

Application Research of Penetration Teaching Mode in the Construction of Electronic Gold Courses

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Abstract: Under the guidance of creating the electronic gold course and the "six excellences one top plan" 2.0, aiming at some problems existing in the electronic major students in colleges and universities, this paper re-plans and designs the electronic practical teaching. A new penetration teaching mode is established in the electronic practical courses. Six kinds of penetration modes are given in detail, namely, the penetration of knowledge points, the penetration of relevant courses, the penetration of multiple hardware, the penetration of multiple software, the penetration of hardware and software, and the penetration of time and space. Several years of practice have proved that the penetration mode is helpful to create electronic gold courses, improve the innovation and challenge of courses, and cultivate electronic graduates with first-class quality and high social recognition.

1. Introduction

In September 2017, the state announced the list of universities and disciplines in the construction of world-class universities and first-class disciplines. So, the "double first-class" construction has been officially started. In the report to the 19th national congress of the communist party of China, general secretary Xi called for accelerating the construction of first-class universities and disciplines, as well as building an innovative country. In August 2018, the ministry of education issued a notice to strengthen the management of classroom teaching and learning process, eliminate watercourses and create gold courses [1]. In April 2019, the director-general of the ministry of education, Yan Wu, proposed new requirements of "six excellences one top 2.0", which will promote the connotation development of higher education, raise the "quality revolution" of personnel training, cultivate graduates of first-class quality and high social recognition.

To build the electronic gold courses, we must pay more attention to the important position of practical teaching, and strive to create a teaching atmosphere that combines theory and practice closely. We should make rational use of modern information technology, construct projects of new modes practical training. According to the requirements of building gold courses, this paper puts forward six kinds of penetrating teaching modes, which can effectively enhance the innovation and challenge of electronic courses and is conducive to cultivate outstanding electronic graduates with innovative consciousness and engineering practice ability.

2. The problems existing in the practice of electronic students

Teaching and educating people is the most fundamental task of colleges and universities. A major change in contemporary education is from emphasizing knowledge and skills to cultivating students' active learning. The focus of higher education is to cultivate students' ability of independent learning [2]. Taking student development as the basis, improving the teaching system of electronic courses, which should not only strengthen the study of professional theoretical courses but also strengthen the training of practical courses [3]. Under the background of emerging engineering, it is of great significance to strengthen practical teaching to improve the ability of

innovative talents.

However, engineering students often meet some problems, such as boring teaching case [4], insufficient experiment resources or sites [5], and so on the exterior problem, lacking the ability of circuit simulation, professional software using and system debugging, weakness in team consciousness, etc. intrinsic issues. These problems limit the cultivation of students' creative consciousness and engineering practice ability. So, some electronic students in colleges lack understanding and insight of the internal links between professional knowledge systems or courses, which make it difficult to meet the demand for new engineering talents in the new era. Therefore, a new penetration teaching mode is established for the electronic practical courses in this paper.

3. Penetration teaching mode

The purpose of penetration mode is to strengthen the connection between different things, make seemingly independent individuals work together, to exert the overall effect between things. For example, the same course plays different roles in different professional structures, and the same knowledge point plays different roles in different application backgrounds. Through various modes, related teaching resources of electronic practical courses are penetrated, and time and space are penetrated, to reconstruct the knowledge structure of the electronic system. Various teaching resources communicate with each other, echo and cooperate.

3.1 The penetration of knowledge points

The penetration of knowledge points is to analyze and sort out different knowledge points in the same course, find their internal connections and carry out mutual penetration, to deepen students' understanding of course knowledge. For example, voting circuit design in digital electronic technology, there are many discrete knowledge points, such as PN junction, NAND gate structure, small-scale logic circuit, Boolean algebra, Karnaugh map and 74LS138 chip, etc., which can be penetrated according to the pattern shown in figure 1, so that students can form a systematic cognition and understanding of relevant knowledge.

