power amplification circuits and DC power supply circuits. The second-level sub-projects are divided into 23 items, focusing on the specific realization of the major functions of the first-level projects. Each sub-project is set according to teaching objectives, theoretical hours, implementation methods and other factors. The classification method reflects the scenarios of analog electronic technology in practical applications, so that students can know the reasons after learning, and promote the combination of theory and practice.

3.2. Online and offline hybrid teaching mode based on BOPPPS

On the basis of the comparative analysis of traditional classroom teaching and online teaching, the "output-oriented" online and offline hybrid OBE teaching mode is introduced, which emphasizes the main position of students in teaching, takes students' thinking activities as the main line of teaching activity design and organization, creates a learning environment with personalized, innovative and challenging, and guides students to build knowledge and cultivate ability in the environment.

According to the teaching objectives of analog electronic technology, the characteristics of knowledge structure and the psychological cognitive laws of students, the teacher makes use of the online MOOC teaching environment of "Analog Electronic Technology", and according to the training objectives of applied talents in our school, reasonably allocates and organizes the implementation of targeted SPOC teaching. The online learning mode of self-determined pace throughout the whole course of the rally type consisting of video task points and test task points is adopted. It not only conforms to the characteristics of high path dependence of science and engineering courses, but also ensures that each student with individual differences in thinking ability has sufficient and necessary time to think and understand knowledge points. According to the performance of students' online learning and the completion of task points, the teacher makes necessary and real-time dynamic adjustments to the requirements and schedule of online teaching content, so as to truly achieve "student-centered heuristic teaching".

Combined with the BOPPPS teaching model, the online teaching and offline teaching are organically integrated. The online and offline mixed teaching mode [7] is composed of three parts: online synchronous teaching link, offline hierarchical classroom teaching link and practical teaching link [8]. The basic teaching content is arranged online, and teaching videos, test levels, virtual simulation [9] and so on are designed. Offline teaching uses BOPPPS teaching model to design each teaching link of each teaching project and clarify the teaching objectives, including the cultivation of practical skills at the level of basic knowledge of electronic technology, practical skills at the level of electronic technology, thinking and cognition, and practical skills at the level of electronic technology application. In the specific implementation, on the basis of PPT and blackboard teaching, classroom tests, group assignments, interactive discussions, etc. are carried out through the cloud class intelligent platform, focusing on the extension, improvement and engineering application of basic theory; practical teaching uses professional laboratories to carry out confirmatory and comprehensive experimental practice teaching, and design and innovative practice are undertaken by subsequent innovative practice courses [10] (as shown in Figure 3).

In terms of teaching organization and implementation, first of all, teachers clarify the learning schedule according to the teaching situation and questionnaire results of the last cycle. Teachers conduct statistical analysis of learning conditions regularly and issue notices to clarify the teaching content and teaching focus of offline classroom. Using online data statistics and reward and punishment integral measures to manage students' learning progress, realize online synchronous learning and solve the problem of lax management commonly existing in online courses. Secondly, before teaching, teachers design relevant discussion topics based on the real-time statistics and analysis of students' online learning and test data of the last unit, through the cloud class smart classroom platform, PPT and blackboard writing, and efficiently guide offline classroom discussions to verify the effect of students' online learning, solve the problems encountered in students' online learning and expand and deepen theoretical knowledge. Thirdly, in classroom teaching, the BOPPPS teaching model is focused on reasonably allocating class hours, carefully arranging teaching activities and teaching tasks. The project-based teaching link design based on the BOPPPS teaching model is shown in Figure 4. In the

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course introduction, new learning content is introduced through videos or stories to help students understand the learning content, attract students' interest and generate learning motivation. Design corresponding learning objectives for each class, take learning objectives as the starting point and landing point to design teaching content, guide students' learning direction and evaluation of learning output; Using question and answer, quiz, group discussion, through blue ink cloud and other ways to make a bottom-up before class, grasp the students' online learning situation; In class, we advocate participatory learning, highlight students' initiative learning and group collaboration learning, stimulate learning interest and enthusiasm, active classroom atmosphere, strengthen students' quality cultivation; By answering questions, quiz, doing exercises, operation demonstration, reporting or carrying out post-test with Blue Ink Cloud tool [11], we can understand the students' achievement of teaching goals, carry out course summary, carry out teaching reflection, and improve the quality of teaching. Finally, students encounter difficulties in the process of online and offline learning, they can get help from teachers and classmates through various information tools platforms of the course, and create an all-weather open environment for students to study, discuss and answer questions.

