Teaching Research of Single-chip Microcomputer Principle Based on Knowledge Architecture

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Teaching Research of Single-chip Microcomputer Principle Based on Knowledge Architecture

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Abstract. According to the "cross penetration" organization way, this paper will take the undergraduate "system ability" training as the goal, comb the relevant knowledge of many core courses for effective connection, construct complete knowledge system of this course, and draw the knowledge point connection. This teaching mode makes clear the skeleton of the learning content, carries out the image concretization of the abstract knowledge, provides an effective idea for the construction and teaching of the single-chip microcomputer course, and provides a strong support for the student' system ability, practice and innovation ability.

1. Introduction

The study of teaching mode can give full play to the subjective initiative of students' learning, and play a very important role in cultivating students' innovative spirit and practical ability [1]. In June 2018, the Ministry of Education proposed "promoting the renewal of curriculum content, promoting classroom revolution, and building a good quality culture" [2] in National Conference on Undergraduate Education in Colleges and Universities in the New Era. In January 2019, the Director of the Department of Higher Education, Wu Yan, made a thematic report "2019, fighting the battle for comprehensive revitalization of undergraduate education", stressing that "no matter how famous and how high college teachers is, their first identity is the teacher, so teaching is their first job and giving class is their first responsibility" [3]. Teachers should constantly improve the teaching mode, constantly promote the updating of course content and bring new progress in subject researches, new experience in practical development as well as new changes in social needs into the teaching content in time.

The course of "principle and application of single-chip microcomputer" is one of the most important specialized courses in undergraduate electronic information majors in colleges and universities, because it has strong system, huge structure system, a wide range of knowledge and a close combination of theory and experiment [4]. At present, in the theory teaching of "the principle and application of single-chip microcomputer", the traditional teaching mode is often adopted, which does not embody the teaching idea of student-centered and teacher-oriented, so it leads to students not being active in listening to classes and not taking the initiative. In practice teaching, the experimental environment is single and the students are not fully previewed, which leads to the disconnection between theory and practice and can't achieve the purpose of experiment. Therefore, teachers should comb the knowledge points of the "single-chip microcomputer principle and application" course and introduce related knowledge points of relevant courses according to the systematic knowledge established by course content frame, such as digital logic circuit, computer composition principle,

computer system structure, program design, data structure and algorithm, etc. Teachers should construct the knowledge system of single-chip microcomputer principle, which is characterized by ability training and knowledge fusion. In practice teaching, teachers should bond the framework of knowledge system, combine simulation with practice, combine fixed experimental environment with mobile experiment, combine experimental project with science and technology competition to realize the integration of theoretical knowledge and practice, which will further enhance the practical ability of undergraduates.

2. Comb the course content and construct the knowledge system

"Principle and application of single-chip microcomputer" course has the characteristics of complex structure, a wide range of content, strong practicality and so on. In order to let students deeply grasp this course, it is necessary to re-plan the course content, meticulously comb and reflect the consistency among knowledge points. Introducing the digital logic circuit, computer composition principle, computer system structure, program design and other related courses of relevance knowledge points in accordance with the training request of systematical ability, which will achieve the overall framework of the course, hierarchy, related knowledge network[5].

2.1. Construct the knowledge structure of course content

This paper makes a detailed analysis of the theoretical course content, expands it according to the knowledge module, and establishes a clear content structure of the course knowledge, as shown in Figure 1.

