Universe Scientific Publishing

DOI:10.18686/ahe.v8i6.13505

Research on Effective Promotion and Evaluation Strategies for Microcontroller Course Design

Jie Yang , Yongjun Jiang , Zhihang Lin , Zhaoyong Hu

Guangdong University of Technology,Guangzhou, Guangdong 510006

Abstract: The traditional microcontroller course design needs to be completed within 1-2 weeks, and students have difficulty completing high-quality course design within such a short time. To address this problem, this paper analyzes problem-solving approaches based on the TRIZ Nine-Screen Method, and then a function model be constructed to presents the issue points. In response to these key issue points, strategies of content pre-arrangement and competition-based evaluation have been formulated. Applying these strategies can effectively enhance the quality of course design and the objectivity of grade evaluation, thereby significantly improving students' practical abilities in utilizing microcontrollers.

Keywords: Course Design; Microcontroller; Nine-Screen Diagram; Function Model

Fund Project:

2024 Education Reform Project of Guangdong University of Technology

1. The main problems existing in the current course design

The microcontroller course design is a fundamental technical course for engineering majors in college, and the main purpose of this course design is the future applying, so the study of this course design lays a solid theoretical and practical foundation for students' future practical applications. The microcontroller course design serves as such a crucial bridge between theory and practical application. Therefore, the content, promotion methods, and assessment forms of microcontroller course design are particularly important[1-2].

The assessment method primarily faces the following issues: (1) Most of the course design projects are software simulation-based, where students primarily design using simulation software on computers. This certainly exercises their software design and simulation debugging skills, but students' perception and experience of actual hardware are nearly nonexistent. (2) There is a discrepancy between the quality of the course design reports and the actual workload involved. Students who perform well in practical work may not necessarily write good reports, while those whose practical work is lacking may produce slightly better reports. (3) Conducting defenses based on paper reports also naturally has its inevitable limitations, making it difficult to effectively distinguish between students' performance. (4) The grades only reflect students' software simulation abilities, and there is still a significant gap between this and their ability to apply microcontrollers in practical scenarios[3-4].

This paper analyzes the problems existing in the assessment method using the Nine-Screen Diagram[5] and Function Model tools of TRIZ [6](Theory of Inventive Problem Solving), fully utilizing resources both within and outside the current system to sort through and solve the problems, and aiming to find solutions with a higher level of ideality.

2. Solution Approach and Resource Analysis Based on the Nine-Screen Diagram

Addressing the issue of slightly low objectivity in the evaluation of microcontroller course design assessment results, the Nine-Screen Diagram is applied for preliminary problem analysis to seek new perspectives. The system is composed of multiple subsystems, including course design projects, students, teachers, reports, etc. From the perspective of the college as the super-system, the grades of course design are the focus of the entire system. However, if we consider the future development of students, when students enter the workforce in the future, they will need not only grades but also strong practical skills. Therefore, looking back, can the goals of

the system be more focused on the cultivation and improvement of practical skills? What resources within the system, sub-system and super-system can be utilized to achieve this goal? There are many microcontroller competitions within the college and many intelligent hardware devices outside the college， can these resources be integrated to achieve the goal?

3. Function model of the system

Addressing the issue of slightly low objectivity in the evaluation of microcontroller course design assessment results, a function model of the system as shown in Figure1. This diagram clarifies the strategy of using competitions as a substitute for evaluation and assesses practical abilities.

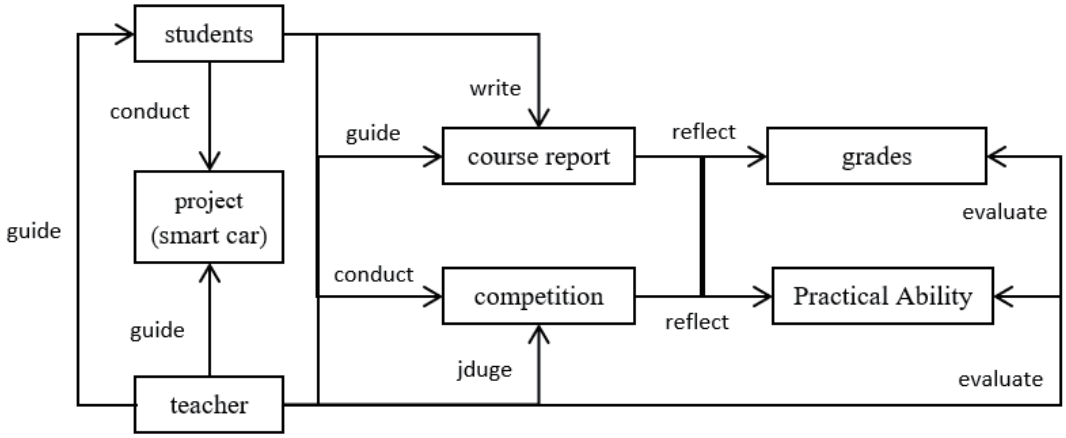

Figure 1. function model of the system

Firstly, traditional software simulation projects are replaced with actual hardware and software projects (such as intelligent vehicles), these can make the hardware and software design, debugging, and operational results intuitive and visible. This not only enhances students' learning enthusiasm but also makes the evaluation of actual operational effects more objective.