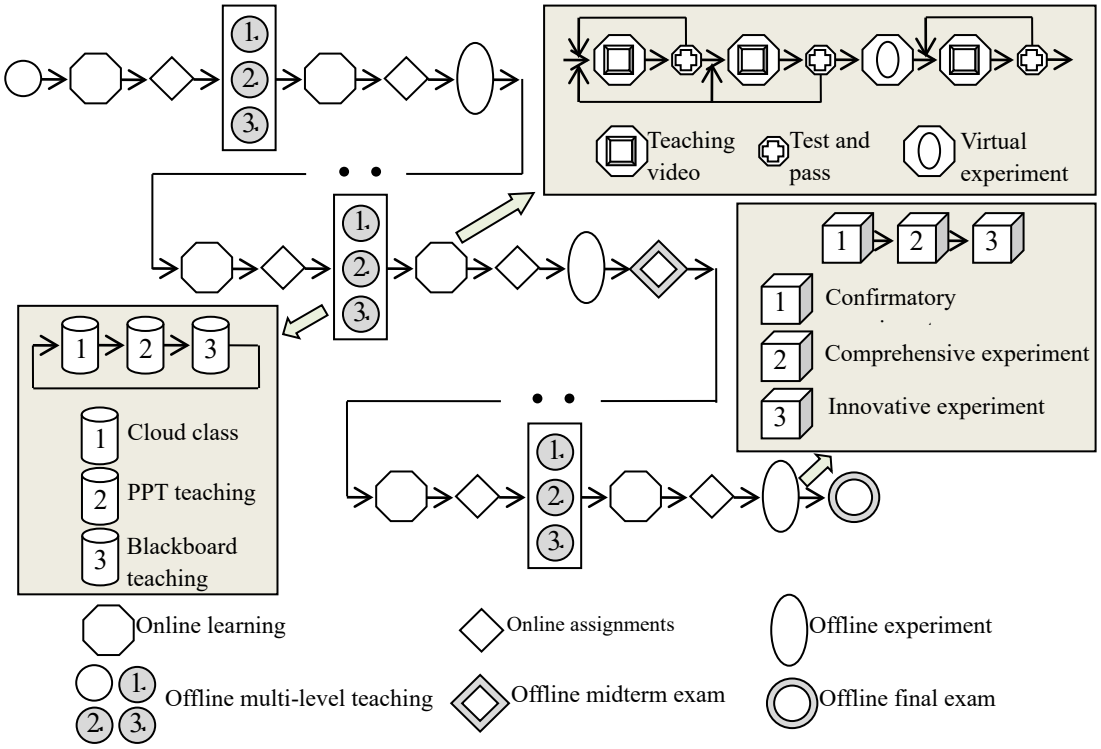

Figure 3: Schematic diagram of online and offline hybrid OBE teaching mode.

3.3. Ideological and political introduction of the course based on hierarchical positioning

According to the research of relevant scholars, to build a full-staff, full-course and all-round training pattern for college students, we should not only give full play to the main channel role of ideological and political theory courses, but also promote other courses and ideological and political theory courses in the same direction, form a comprehensive coverage, rich types, progressive levels and mutual support of ideological and political education curriculum system, and strengthen ideological and political education and value guidance, and integrate the professional ideological and political courses into the talent training program, throughout the whole process and each link of education and teaching. Focusing on the talent training objectives of science and engineering majors, the framework [12] of the ideological and political curriculum system with hierarchical and multi-professional courses is shown in Figure 5.

