



Exploration of Teaching Reform in Embedded Systems Courses Based on OpenHarmony

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Abstract

With the rapid development of information technology, embedded systems have been widely used in industrial control, aerospace and military, information appliances, and other fields. However, the traditional teaching mode of embedded system courses is no longer able to meet the current demand for embedded talents in society. This article aims to improve the teaching content, methods, and evaluation system by introducing the open-source operating system OpenHarmony and corresponding hardware platform. It explores the teaching reform of embedded system courses based on Open Harmony, which has observable improvements in student performance, participation, and employability. It provides more composite talents with practical ability and innovative consciousness for the field of embedded systems.

Subject Areas

Information Science

Keywords

Teaching Reform, Embedded Systems Courses, OpenHarmony, Curriculum Innovation, Educational Methodology, Practical Teaching, Technology Integration

1. Introduction

Embedded systems are highly integrated courses involving multiple disciplines, such as digital circuits, analog circuits, computer communication, and microprocessor principles. The rapid development and continuous emergence of new technologies have made the traditional teaching system, teaching methods, and

experimental methods outdated and difficult to adapt to the needs of the information age. Therefore, reforming the teaching mode of embedded systems courses and introducing new teaching content and methods have become urgent issues that need to be addressed.

OpenHarmony, initiated and maintained by Huawei, is an open-source distributed operating system aimed at providing a unified runtime and development framework across multiple devices, supporting different hardware platforms and device types. Its open-source and open nature makes it an ideal choice for embedded systems teaching. This paper explores the teaching reform of embedded systems courses based on OpenHarmony and proposes a series of innovative initiatives to enhance teaching effectiveness and the quality of talent cultivation.

2. Problems in Traditional Embedded Systems Teaching

2.1. Outdated Textbooks

Traditional embedded systems textbooks often contain outdated content and fail to meet market development demands. They are heavy on rigid concepts and principles, lacking practical application cases [1].

Case: The textbook used in the embedded system course at a certain university is from many years ago, and the hardware platform and development tools explained in it are outdated. During the learning process, students find that there is a significant gap between the knowledge they have learned and the current market demand [2]. A student once said, “I learned a lot in the course but found that this knowledge is outdated in the current enterprise. The hardware platform I learned is no longer used in the job market, and I am not familiar with the new hardware platform.”

2.2. Single Teaching Method

Traditional teaching methods rely heavily on teacher-centered instruction, with students passively receiving knowledge, which makes it difficult to stimulate learning interest. Additionally, the teaching and experimental sessions are disconnected, leading to a lack of practical operation skills among students.

2.3. Lack of Design in Experimental Content

Traditional experimental content is mostly verification-based and lacks design-oriented experiments, which hinders the cultivation of students' innovative abilities. Moreover, the experimental content is outdated and severely disconnected from real life [3].

2.4. Single Assessment Method

Traditional assessment methods focus only on written exam scores, failing to reflect the practical nature of embedded systems courses and the student's practical and innovative abilities.

3. Reform Method of Embedded System Course

Teaching Reform Plan for Embedded Systems Courses Based on OpenHarmony.

To address the above issues, this paper proposes the following teaching reform plan for embedded systems courses based on OpenHarmony.

3.1. Update Teaching Content

In selecting textbooks, systematic, continuous, and experimentally novel textbooks closely connected with reality should be chosen. Additionally, teachers should adjust or eliminate outdated content in textbooks based on industry trends and integrate the latest embedded technologies into the teaching content.

OpenHarmony, as a locally developed open-source terminal operating system, has broad application prospects. Introducing OpenHarmony and its corresponding hardware platforms (such as the Hisilicon Hi3861V100 development board) into the teaching content can not only help students master the latest embedded technologies but also enhance their market competitiveness.

3.2. Innovate Teaching Methods

3.2.1. Inquiry-Based Teaching

When explaining the basic theoretical knowledge of embedded systems, teachers should emphasize the similarities and differences between embedded systems and general-purpose computer systems, using analogy and comparison for explanation [4]. Additionally, inquiry-based methods guide students in transferring and mapping their existing knowledge and theories of general-purpose computer systems to embedded platforms, thereby creating a deep understanding of the characteristics and key theories of embedded systems.

3.2.2. Combination of Theory and Practice

Integrate the learning of theoretical knowledge into experiments, using experiments to promote the absorption of theoretical knowledge. Promote a teaching method that prioritizes experiments, breaking the traditional separation between classroom theory and laboratory experiments. Move the classroom to the laboratory, fully utilizing laboratory resources, and combining experiments with theoretical instruction.

3.3. Design Experimental Content

3.3.1. Basic Experiments

Design some basic experiments in combination with textbook content to help students consolidate theoretical knowledge.

3.3.2. System Experiments

Select common embedded application examples in life to design systematic experimental content, stimulating students' learning interest and desire for hands-on practice.

3.3.3. Innovative Experiments

Encourage students to design their own experimental content, independently consult and organize materials, determine experimental themes and objectives, discuss problem-solving ideas and design principles, and independently complete program flowcharts, program development, and computer debugging. This autonomous experimental training not only exercises students' research, innovation, and practical problem-solving skills but also enriches teaching resources and promotes teacher improvement.

3.4. Introduce Practical Cases

Introduce the actual needs and cases of companies such as Huawei into teaching, enabling students to master embedded system design and development skills while solving practical problems. For example, through practical application cases of OpenHarmony, students can gain an in-depth understanding of the design and development process of embedded systems, comprehensively mastering embedded system design techniques, basic hardware architecture and structure, system operation modes, embedded software development, system debugging and verification methods, etc.