Secondly, simple oral defenses are replaced with group competition assessment methods. Oral defenses are more focused on theoretical discussions and exchanges, which can be difficult to effectively verify in a short period of time. In contrast, the results of group competitions, such as who finishes first and who achieves the best performance are intuitive and visible, reducing scoring controversies and better motivating students to thoroughly grasp theoretical knowledge and practice.

Lastly, the content of the course report must be consistent with the content and results presented during the competition. Students cannot fill in content in the report that was not actually accomplished to maintain consistency between the two and enhance the fairness of course grade scoring and practical ability evaluation.

4. The strategy of Using Competitions to Replace Traditional Evaluation

The implementation stage of course design is the focus of the overall assessment, accounting for 80% of the score. Figure 2 shows the strategy of using competitions to replace traditional evaluation. Considering the varying levels of students, setting the assessment too easy or too difficult can comprehensively affect its difficulty, fairness, and balance. In this paper, the difficulty level of project assessment is changed from a single fixed mode to a three-tiered mode with difficulty coefficients of 1, 2, and 3, corresponding to the completion of basic functional modules, extended functional modules, and challenging functional modules. However, the transition between these three tiers is not abrupt or vastly different in terms of question types. Instead, they represent a gradual increase

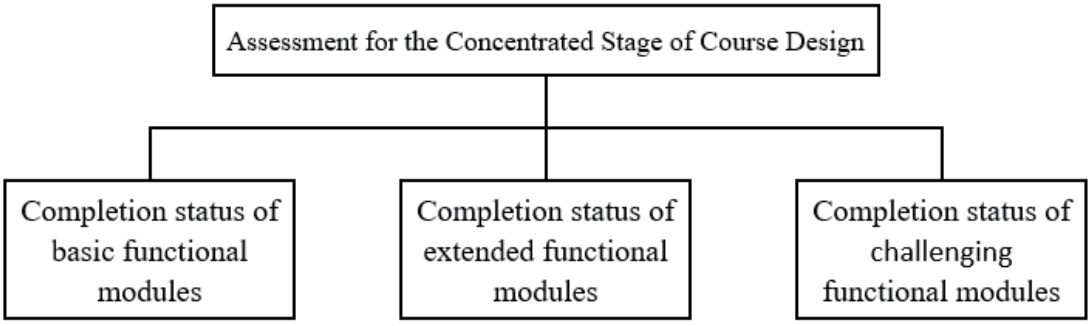

Figure 2. the strategy of using competitions to replace traditional evaluation

in difficulty, meaning that each increase in difficulty builds upon the previous level, avoiding disputes and unfairness caused by excessive differences in project content.

5. Summary

For the objective limitation of limited time in the traditional course design, this paper addresses the issue of how to ensure and further improve the quality of the course design. It proposes a new solution, which is to comprehensively apply a strategy of advancing in sync with theoretical classes before the implementation of the course design and a strategy of using competitions as a substitute for evaluation during the implementation stage. This approach enhances the workload and quality of the course design content, it not only improves the objectivity of grade assessment, but also boosts students' ability to practically apply microcontrollers.

References:

[1] Zhou Yu, Zhou Lijuan, Zhu Wenqiu, Peng Zhaoyi, Yang Zhenya. Research on the Reform of Microcontroller Course Design Teaching under the Background of "Emerging Engineering Education"[J]. Equipment Manufacturing Technology, 2022, 9: 186-194.

[2] Cao Yipeng, Wu Hao, Mao Yane. Exploration and Practice of the Reform in Microcontroller Practical Teaching under the Concept of OBE [J]. Modern Educational Equipment in China, 2022, 9: 128-136.

[3] Qi Fenglian, Hou Lingling, Zou Yuanyuan. Teaching Exploration of Single-Chip Microcomputer Series Courses of Mechanical and Electrical Majors Against Background of Emer-ging Engineering Education [J]. Educational Technology and Equipment in China, 2023, 2: 88-91.

[4] Ma Chunyan, Zheng Lijun, Jia Yanbing. Exploration of Practical Teaching Reform in the Course of Microcontroller Principles and Interface Technology Based on the ETPP Model [J]. Higher Education, 2024, 19: 131-134.

[5] Yu Baiku, Wu Yongzhi, Sun Guoqiang. The Use of the Nine-Screen Method in TRIZ Theory and the Analysis of Common Problems [J]. Henan Science and Technology, 2024, 7: 153-158.

[6] Quan Shuanglu, Wang Yongquan, Guo Yanjie, Hu Gailing, Jin Yue. Practical training path of introducing TRIZ into mechanical innovation design for college students in context of new engineering [J]. Machine Design, 2024, 4: 153-157.