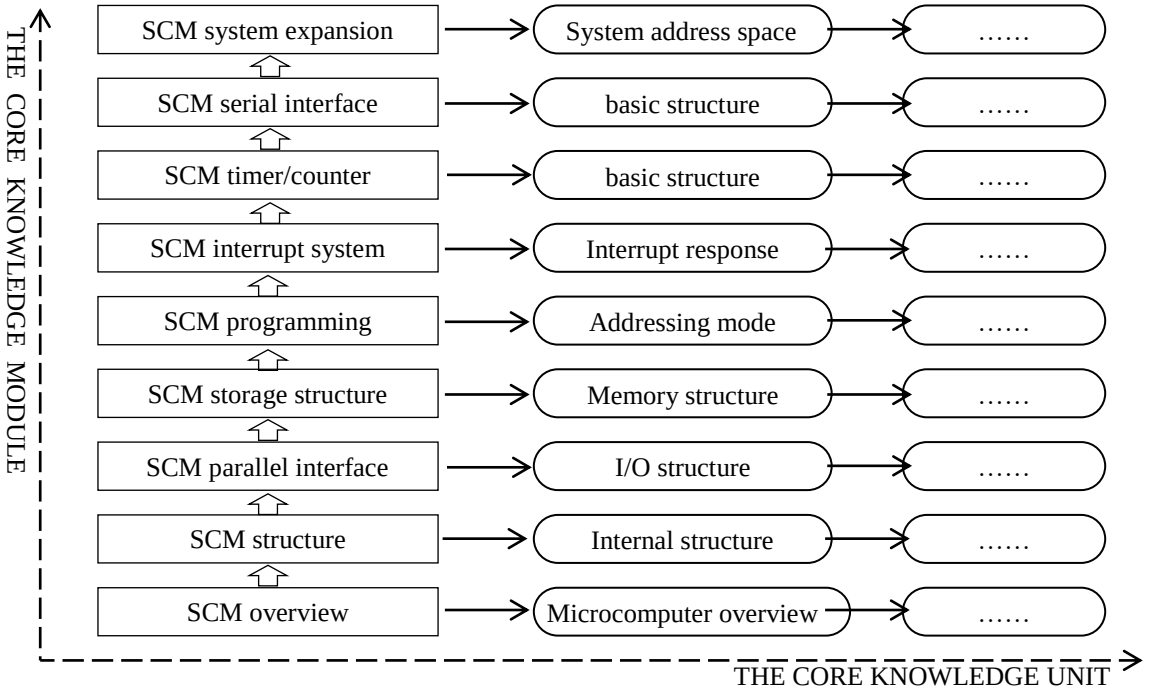

Figure 1 "Single-chip principle and application" course knowledge structure

The vertical line in the figure mainly starts from the point of view of the core knowledge module of single-chip microcomputer, covering each chapter of curriculum theory in order to provide students with a systematic main line. The specific modules include: single-chip overview, single-chip internal structure, single-chip parallel interface, single-chip storage structure, single-chip instruction system and program design, single-chip interrupt, single-chip computer timing/counter, single-chip serial interface, single-chip microcomputer system expansion and single-chip microcomputer system development. Horizontal lines are the core knowledge unit in each chapter and are extensions to the vertical line. The design of this knowledge structure embodies the integrity and systematization of the

curriculum, can further comb the theoretical knowledge structure, and enhance the students' understanding of the curriculum [5].

2.2. Construct curriculum knowledge system

Teachers should integrate, update and plan the content of the course, attach importance to the coherence and connection of knowledge between the courses related to "the principle and application of single-chip microcomputer", analyze and optimize the key points, difficulties and solutions of each chapter, each section and each knowledge module of the course, and strive to make the teaching content more adaptable to the needs of capacity development [6].

The course involves the relevant knowledge points, which does not mean simple repetition of the explanation to achieve a systematic, holistic knowledge mastery effect. Reconstruct and optimize the related knowledge points from the perspectives of "scientific, developmental, systematic, integrity and intersectionality", in order to determine the most effective form of knowledge system organization.

"Scientific" requires ensuring clear, accurate, consistent and ordered knowledge, cultivates students' rigorous scientific thinking ability. "Developmental" requires looking forward to the height of the discipline, paying attention to the latest research results of the subject direction and new ideas, cultivating students' innovative ability. "Systematic" emphasizes the role of curriculum in the discipline, the interpenetration of related courses as well as the formation of a more perfect teaching content structure. "Integrity" ensures that the reconstructed knowledge system has the integrity of the curriculum, the integrity of knowledge, and does not omit the content and knowledge points of the subject. "Intersectionality" emphasizes the integration, interaction, and cohesion between the different courses in the discipline so as to improve students' comprehensive ability and train the compound talents who are suitable for the society.