As the main course of measurement and control major, analog electronic technology is in the core position of ideology and politics in the curriculum ideological and political system, which has a great impact on students' follow-up major main course learning, and has a profound impact on students' emotional cultivation and value shaping. Around the purpose of "educating people for the Party and educating talents for the country", the first problem to be solved in the curriculum is "what to do concretely". The ideological and political implementation of engineering specialized courses is divided

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into six aspects: strengthening ideals and beliefs, cultivating patriotic feelings, strengthening moral cultivation, increasing knowledge and insight, cultivating the spirit of struggle, and enhancing comprehensive literacy. The specific implementation methods of curriculum ideological and political system include: content implication method, knowledge extension method, case application method, poetry encouragement method, philosophy application method, practice training method and cultural edification method, etc. The following takes philosophy application method as an example to explain: Philosophy application method refers to the application of some philosophical thoughts and views to guide the implementation of a certain curriculum thought and politics. In the power amplifier circuit teaching, the contradiction theory of natural dialectics is introduced, combined with the heuristic teaching, according to the process of "raising questions - solving problems - analyzing circuits, discovering new problems", the contradiction theory is combined with the heuristic teaching to cultivate students' critical thinking. For example, when analyzing a class A power amplifier circuit, the first question is raised: "The efficiency of the circuit is quite low, how to improve the efficiency of the collector amplifier circuit?"

