Research on the Application of Just-in-Time Teaching in Analog Electronics Course

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Abstract. Just-in-Time Teaching emphasizes the application of modern education technology and the combination of students' active learning. In the implementation process of the mode, the construction of network teaching resources and feedback chain play an important role. Based on the cloud learning supermarket, JiTT is implemented in the ways of pre-class exploration, in-class guidance and after-class extension. The granulated teaching resources in "Cloud learning supermarket" are conducive to students' independent exploration before class, independent learning of circuit principles and circuit design during class, and independent learning of circuit related knowledge and skills after class. The communication platform of "cloud learning supermarket" can also build a timely feedback chain, providing convenience for timely communication between teachers and students. The effective implementation of this model is conducive to stimulating students' interest in learning, improving teaching effect, enhancing interaction between teachers and students, and implementing comprehensive evaluation.

Key words: JiTT,Teaching mode,Analog electronics,Cloud learning supermarket

1 Introduction

At present, the source structure of electronic students in polytechnics is diversified, students have different learning motives and uneven academic foundation, which brings unprecedented opportunities and challenges to electronic education in higher vocational education. The traditional teaching mode ignores the differences of multi-level students' initial ability and individual needs, and rarely designs the teaching content and teaching methods according to students' "latest development zone". In the teaching process, the initiative of students is not fully aroused, resulting in the lack of students' learning interest and enthusiasm. In addition, the traditional teaching evaluation mostly adopts the single way of "normal assessment and final examination", and the evaluation index is standardized, which is difficult to stimulate the students' learning drive and truly understand the students' inner thoughts. It is urgent to "take students as the center" and take multiple measures at the same time to improve students' sense of efficacy and independent learning ability at different levels.

JiTT mode is a kind of online and offline interactive integration teaching mode, which based on "Web-based study assignment" and "Active learner classroom" , emphasizing timely feedback evaluation. JiTT, also known as "timely teaching" is a new teaching strategy put

NMDME 2023, October 13-15, Xi'an, People's Republic of China

DOI 10.4108/eai.13-10-2023.2341295

forward by physics teachers of Purdue University and US Air Force Academy represented by Novak at the end of the 20th century to improve undergraduate students' interest[1] in learning physics. JiTT was first applied to the teaching of introductory physics courses, and later applied to biology, chemistry, mathematics, engineering and other courses[2,3].

In 2004, professors Tammy Bailey and Jeffrey Forbes of Duke University in the United States applied JiTT mode to the teaching of "Introduction to Computer Science" course, and the course was divided into network part and classroom part. Through warm-up exercises, PRS (Personal Response System) lectures, students' self-inquiry and other activities, the teaching effect[4] is satisfactory.

Kathleen A.M.rs of Indiana University and Gregor Novak of the United States Air Force Academy used the JiTT model in biology, for example, through pre-class preview content, warm-up response, interactive lecture, assessment and other aspects, and improved students' pre-class preview rate and skill mastery[5].

Professors Kathleen A.Maarrs and Gragy W. Cism at Purdue University in Indianapolis said JiTT, which includes constructivism, self-directed learning and formative assessment, has a positive effect[6] on teaching and learning in biology.

There are more researches on the application of JiTT model to undergraduate education in China, but few researches in polytechnics' electronic courses. With "JiTT" as the theme, there are 239 articles in the search of CNKI, including 174 academic journals, 36 dissertations and 4 conferences. In 2005, Li Tian expounded the characteristics of Just-in-time teaching, which has enlightening significance[7]to change the current situation of "teachers speak and students listen" in undergraduate teaching of our country. By analyzing the classic case of JiTT application in foreign countries and comparing with the traditional teaching, Yuxiang Liu obtains the advantages of JiTT as well as its enlightenment[8] for our country's teaching reform. Professor Kekangn He introduced the background, connotation, implementation steps and cases[9] of JiTT mode in detail. By elaborating the specific application of JiTT in Duke University and Harvard University in the United States, Meng Ma concluded that the feedback loop, the role change of teachers and students, the construction of curriculum resources and the change of evaluation mode play an important role[10] in promoting teaching. Yahong Wang et al. combined the mobile Internet and JiTT method to implement SPOC teaching mode for college physics, the research shows that the average score and pass rate of the experimental group are higher than that of the control group, and nearly 94% of the students like this teaching mode[11]. Bo Dong, Tao Sun , Wang Yahong and Fanqiong Deng and other authors concluded that JiTT based on current information technologies such as Mosoteach, SPOC and Rain classroom has great advantages[12,13,14] in improving students' learning interest, independent learning ability and ability to explore problems at different levels.