3.5. Establish a Diversified Evaluation System

Establish a diversified evaluation system that includes project completion, practical training performance, and feedback from corporate mentors. Evaluation standards should align with actual enterprise requirements to ensure that student capabilities meet corporate demands.

3.6. Expanding Teaching Reform to Institutions with Limited Resources

Institutions with limited resources need to pay more attention to optimizing resource allocation when promoting teaching reform. This can be achieved through the following methods:

Shared resources: Establish inter-school or regional resource-sharing mechanisms to enable institutions with limited resources to share experimental equipment, teaching software, and other resources from other institutions [5].

Integrate internal resources: Fully tap into the potential within the organization, and integrate existing experimental equipment, library materials, and other resources to improve resource utilization.

4. Implementation and Effectiveness of Teaching Reform

4.1. Tight Integration of Teaching Content with Actual Needs

By introducing OpenHarmony and its hardware platforms, teaching content is closely integrated with actual needs, enhancing students' practical abilities and employability [6]. Additionally, by continuously updating teaching content, the relevance and practicality of the content are maintained.

4.2. Enhance Students' Innovative Abilities

Through design-oriented and innovative experiments, students' innovative abilities and team collaboration skills are cultivated. Students autonomously design experimental content in experiments, going through processes such as consulting materials, determining experimental themes and objectives, discussing problem-solving ideas and design principles, etc., which not only exercise their research and practical problem-solving skills but also cultivate innovative thinking and abilities [7].

4.3. Promote Industry-University-Research Cooperation

Ensure that teaching content and methods are in sync with the constantly evolving technology and industry demands in embedded systems. Our university has established close industry university research cooperation relationships through collaborations with companies such as Huawei [8]. Enterprises are deeply involved in course design, teaching implementation, project guidance, and providing practical application scenarios and requirements. Through industry university research cooperation, understand the needs of enterprises and technological development trends, and adjust teaching content and methods in a timely manner. Actively participate in research projects and technology development related to embedded systems, and promote industry academia research cooperation. Through industry academia collaboration, apply the latest research findings and technologies to teaching to improve teaching quality and standards.

4.4. Promote Scientific and Technological Achievement Transformation

Universities and enterprises jointly establish embedded system research and development platforms to achieve resource sharing, improve research and development efficiency, and promote the transformation of scientific and technological achievements [9]. Through industry-university-research cooperation, the development and application of embedded system technologies are promoted, providing strong support for industrial development.

5. Evaluation of the Effectiveness of Curriculum Reform

After the embedded course reforms based on OpenHarmony mentioned in this article, the following effects have been achieved.

5.1. Student Performance

Academic performance improvement: After the reform, students' average final exam scores increased by 15%, and the excellence rate increased by 20%. This indicates that students have made significant progress in mastering theoretical knowledge.

Enhance learning interest: Through a questionnaire survey, 90% of students expressed an increased interest in embedded system courses, and 80% of students

believe that the course content is more closely related to practical applications.

Innovative ability cultivation: In the reform curriculum project, students proposed various innovative solutions and achieved excellent results in the embedded system competition held by the school.

5.2. Participation Level

Classroom participation: After the reform, the frequency of classroom discussions and questioning increased by 30%, and students actively participated in classroom interactions, resulting in a more lively classroom atmosphere.

Extracurricular practice participation: Students' enthusiasm and effectiveness in participating in experiments, projects, competitions, and internships have significantly improved. For example, the number of students participating in embedded system competitions has increased by 50%, and feedback from internship units has become more positive.

Collaborative learning and teamwork skills: Through team projects, students' cooperation becomes closer, and their teamwork abilities are exercised and improved. The quality and time efficiency of team project completion have been improved.

5.3. Employ-Ability

Employment rate and employment quality: After the reform, the employment rate of graduates in this major increased by 10%, the quality of employment units increased, and wages and benefits increased.

Professional skills mastery: Through enterprise internships and project practices, students have acquired solid professional skills in embedded systems, as well as project experience and problem-solving abilities.

Ability to adapt to the workplace: According to feedback from employers, graduates after the reform have shown better communication skills, teamwork skills, and problem-solving abilities, and are able to adapt to the work environment more quickly.

5.4. Student Feedback and Survey Results

In order to gain a deeper understanding of the effectiveness of teaching reform, we conducted student feedback and surveys. The results indicate that:

95% of students believe that the reformed teaching methods are more practical and interesting;

85% of students stated that the reformed curriculum content is more in line with practical needs, which helps to improve their practical abilities;

80% of students believe that the reformed curriculum projects will help cultivate their innovation and teamwork abilities;

75% of students stated that the reformed teaching methods have greatly improved their employ-ability.

6. Conclusion

This paper explores in detail the teaching reform plan for embedded systems courses based on OpenHarmony, comprehensively elaborating on teaching content, teaching methods, experimental design, introduction of practical cases, and evaluation systems. The hope is that these reform measures will provide useful references and insights for the teaching of embedded systems courses. The teaching reform of embedded systems courses based on OpenHarmony, through measures such as updating teaching content, innovating teaching methods, designing experimental content, introducing practical cases, and establishing a diversified evaluation system, significantly enhances teaching effectiveness and the quality of talent cultivation. In the future, teaching reform should continue to be deepened, cooperation with enterprises strengthened, and industry-university-research integration promoted to cultivate more high-level embedded engineers.

Conflicts of Interest

The authors declare no conflicts of interest.

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