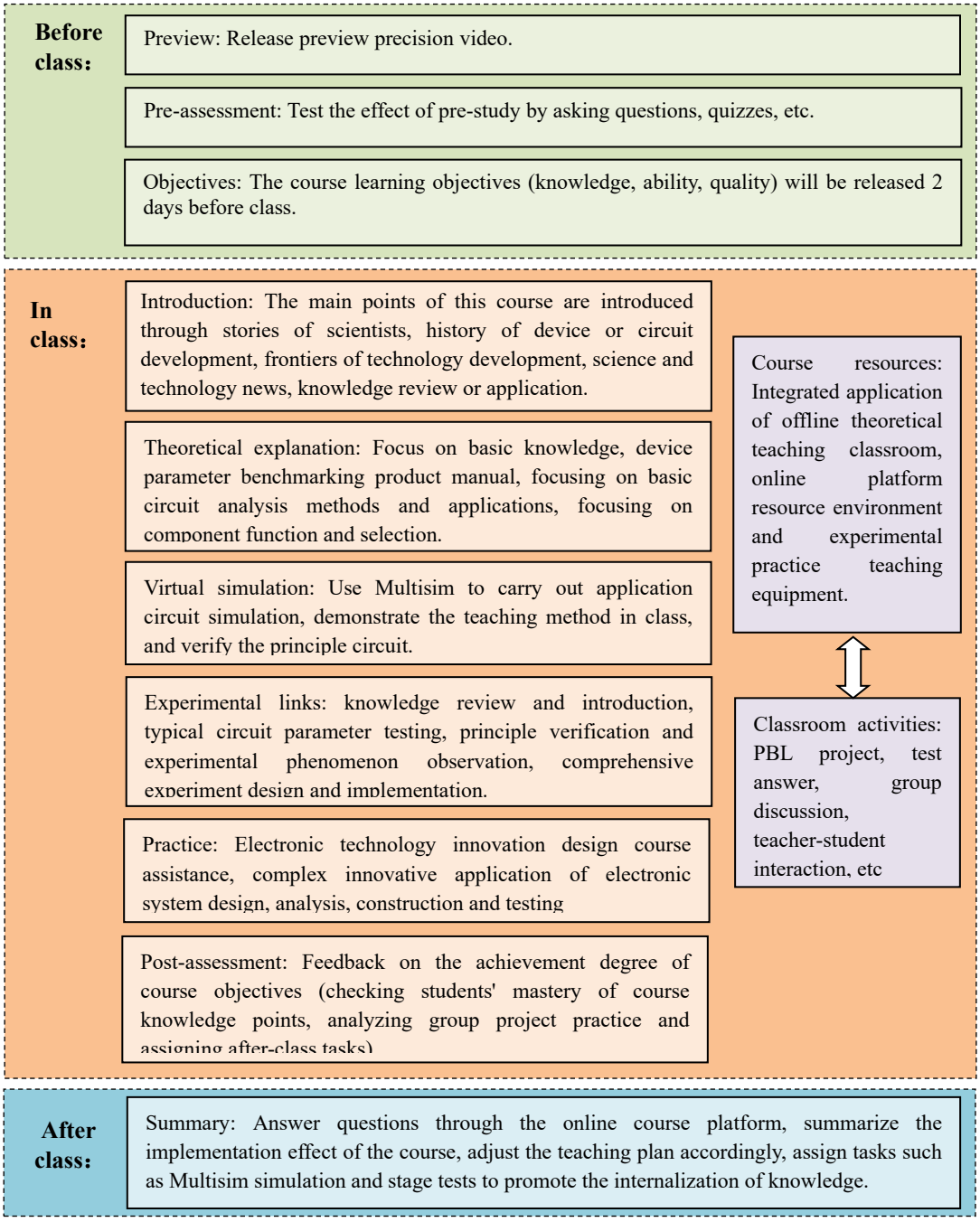

Figure 4: Project teaching link design based on BOPPPS teaching model.

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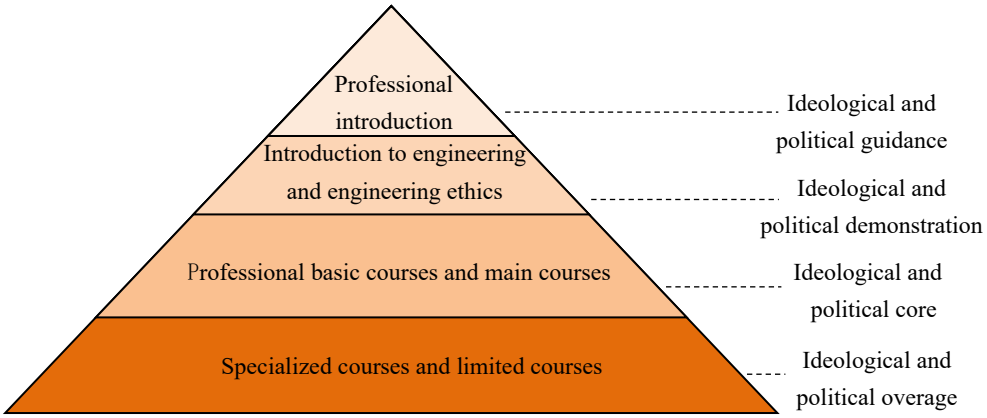

Figure 5: Hierarchical ideological and political teaching system of professional courses.

Then discuss the countermeasures, in order to improve efficiency, it is necessary to reduce the loss of DC power supply, in which the DC voltage has been fixed can not be reduced, so the collector current can be only reduced, that is, adjust the static operating point Q, so the Q point is moved down along the DC load line, a move to the end, so that the collector current is equal to zero, and DC consumption is eliminated. Then we continue to analyze the circuit and find a new problem: After the static working point is moved down, the circuit output waveform has a serious cutoff distortion. Finally, the contradiction is summarized: the static working point moved down improves the efficiency, but new problems appear in the circuit, and serious cutoff distortion occurs. How to deal with the contradiction between efficiency and distortion arouses new discussion.

3.4. Optimize the assessment method and promote continuous improvement of the course

In order to effectively evaluate students' learning process results in a more scientific and objective way, the original "the whole life is determined by one test" outcome evaluation mechanism is changed, the formative evaluation system is introduced, and the "N+1" process and final assessment form is adopted, and the online self-study and offline classroom learning outcome assessment are combined to examine students' process learning effects. The virtual simulation and engineering experiment are combined to evaluate students' engineering practice ability. The project teaching content and scattered knowledge points are combined to realize the distinction between macro quality and detail application ability. The result distribution of diversified assessment methods for specific courses is shown in Table 1.

Course assessment includes formative assessment and final exam. Formative assessment is achieved through process assessment, which includes online assessment, experimental assessment, mid-term exam and project report. Online assessment includes video learning, unit test, simulation exercise, group task and homework. The final exam will be conducted by offline closed-book examination.

Table 1: The distribution of the scores of the diversified assessment methods.