There are also many researches on the application effect of JiTT, which show that the method makes full use of the advantages of digital and networked learning, so that students' learning is not limited by time and place, satisfies the personalized learning of students, stimulates students' learning motivation by providing timely and effective feedback, and improves the learning effect.

According to the study of literature materials and years of practical teaching in polytechnics, the current polytechnics' students are eager to become talented, and are used to collecting

learning materials online, and are not able to learn book knowledge quietly; They like to look for help from peers, but lack the ability to solve problems independently. The traditional mode of teaching evaluation makes students' self-confidence and efficacy low; The research of this mode has far-reaching guiding significance and practical value for the reform of teaching mode for the platform course of electronic majors in polytechnics—the simulation electronic technology course, and for the training of high-quality technical and skilled electronic talents and their individual development needs.

2 The teaching design of Analog electronics which based on JiTT

2.1 Differences between JiTT and traditional teaching mode

The traditional classroom is "teacher-oriented", which is prone to the phenomenon of filling the classroom, and there is less effective interaction between teachers and students. Teachers are easy to implement experiential teaching based on existing experience and subjective assumptions. However, the current polytechnics' students have diversified sources and different basis. The traditional teaching can not be implemented to teach students according to their aptitude, and the students' sense of efficacy is weak. JiTT emphasizes the construction of "feedback loop" to provide a platform for real-time interaction between teachers and students. Through network resources and platforms, teachers guide students to carry out independent pre-learning before class, implement accurate teaching by analyzing learning conditions, and explore problems after class to help students consolidate and expand what they have learned and improve their innovative thinking and ability.

2.2 Build a hierarchical, granular and personalized "Cloud learning supermarket"

JiTT emphasizes students' independent online learning, but students' learning basis is quite different, so it is necessary to build rich online resources. Teachers will make micro courses of theory and practical training guidance, supporting PPT, reference materials, practical training instructions, loose-leaf electronic textbooks and topic banks in different areas of the "Cloud learning supermarket", so that students can quickly search the required resources according to the navigation. Micro-lessons include theoretical explanation, practical training guidance, virtual simulation, animation demonstration and other contents, and the time is mainly less than ten minutes, so that students can use fragmented time to learn. The PPT is presented in a simple, graphic and graphic way, which highlights the important and difficult points; Reference materials involve knowledge points to supplement knowledge and expand the content. The training instructions mainly include the learning objectives, detailed operation steps, and precautions for each project. Loose-leaf electronic textbooks are used to benchmark post ability objectives, reconstruct the course knowledge system, highlight the cultivation of students' skills, and shield irrelevant content, so as to facilitate students to carry out independent learning. The question bank examines students' mastery of knowledge points and skills by multiple-choice questions, filling-in questions, judgment questions, short-answer questions, calculation questions and other questions. The hierarchical, granulated and personalized "Cloud learning supermarket" makes it convenient for students to carry out learning anytime, anywhere and on demand, and teachers can also adjust teaching in time according to students' learning conditions.

2.3 Carry out online and offline teaching activities with the "Cloud learning supermarket" as the carrier

Taking "the design of power module" in the analog electronics course as an example, this paper introduces in detail how to implement the JiTT mode with "Cloud learning supermarket" as the carrier.