The principle and application knowledge system of single-chip microcomputer takes "system ability training" as the main line and has the characteristic of "knowledge association fusion", are shown in Figure 2.

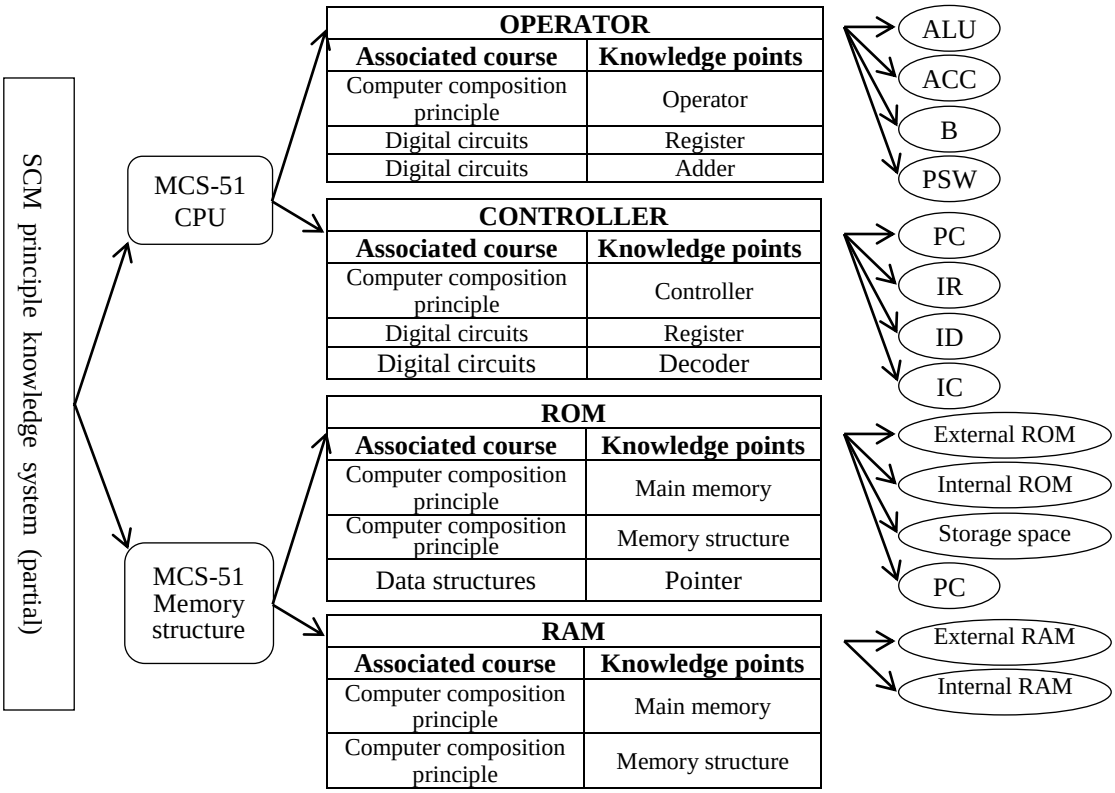

Figure 2 The principle and application knowledge system of single-chip microcomputer

3. Reconstructing practical teaching and improve innovation ability

The course of "the principle and application of single-chip microcomputer" synthesizes the knowledge of electronic technology, computer composition principle and program design, which is in the core position in the curriculum system of electronic information specialty. In experimental teaching, it is possible to condense the idea of universal significance and the method of solving the real problem, which can achieve the purpose of divergent thinking and learning [7].

At present, practice teaching of "principle and application of single-chip microcomputer" is still stuck in a fixed laboratory or training room in many colleges and universities. Experimental operation is passively implemented by students. In order to improve students' innovative practical ability, strengthen the combination of theory and practice, and improve students' social adaptability, the practice teaching of "principle and application of single-chip microcomputer" in our college has also adopted simulation experiment (proteus) and pocket single-chip microcomputer as the supplement of practical teaching on the basis of fixed laboratory environment [8], which forms a practical teaching model with characteristics. This is shown in Figure 3.