Assessment link	Formative evaluation process				Final examination	Total
	On-line assessment	Experimental examination	Mid-term examination	Project report	Closed book examination	
Grade ratio	10%	20%	10%	10%	50%	100%

In order to realize the teaching goal of OBE and continuous improvement in analog electronic technology course, an evaluation mechanism for the achievement of the course goal and a management system for the positive interaction, continuous inheritance and development of the course teaching team teachers are established. Before the start of the course, the OBE teaching implementation plan and the corresponding OBE teaching questions to the output and review the evaluation plan are written. After the course examination, the evaluation value of the achievement of the course objectives is calculated based on the course OBE teaching syllabus and the contribution of each course OBE evaluation link to the course objectives. The evaluation value of the achievement of the course objectives adopts the

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scores of students enrolled in each academic year as samples to conduct statistical analysis of the scores of all evaluation links of the course. Meanwhile, the subjective evaluation of the course objectives is conducted by means of questionnaires, including the quantitative evaluation method and the subjective evaluation method of the achievement of the course objectives. According to the analysis of the achievement of course objectives, teachers put forward the continuous improvement measures of teaching content, teaching methods and evaluation methods.

4. Course evaluation and reform effect

4.1. Subjective evaluation of achievement of course objectives

The course objectives are shown below:

Objective 1: Master the basic knowledge of electronic devices such as diode, transistor and integrated operational amplifier and the basic circuit analysis methods.

Objective 2: Master the characteristics of basic analog circuits and their applications, and learn how to generalize their analysis methods to other parts of an automated test system.

Objective 3: Be able to understand the role of discrete semiconductor devices and integrated operational amplifiers in complex circuits, and analyze basic operational circuits, waveform generation and transformation, filtering circuits and other circuits by using the characteristics of semiconductor devices, and understand the influence of changes in some parameters on circuit performance.

Objective 4: Be able to master the analysis methods of combination amplifier circuit and multistage amplifier circuit, understand how to decompose them into multiple single-tube amplifier circuits, and then solve the methods of static operating points and dynamic performance indicators.

Objective 5: Be able to master the use methods and basic experimental methods of common electronic instruments, and understand the characteristics and related measurement indicators of semiconductor components and basic units through confirmatory experimental observation.

Objective 6: Able to independently design and complete basic experiments, master and analyze the performance index requirements of some circuits in the automated test system, and then design the experimental scheme of the integrated circuit system by combining various basic circuits accordingly.

Objective 7: According to the experimental scheme and experimental conditions, build the experimental system and carry out the experiment safely; In the process of experiment, we should have the ability to think independently and solve the problems in the experiment, the ability to troubleshoot in the experimen t, and the ability to analyze and deal with the experimental results.

Objective 8: Be able to analyze or design analog circuits commonly used in engineering, and use relevant software systems to simulate and predict; The limitation of simulation software is understood through the comparison and analysis of simulation and actual circuit results.

4.2. Objective evaluation of the course goal achievement

The objective achievement degree of course objectives is calculated through course scores, as shown in Figure 6. The low achievement degree of course objectives 3 and 4 of Grade 2020 students corresponds to the lack of in-depth analysis and mastery of multistage amplifier circuit, integrated operational amplifier circuit and power amplifier circuit. Therefore, after targeted case analysis of these circuits is added in the teaching process of grade 21 students, the achievement of these two course objectives of grade 2021 students will be improved.

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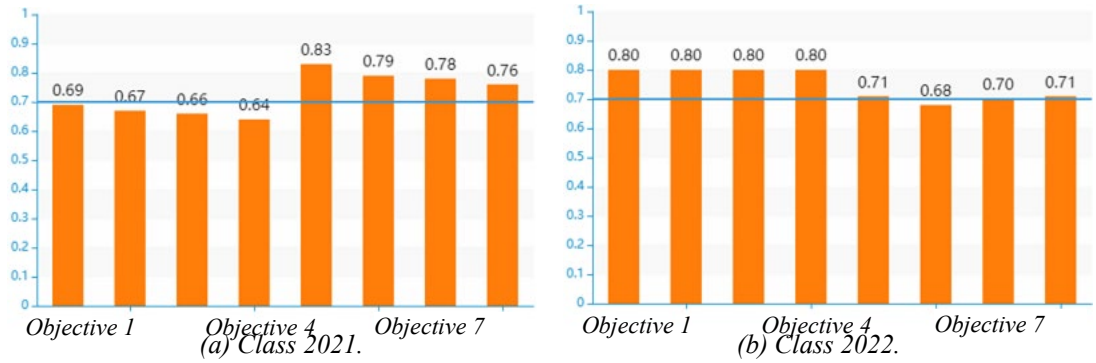

(a) Class 2021. (b) Class 2022.

