The Practice of Online and Offline Blended Course Construction of Electronic Design Automation Technology Based on FPGA

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Abstract: Higher vocational education is characterized by professionalism, openness and practicality, while online and offline blended teaching is highly compatible with the characteristics of higher vocational education. In response to the current dilemma of chip's neck jam , the course of Electronic Design Automation Technology is based on the chip front-end design post, aiming at cultivating the collaborative design ability and professional quality of embedded systems required for FPGA application development. Relying on the provincial-level high-quality online open course, the construction of online and offline hybrid courses has formed certain characteristics and innovations in course content design, teaching mode reform, teaching method application, teaching assessment and evaluation.

1. Introduction

The engineering courses in higher vocational colleges have the characteristics of close relationship between theory and practice and strong practicability. The mixed teaching mode of organic combination of online and offline conforms to the cognitive characteristics and learning habits of higher vocational students, which can effectively improve the teaching effect of higher vocational engineering and cultivate students " engineering practice ability[1]. General Secretary Xi Jinping said at the 19th Congress of academicians of the Chinese Academy of Sciences and the 14th Congress of academicians of Academicians of the Chinese Academy of Engineering that practice has repeatedly told us that typical core technology cannot be bought or acquired. Only by keeping key and core technologies in our own hands can we fundamentally guarantee national economic security, national defense security and other security[2]. The course of Electronic Design Automation Technology is based on the chip front-end design post, aiming at cultivating the collaborative design ability and professional quality of embedded systems required for FPGA(Field Programmable Gate Array) application development.Relying on the provincial-level high-quality online open course, the construction of online and offline hybrid courses has formed certain characteristics and innovations,to meet the open and practical teaching characteristics needed of higher vocational education[3]. According to the technical advanced logic of primary verification (simple logic circuit design) - > advanced improvement (complex hierarchical circuit design) - > high-level innovation (integrated system design), the course gradually improves students " professional skills, cultivates students " personal identity, family belonging, collective sense of honor, social responsibility and national pride, and then cultivates the feelings of serving the country with science and technology[4]. The teaching process is designed according to the working process of the enterprise, strengthen the craftsman spirit of "dedication, leanness, concentration and innovation", permeate the professional quality and scientific spirit, realize the synchronous spiral improvement of skills and quality, and build the curriculum teaching system of "Theory-Application-Engineering".

2. Curriculum Positioning

Electronic design automation technology course is the professional core courses of electronic

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information engineering technology, applied electronic technology, embedded technology and application of higher vocational colleges, which is the main channel to impart knowledge, cultivate skills and improve quality. After studying the courses of C Language Programming, Digital Electronic Technology and Single Chip Microcomputer Technology Application, we further consolidate the theoretical basis of hardware description language, improve the comprehensive professional ability of FPGA application development, cultivate the feelings of serving the country with science and technology, the craftsman spirit of dedication, leanness, concentration and innovation , professional quality and scientific spirit, and lay a good foundation of knowledge, skills and quality for subsequent graduation design and post practice.

3. Teaching Philosophy

The course adheres to the teaching philosophy of student-centered, action-oriented and task carrier[5], and takes the third-order spiral progressive learning projects as the task to create a real workplace environment, so that students can experience immersive learning through role-playing.

3.1. Student Centered

From the perspective of cultivating students' engineering thinking, we adopt group teaching to simulate enterprise work scenarios and set up different positions to create a real workplace environment, so that students can actively perform their job responsibilities and experience immersive learning through role-playing. Under the guidance of the pre-class, in-class and after-class task books, the students can explore and study cooperatively independently, highlight the main body position of the students, and cultivate the students" independent learning ability and the sense of post responsibility.

3.2. Action Oriented

The practice teaching of course is organized and implemented according to the whole life cycle development process of FPGA products, from scheme design, to code writing, to simulation verification, and finally to download and debug. The work links are interlocking, and the craftsman spirit of dedication, leanness, concentration and innovation is strengthened, so as to realize the zero distance cultivation from school to engineering practice.