(1)Research before class

Before class, the teacher will put the micro lessons, PPT, documents and exercises of the principles of rectifier, filter and voltage regulator circuit in the power module into the "Cloud learning supermarket", and issue principle tests and virtual welding tasks. By learning the resources in the "Cloud learning supermarket", exploring with other students, consulting teachers online and completing exploration tasks, the students initially mastered the teaching key points. According to students' learning records and online feedback in "Cloud Learning Supermarket", teachers analyze students' knowledge and skill base, cognitive and practical ability, learning characteristics and other learning conditions, timely adjust teaching strategies, and carry out targeted teaching.

(2)Guide learning in class

In the class, the teacher guides the students to experience the function of the power module, which is the teaching aid of the course, to enhance the students' cognition and learning interest in the task; Students have questions in the experience, and carry out targeted learning with questions to improve the learning effect; The whole class is divided into five stages, which are functional conception, functional experience, block diagram design, index design practice and result display. Teachers record students' classroom performance in each stage in the form of points, and record their value-added points for students who make progress in a certain aspect.

Functional conception stage. Teachers guide students to review the principle, demonstrate the function of the power module, students compare the schematic and PCB, identify the devices used in the power module, discuss and share the results; The teacher record the shared students' scores in the "Cloud learning supermarket". **Functional experience stage.** The teacher guides the students to experiment and clarify the function of the power module; Students measure the key test points of the four parts of the circuit to form a preliminary understanding of the circuit principle and function. **Block diagram design stage.** Teachers guide students to brainstorm, try to analyze circuit principles, design functional block diagrams and upload them to the "Cloud learning supermarket"; According to the discussion of the students, the teacher taught the principle of power supply in a targeted way. If more than 80% of the students have understood, they can carry on a deeper exploration of the problem or move to the next teaching link. Through the teacher's explanation, animation watching and functional experience, the students have a deeper understand- ing of the circuit structure and working principle of the power module.**Index design practice stage.** The teacher explains the meaning of the circuit index and the influence of the key parameters on the circuit. The students cooperate according to the way of complementing each other's advantages, using the Multisim software to design the circuit function and parameter index (output voltage, ripple). In this process, teachers carry out individualized guidance by Patrolling the classroom.**Results display stage.** Student representatives will present results and evaluate each other in groups, share quality cases of electronic products, further

understand circuit principles and improve quality awareness, and "Cloud Learning Supermarket" will record students' mutual evaluation results. According to the job requirements of the enterprise, the enterprise tutor makes online comments on the students' achievements and points out the optimization direction. The teacher summarized and commented on the situation of each group, and gave targeted guidance to the students based on the opinions of the enterprise tutor.

(3)Learn more after class

JiTT teaching mode emphasizes on conducting web-based "Wrap-up Puzzles". After-school extension is helpful for students to consolidate what they have learned, move to higher level knowledge and promote their divergent thinking.

After class, the teacher assigned three levels of extension tasks: "±12V fixed bias linear DC voltage stabilized power supply", "high-power, low-temperature floating adjustable precision voltage stabilized power supply" and "short-circuit (when the output voltage is lower than 1% of the rated value) sound and light alarm power supply", the implementation of stratified and classified teaching, so that students with different foundation can choose independently different difficulty and ease of expansion tasks, further improving the students' ability of circuit design, independent exploration and innovation. Through the cloud platform, teachers answer specific questions timely to reduce students' fear of difficulties.

3 The main problems to be solved

3.1 Build a "Cloud learning supermarket" supported by big data to drive precision teaching decision-making and implementation system

In the "Cloud learning supermarket", teachers are the "shopping guide", the designer and guide; Students are "customers", experiencers and subjects. Teachers develop learning resources accord- ing to teaching objectives and learning conditions, and pay attention to the fun, granulation, gradient and random combination of resources. It is convenient for students at different levels to choose the content of different modules and degrees of difficulty to learn, and improve students' self-efficacy.

Students' learning situation will be recorded in the form of scores in the "Personal electronic portfolio" in the "Cloud learning supermarket". By viewing the portfolio, students can reflect on their recent learning situation and constantly adjust their learning status.