Figure 6: Comparison chart of course goal achievement.

Through the analysis of the subjective and objective evaluation results of the achievement degree of the course objectives, it can be seen that through the design of "project-based" teaching content, the implementation of online and offline mixed teaching methods, the hierarchical introduction of curriculum ideology and politics, and the construction of a perfect assessment and evaluation system, students' learning interest is enhanced, and their learning initiative and autonomy are promoted. The understanding and internalization of course knowledge have been further strengthened, the difficult problems existing in traditional curriculum teaching have been solved, and the teaching objectives of course knowledge, ability and quality training have been better realized.

5. Conclusion

Based on the OBE concept and BOPPPS teaching mode, the project-style teaching scheme of deep Integration of theory course and experiment course of analog electronic technology is designed in this paper. Through this teaching method, students can enhance their intuitive experience of abstract concepts and deepen their understanding and mastery of the course content. Through the explanation of basic circuit principles and the Multisim simulation and experiment projects in a timely and seamless connection, it is very beneficial to cultivate students' system concept and engineering concept. Through practical teaching, it is found that this teaching mode is well liked by students, and can stimulate students' learning motivation to the maximum extent and improve students' learning interest. Course reform is still continuing, we will continue to optimize the teaching content and improve the project design in the course construction in the future.

References

[1] Wang Z Y, Cheng L. Fundamentals of analog electronics[M]. Southeast University Press, 2019.
[2] Hu G S. Research on the teaching quality control system of electrical major based on the training of applied talents[J]. Educational modernization, 2018, 5(10): 15-18.
[3] Zhang Z K, Wu M, Lu N, Li X L. Research on curriculum reform of analog electronic technology under the background of engineering certification[J]. Journal of Higher Education, 2019, (1): 127-129.
[4] Li X Y, Hu H, Liu X D, Zhang J. Exploration and practice of hybrid teaching of analog electronic technology[M]. University Education, 2022: 135-137.
[5] Li D D. Project-based Teaching Design Based on OBE Concept for Deep Integration of Theoretical and Experimental Courses of Analog Electronic Technology[J]. Curriculum teaching, 2023, (8): 92-96.
[6] Ma L G. Exploration of teaching mode and process assessment mode based on OBE concept -- taking "Analog Electronic Technology" course as an example[J]. Wireless interconnection technology, 2022, (10): 166-168.
[7] Guo Y. Research and Practice on Innovative Application of "Online and Offline" Blended Learning Mode—Take "Analog Electronic Technology" Course as an Example[J]. Modern Information Technology, 2021, 5(21): 183-187.
[8] Ma B F, Wu R K, Zhang H, Zhang S N. Teaching Reform and Practice of the Course of "Analog Electronic Technology"[J]. Journal of Fujian Polytechnic normal University, 2022, 40(2): 226-231.
[9] Zhang X Y, Tao G B. Research on the teaching mode of "Integration of Theory and Virtual Simulation" in the course of "Analog Electronic Technology"[J]. 2023 6th International Conference on

ISSN 2522-6398 Vol. 9, Issue 2: 74-83, DOI: 10.25236/FER.2026.090210

Humanities Education and Social Sciences, 2023. 10.
[10] Chen H, Fei Y N, Zhong J M, Li L. Online and offline mixed OBE teaching practice of analog electronic technology based on information technology[J]. Journal of Higher Education, 2022, (22): 89-93.
[11] Huo J J. Research on mixed teaching mode of analog electronic technology course based on Blue Ink Cloud class[J]. Industry and Technology Forum, 2021, 20(20): 153-154.
[12] Li L J, Liu H, Yao T S. Ideological and political implementation methods of science and engineering courses -- taking "Analog Electronic Technology" course as an example[J]. Education and teaching forum, 2023, (7): 153-156.