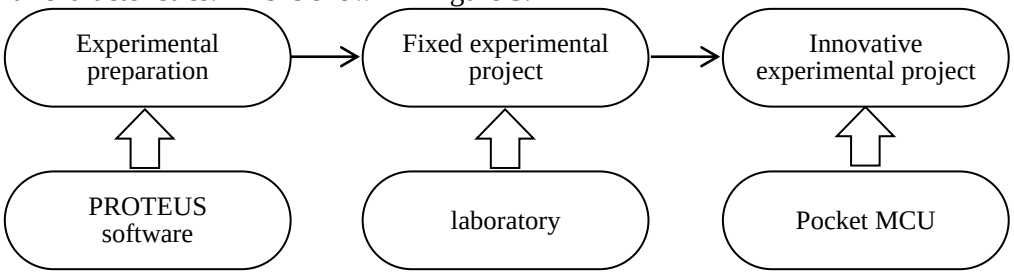

Figure 3 The practical teaching mode

3.1. Strengthen the experiment preview and introduce the simulation experiment

Experimental teaching use the theoretical knowledge to design hardware and software, further consolidates the theoretical knowledge, enhances the application ability of combining theory with reality. Experiments in a fixed laboratory environment require students to fully preview before doing experiment. Usually, students can only look at the guidance book and imagine the process and results of the experiment. After the introduction of PROTEUS simulation software, students can use PROTEUS software on their own computer to conduct imitation real training. The first step is hardware construction and software design, and then doing joint debugging. The teaching model that doing simulation preview in advance, then doing physical operation in the laboratory are more likely to help students master the whole experiment of the principle, process and phenomenon. In the comprehensive practical training and graduation design of single-chip microcomputer, students are required to carry out the simulation design on PROTEUS software according to their own subject, and then carry on the hardware construction, software programming and final debugging after the operation is correct [9].

The PROTEUS simulation software is applied to the preview part in the practical course teaching of single-chip microcomputer, which improves the students' interest in learning and achieves higher effective.

3.2. Improve practical ability and introduce mobile experiments

At present, engineering practice teaching in engineering colleges is mainly completed through experimental courses. The experimental courses are basically completed in a fixed experimental site, because there are many related majors and classes, so there is a lack of practice time and place. The experimental content and industry needs are not closely integrated. The experimental process is scripted. Innovative practice content is insufficient. Therefore, it is necessary to carry out the targeted reform of the engineering practice teaching mode [10].

In the practice teaching of "principle and application single-chip microcomputer" course, students are required to complete the prescribed experimental projects and carry out innovative mobile experiments. Pocket single-chip microcomputer microminiaturizes the single-chip experimental equipment for carrying, and students can choose their own time and occasion to experiment with an experimental teaching model. This experimental teaching mode takes students as the center, give full play to students' initiative, enthusiasm and creativity, and form the ability of constructing new knowledge and active construction [8]. Beijing Jie Chuang Eternal Technology Co., Ltd. developed a pocket single-chip microcomputer (JC-STC-POK), based on knowledge points, design various types of experimental projects, such as basic experiment, comprehensive design experiments and innovative experiments. The same experimental project also set up different levels of experiments, including the basic experimental level to improve the level of experiment and the level of innovation experiment [8]. The experimental model of pocket single-chip microcomputer conforms to the educational idea of "learning by doing", emphasizes that the learning activities go far beyond the classroom, which is the process of exploring the real world, interacting with the real world and creating knowledge [11].