By viewing students' learning situation on "Cloud Learning Supermarket" and students' "personal electronic portfolio" in the class, teachers can understand which kinds of resources in Supermarket are more popular, which activities students are more willing to participate in, have an overall grasp of the learning situation of the class, timely adjust the teaching strategy, and push relevant materials to the weak students, and implement accurate guidance.

"Cloud learning supermarket" can record online learning and offline assessment, and the efficient and intelligent teaching ecological environment provides big data support for teaching, which is convenient for teachers to reflect on teaching and provides an important basis for the subsequent adjustment of teaching strategies, thus forming a closed loop of

teaching "feedback chain". The "feedback chain" based on "Cloud learning supermarket" provides the maximum convenience, timeliness and interactivity for JiTT mode, which is also an important feature of JiTT better than previous teaching.

3.2 Construct quantifiable and visualized evaluation feedback system with the help of "Cloud learning supermarket"

The online resources developed based on "Cloud Learning supermarket" are convenient for pre-class exploration, in-class guidance and after-class extension. By setting reasonable assessment weights and weights of various teaching activities, teachers record students' participation and accuracy in the form of "scores", and carry out quantitative evaluation throughout the whole teaching process to form dynamic comprehensive assessment before, during and after classes. Quantitative evaluation is conducive to teachers and students to clearly see their own and each other's strengths and weaknesses, students to maintain continuous learning curiosity and high sense of learning efficacy.

Instead of the chronic problem of only "score and skill" as the final result in the past, a triple evaluation of achievement, participation and value-added should be constructed, and students' skill level improvement and craftsman spirit should be taken as the evaluation object. Strengthen quantifiable process and value-added evaluation, record students' progress in a certain teaching link, record efficient teamwork and circuit design quality in the form of value-added scores, and solve the irrational evaluation of results caused by students' differentiation. Scientific evaluation can comprehensively evaluate the value added of students, effectively activate the enthusiasm of underachiever, and ensure the scientific, rational and multi-dimensional evaluation.

3.3 Update teachers' concepts and build a guarantee mechanism for the sustainable development of teachers' information literacy

Teachers with high information literacy are an important part of the success of JiTT mode. The comprehensive information ability of teachers can be improved by means of collective lesson preparation, series training of IT teaching ability and teaching ability competition. Focus on training teachers to make PPT, build online resources, construct visual evaluation feedback system, timely feedback loop, information ethics awareness and other aspects of improvement, and finally build a high-level teacher team with "the experienced and young, reasonable structure, clear division of labor, and high information literacy".

However, because teachers are good at different fields, the training mode should reflect the principle of individuation. For example, schools can carry out teacher training in PPT making, online teaching resources construction, quality course website construction training, information retrieval ability improvement training and other different contents. Teachers can choose one or several of them for key training according to their own characteristics. After the training, teachers can further promote their ability of information literacy through sharing and communication, ability display and training assessment.

4 Conclusions

Modern college students are the natives of the Internet, and they have a strong ability to use the Internet. By constructing granulated and hierarchical teaching resources and carrying out JiTT mode with "Cloud learning supermarket" as the carrier, the analog electronics course in polytechnics can actively "cater" to students' preferences, which is conducive to students breaking the restriction of time and space and carrying out independent learning. Through the "feedback loop", teachers can know the learning situation at any time, give feedback in time, and implement accurate and scientific teaching strategies.

Fund project: Research and practice on Teaching Reform of Higher Vocational Education in Guangdong Province in 2021" Research on the Reform Path of "Three Teaching Reforms" of Electronic Professional Platform Courses in Higher Vocational Colleges Based on JiTT Mode"(GDJG2021075); Research and practice on Teaching Reform of Higher Vocational Education in Guangdong Mechanical & Electrical Polytechnic in 2021"Research and practice of vocational learning quality evaluation system from the perspective of meta-evaluation" (YJZD2021-32),"Research and design of intelligent self-service shopping supermarket based on RFID"(YJYB2021-64), Funding by Science and Technology Projects in Guangzhou (202201011706).

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