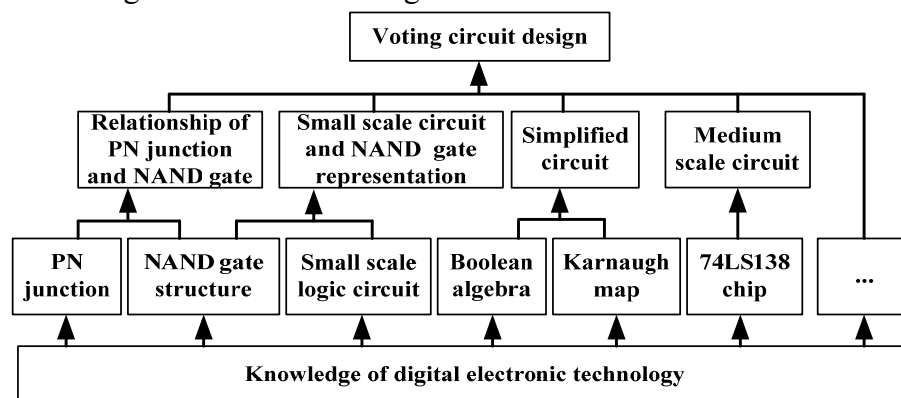


Fig1 The penetration pattern of knowledge points

3.2 The penetration of relevant courses

The purpose of penetration of relevant courses is to help students build professional knowledge architecture. The concrete implementation method is to study the similarities and differences of different professional curriculum structure, such as measurement control and communication engineering. According to the teaching syllabus and the connection and context between the topology analysis of electronic relevant courses, introductory courses were regarded as background, professional backbone courses were taken as foundation, specific penetration cases were established among analog electronic technology, digital electronic technology, high-frequency electronic circuit, sensor technology, principle of microprocessor, FPGA technology, communication principle, etc., as shown in figure 2. Figure 3 shows the penetration case between the course of digital electronic technology and the course of communication principle. The information transmission design is

realized by combining the counter principle with the bandpass transmission theory.

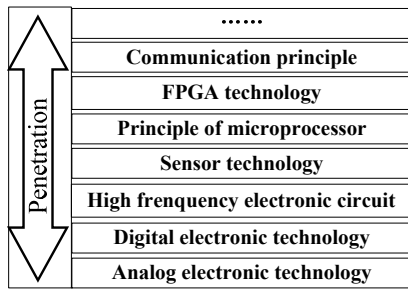


Fig 2 The penetration of relevant courses

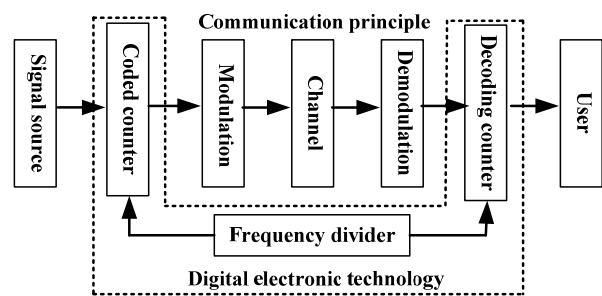


Fig 3 The penetration case

3.3 The penetration of multiple hardware

In order to cultivate students' ability of designing various hardware circuits flexibly and autonomously, multiple kinds of hardware are penetrated to build a complex electronic system with specific functions, such as discrete components, single-chip microcomputer, sensor, embedded system, microcomputer, analog discovery 2, DSP and FPGA, etc., as shown in the left half of figure 4. Figure 5 shows a traffic light control case, which is composed of a variety of hardware resources such as single-chip microcomputer, discrete components, and medium scale circuit.