3.3. Task Carrier

The course takes the third-order spiral progressive learning project of primary verification -> advanced application -> high-level innovation as the carrier. Through task guidance and group cooperation, it systematically cultivates students' embedded system collaborative design ability and professional quality required for electronic product design and development, and infiltrates the scientific spirit of exploration.

4. Teaching Design

Using big data to analyze students' learning situation, students at this stage generally have insufficient knowledge reserve of hardware description language, shortage of practical experience in electronic product development, and lack of professional quality. According to the curriculum positioning, the three-dimensional teaching objectives of the quality, knowledge and ability of this course are defined as "four haves", "three knows" and "three abilities". Quality goal "four have" is the feelings of home country, artisan spirit, professionalism, scientific spirit ; knowledge target " three knowledge " is to know the FPGA development process, to know the PLD (Programmable Logic Device) working principle, to know the Verilog HDL syntax points ; ability target "three ability"is to have Verilog HDL programming design capabilities, chip prototype verification capabilities, and FPGA application development capabilities.

4.1. Teaching Objectives Design

The course takes the third-order spiral progressive learning project of primary verification -> advanced application -> high-level innovation as the carrier. Through task guidance and group cooperation, it systematically cultivates students' embedded system collaborative design ability and professional quality required for electronic product design and development, and infiltrates the scientific spirit of exploration.

4.2. Teaching Contents Design

In terms of teaching content, we integrate the " Post,Course,Competition and Certificate " (post : FPGA application development position, competition : electronic product chip level inspection and maintenance and data recovery, certificate : FPGA engineer (primary) certificate) to reconstruct the course, break the traditional knowledge architecture, and adopt the " primary verification-advanced improvement-high level innovation " three-stage spiral progressive project as the carrier. The " primary verification " stage covers three projects. The four-bit adder design aims to introduce how to use the schematic input design method to design the digital circuit system in the Quartus II development environment, and to boost students self-confidence in the zero-base. The design of the three-person voter aims to introduce the steps and methods of how to use the hardware description language input design method to design the combinational logic circuits, simultaneously cultivate the sense of fairness, justice and democracy, and awaken the sense of personal identity through personal self-cultivation. Through the design of digital electronic clock, the course systematically introduces how to use Verilog HDL language statements to design sequential logic circuits, so as to enhance the sense of family belonging in the sense of time urgency. Advanced improvement stage covers two projects, sound and light warning device design, aims to introduce the top-down layer of complex circuits design method, By playing school songs and red songs, feel school motto spirit of "Devote to family and country, create with hand and mind", enhance collective sense of honor by telling school history stories.Through the design of traffic manager, the design of digital circuit system is carried out by means of finite state machine. Students use their professional knowledge to help them travel safely and internalize the social responsibility of technology for the people. The use of open creative design in high-level innovation stage, innovation as the wing, cultivate the consciousness of innovation, establish the concept of innovation, practice science and technology to serve the country.

4.3. Curriculum politics design

The course is based on the current chip "neck jam" and "chip hot" political hot spots, taking " China Chip-Craftsman Dream" as the main ideological and political line of the course, and taking "carrying forward the craftsman spirit and shaping the ‘four haves youth’ ” as the course quality goal. The "four haves" quality goal focuses on:

①Has feelings of family and country: it is committed to manufacturing the "China chip", gradually cultivate students’ personal identity, family belonging, collective honor and national pride, and then cultivate the feelings of serving the country through science and technology.

②Has the craftsman spirit: carry forward the craftsman spirit, and cultivate the craftsman spirit of "dedication, lean, focus and innovation" in the process of product design, code writing, timing simulation, comprehensive debugging process.

③ Has professional qualities: in the group division and cooperation to complete the design task, develop rigorous and meticulous professional behavior habits, honest and trustworthy professional ethics, courage to resist setbacks professional attitude, cost awareness, quality awareness and other professional specific qualities, as well as a reasonable division of labor, unity and cooperation team spirit.