Experiment Teaching case of pocket single-chip microcomputer I/O port: IAP15W4K58S4 single-chip microcomputer has 8 I/O ports, including P0.0～P0.7, P1.0～P1.7, P2.0～P2.7, P3.0～P3.7, P4.0～P4.7, P5.0～P5.5, P6.0～P6.7, P7.0～P7.7. All I/O ports can configure the software into one of four operating modes, namely: quasi-bidirectional/weak pull-up (standard 8051 output mode), push-pull output/strong pull-up, high-resistance input, open leakage output. The IAP15W4K58S4 of the single-chip microcomputer is a quasi-bidirectional/weak pull-up mode after power reset. Each I/O port drive capability can be up to 20mA, but the current of the entire chip cannot exceed 120mA [12].

In the experiment project of pocket single-chip I/O port, P3.7, P4.1, P4.2 and P4.3 of using IAP15W4K58S4 chip set the I/O port for the quasi-bidirectional/weak pull-up output mode, connecting four LED lights, programming to achieve LED lights light and loop from right to left. The thinking map for the project is shown in Figure 4.

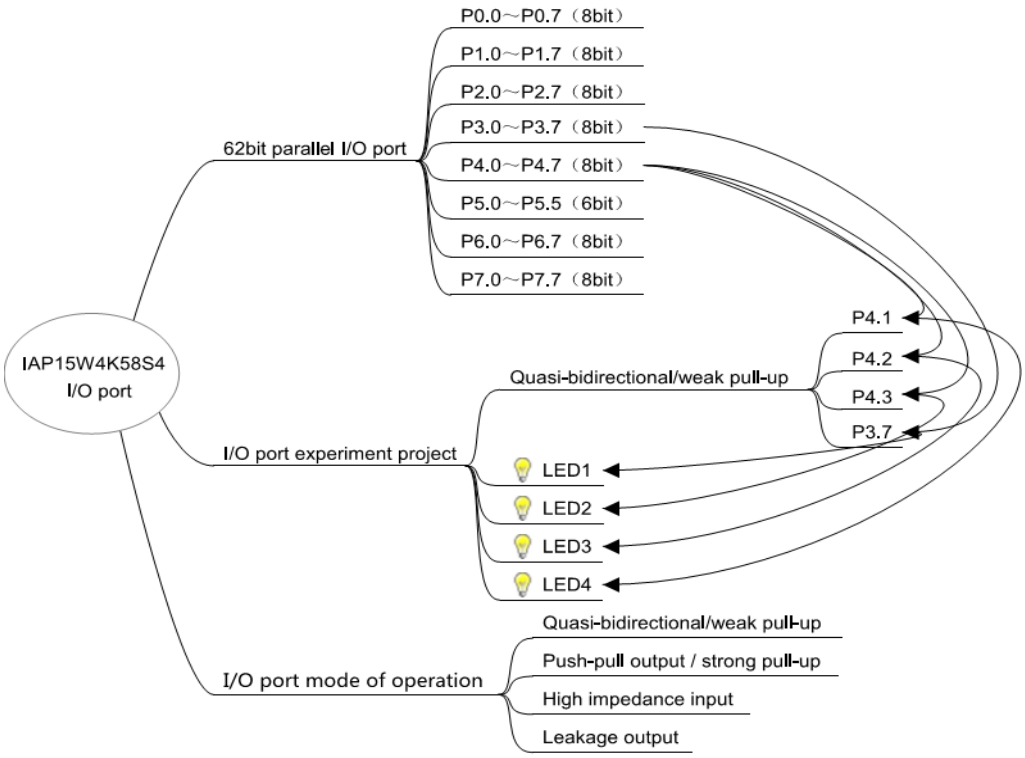

Figure 4 The thinking map for the project

4. Conclusion

The “principle and application of single-chip microcomputer” course is a professional basic course for electronic information majors, which has a role to play in other courses. Through practice, with the “system ability” training goal of professionals, the relevant knowledge of many core courses is effectively correlated according to the cross-penetration organization way, constructing the complete knowledge system of the course, drawing the connection between knowledge points, which can enable students to clarify the context of learning content, embody the abstract knowledge, improve students’ learning ability. This teaching mode provides an effective idea for the construction and reform of single-chip microcomputer course, and provides a strong support for students’ systematic ability, practice and innovation ability.

Acknowledgments

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