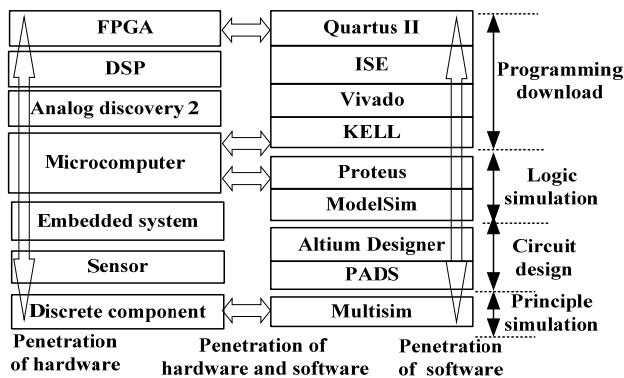


Fig 4 The penetration pattern of hardware, software, and hardware and software

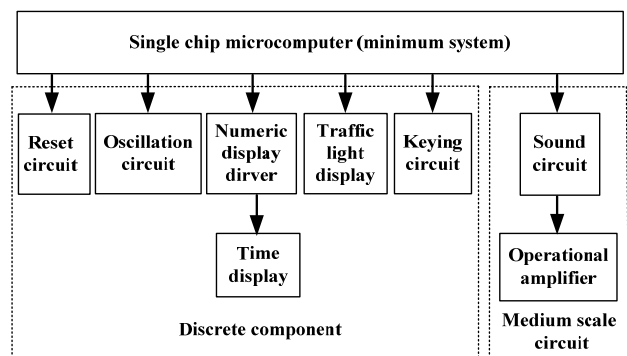


Fig 5 The hardware penetration case of traffic light control

3.4 The penetration of multiple software

The purpose of software penetration is to train students to skillfully use various software, so students can complete specific engineering research and development tasks, and cultivate students' engineering development ability. Considering the actual project engineering, software development includes several specific stages, such as principle simulation, circuit design, logic simulation, programming download, etc. According to the engineering practice, various kinds of software, such as Multisim, Altium Designer, Proteus and Quartus II, and electronic content simulation are penetrated with practical teaching. The specific process is shown in the right half of figure 4.

3.5 The penetration of hardware and software

This penetration method combines the actual process of design, simulation, hardware implementation, debugging and data processing in engineering practice, and realizes the mutual combination of software development and hardware circuit, enables students to master the development and design method of an engineering system, as shown in the middle part of figure 4. For example, two methods can be used in the design of the voting circuit, as shown in figure 6. One method is to use analog discovery 2, 74 series chips, analog circuit, and electronic experiment box to form the circuit, use Multisim software to draw circuit schematic diagram and simulate, then draw PCB board diagram, finally weld and debug. Another method is to build hardware circuit by

using EDA experimental box, FPGA chips, and single-chip microcomputer, use Quartus II software for simulation, then make PCB board diagram, finally weld and debug.

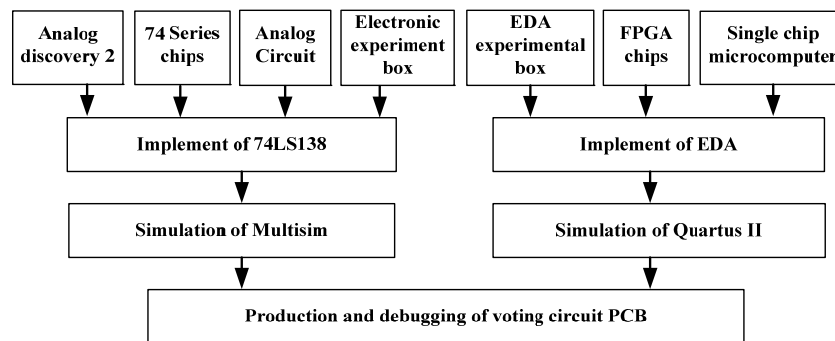


Fig 6 The penetration case of hardware and software for voting circuit

3.6 The penetration of time and space

The penetration of time and space is to provide students with convenient learning conditions, maximize the utilization rate of experimental equipment, and enable students to carry out hands-on practice anytime and anywhere, no limit to class schedule and laboratory. In class, the fully open experimental teaching management system can be used to schedule practice time flexibly and autonomously. After class, portable pocket experimental boards, such as AD2, EDA circuit board, single-chip microcomputer simulator, and FPGA simulator, are used for extracurricular learning.

4. Conclusion

To solve the problems about weak professional skills of colleges and universities electronic students, and train graduates of high quality and high social recognition. This paper puts forward six kinds of penetration teaching mode, which fuse a variety of practice teaching resources for electronic courses, make seemingly independent individuals work together, play the overall effectiveness of the electronics knowledge. Several years of teaching practice shows that the practical teaching reform in this paper has improved the innovation and challenge of electronic courses, strengthened professional knowledge and skills, enhanced students' awareness of independent learning and innovation, and improved students' engineering practice ability.

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