④ Has scientific spirit: in the process of completing engineering tasks, gradually cultivate the principle spirit of pursuing truth, endless spirit of exploration, empirical spirit of respecting facts and realistic spirit of seeking truth from facts.

4.4. Teaching mode innovation

Curriculum innovation is guided by the "7E" interactive teaching mode, "7E" is Explore-Examine-Explicate-Educt-Exercise-Estimate-Expand. With students as the main body, teachers carefully design in advance and carry out teaching according to the curriculum standards, so as to effectively achieve the effect of pre class preview, in class empowerment and post class promotion.

First exploration, through the exploration before the class, the teachers upload the learning resources to the course platform, and release the pre-class preview notice through the mobile learning terminal. According to the pre-class task book, the students watch the micro-class videos, preview the key knowledge points, and learn independently on the course platform.

Second examine, through the pre-class test, the students complete the preview test, the test set doubt, guide the students to think. Teachers adjust the teaching strategies according to the completion of students' independent learning before class.

Third explicate, which means to clarify the task. Students should make "three clarifications" according to the task book - clarify work tasks, clarify division of responsibilities, and clarify time nodes.

Forth educt, the teacher analyzes and explains the principles, the students record the key points of knowledge and technical elements, analyze and discuss the work plan within the group, and form the design scheme.

Fifth exercise, Relying on self-developed experimental kits, the team cooperates according to the division of job responsibilities to jointly complete practical tasks and strengthen the attitude of dedication to work. Teachers can provide individualized guidance at any time to jointly solve problems encountered. Through task guidance, genuine knowledge comes from practice and cultivate the principle spirit of pursuing truth. Competition between groups stimulates students' interest in learning. For students at different levels, different difficult tasks are designed, teach in layers, guide students to challenge themselves, and pursue outstanding work effectiveness. The design is promoted layer by layer, and the teachers timely demonstrate the key points of the design to guide students to break through the teaching difficulties.

Sixth estimate, which means evaluation and summary. Each group to show results, guide students to self-reflection, improve the design, temper excellence style of work. Assessment and evaluation integrates teacher evaluation, intra-group mutual evaluation, inter-group mutual evaluation and enterprise mentor evaluation to achieve multi-agent assessment and full-process information-based assessment. Finally, the classroom summary further promotes the internalization of students ' knowledge and the strengthening of skills.

Seventh expand, which means after-class expansion. According to the after-class task book and relying on the professional provincial teaching resource database, students can complete after-class expansion training and after-class testing independently, and realize the expansion of classroom knowledge, so as to consolidate new knowledge and strengthen skills. There is also online discussion, sharing design experience and heart process, mutual help to answer questions. They can also participate in skills competitions or social services such as public science popularization and voluntary maintenance, accumulate value-added evaluation points, and enhance their sense of social responsibility.

4.5. Application of teaching methods

There is no definite method of teaching, but the key is to get the right method. The teaching method of "five types of demonstration" (demonstration design, demonstration programming, demonstration simulation, demonstration debugging, demonstration application) is innovated in the curriculum, and the task driven method, group cooperation inquiry method, discussion method, etc. are comprehensively used. Task driven method: the task is to guide students to improve their professional skills. While completing the task, it can enhance students' self-confidence and self-identity. Group cooperation inquiry method, mutual help within the group, PK competition between groups, cultivate students' communication ability and team cooperation awareness, enhance the awareness of classroom participation and post responsibility, and stimulate the collective sense of

honor and classroom vitality. The discussion method is to discuss technology and ideological and political topics, collide with thinking sparks, make the truth more clear, and simultaneously cultivate students' language and written expression ability and the principle spirit of pursuing truth.

The teaching method of "five types of demonstration", teachers' demonstration design, demonstration programming, demonstration simulation, demonstration debugging, demonstration application, gives full play to the advantages of information resources, makes use of animation, video, micro classes and other teaching resources, skillfully uses live broadcast means, large screen demonstration and standardized operation skills, helps students understand abstract principles in an intuitive and concrete way, creates a guided learning experience, stimulates students' interest in learning, and resolves learning difficulties, break through the teaching focus, improve students' participation in the classroom, and cultivate the innovative spirit of exploration and practical ability to solve problems.

4.6. Reform of evaluation methods

In terms of assessment and evaluation methods, with the help of information technology, focusing on knowledge, ability and quality objectives, students are the center, from the two dimensions of "online platform+offline classroom" and the three stages of "pre class, in class and after class" respectively, and the four evaluation subjects of "self-evaluation+student mutual evaluation+teacher evaluation+platform evaluation" are embodied, according to the five combination ideas of "combining process and result evaluation, combining closed and open evaluation, combining subjective and objective evaluation, combining qualitative and quantitative evaluation, and combining target evaluation and value-added evaluation", the "12345" multi dimensional comprehensive evaluation is implemented, and finally the four promotion strategies of "promoting engineering thinking, promoting professional quality, promoting professional ability, and promoting professional knowledge" are realized, effectively improve students' learning enthusiasm and self-restraint.

5. Conclusion

With the help of the MOOCs platform, the course adopts the online and offline hybrid teaching, with students as the main body, completing the integrated teaching of knowledge and skills, theory and practice, professionalism and literacy, forming the following characteristics and innovations:

5.1. Innovation of teaching mode

Innovative "7E" interactive teaching mode of learning guidance: to "explore" is used to lead thinking, to "examine" is used to clear learning situation, to "explicate" is used to confirm the task, to "educt" is used to determine the plan, to "exercise" is used to improve skills, to "estimate" is used to push improvement, to "expand" is used to promote consolidation. With students as the main body, teachers are skillfully designed layer by layer to enhance students' awareness of classroom participation, break the dull traditional classroom, and let students "enjoy learning, can learn and be learned".

5.2. Innovation of teaching methods

The course innovates the teaching method of "five types of demonstration", gives full play to the advantages of information resources, makes use of animation, video, micro-class and other teaching resources, skillfully uses live broadcast means, and displays standardized operations on large screens to stimulate students' interest in learning, resolve learning difficulties, and break through teaching priorities.

5.3. Features of teaching system

The "theory-application-engineering" progressive teaching system with the "primary verification-advanced improvement-high level innovation" three-stage spiral progressive learning project as the carrier has been constructed. Six projects, including the designs of three person voter

and the digital electronic clock and e.t, have been successively used as the task carrier to gradually improve the students' professional skills and professional quality, and gradually cultivate the students' sense of personal identity, family belonging, collective honor, social responsibility and national pride, In turn, the national feelings of science and technology newspaper will be deeply rooted, and the silent effect of ideological and political education will be achieved, so as to achieve synchronous spiral improvement of skills and accomplishments.

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References

[1] Gao Juan.Research on the Mixed Teaching Mode of Engineering Major Courses in Higher Vocational Education--Taking the Hydraulic and Pneumatic Transmission Course as an Example[J]. Modern Vocational Education,2020,(30):92-93

[2] Speech at the 19th Academician Conference of the Chinese Academy of Sciences and the 14th Academician Conference of the Chinese Academy of Engineering[EB/OL]. https://www.ccps.gov.cn/xxsxk/zyls/201812/t20181216_125694_1.shtml, 2018-05-28.

[3] Wei Liusi,Tan Yongping,Tang Yifa.Research on Hybrid Curriculum Construction Based on the Characteristics of Higher Vocational Education[J].Education and Occupation,2021,(03):103-106

[4] Wang Lihua.Analysis on the Connotation and Characteristics of Family and Country Feelings[J]. Mangzi,2018(08):39-40

[5] Xu Yaoqiang.On"Craftsman Spirit"[J].Red Flag Manuscript,2017,(10):25-27

[6] Duan Zuozhan.An Analysis of the Connotation and Characteristics of Teaching Ideas[J]. Education Guide,2011,(11):15-18

[7] Zeng Tianshan. On the Comprehensive Cultivation of Talents by Means of Integrating" Posts, Courses,Competitions and Certificates"[J].Education Research,2022,43(05):98-107.