On the Innovation of Computer Aided Design Teaching Mode Under Multimedia Information Technology

Ting Wang, Ming Wei, and Hai-bo Lu(✉)

Applied Technology College of Soochow University, Daxue Road, Kunshan, Suzhou, China
{Twang1,weim_anqp,lhb3212}@suda.edu.cn

Abstract. Computer-aided design is a foundational engineering subject for electronic and information-related majors, as well as an information technology course that emphasizes both theory and practice to develop students' computer-aided drawing theory and practical skill. The teaching team has consistently improved and modified this course, as well as established a rich multimedia information platform, to address pain points such as the disconnect between sketching and practice. The curriculum resources have been enlarged, the knowledge system has been rebuilt, and the instructional content has been organized by project. It has been realized the integrated practical teaching technique of "computer assisted drawing-board making-debugging". There are three steps to the educational process: multimedia massive open online course learning, smart classroom discussion, and integrated practice. It also comes with a comprehensive online and offline evaluation system. The teaching impact has been greatly improved as a result of this novel multimedia information reform, and it has some promotional value.

Keywords: Computer-aided design · Information technology · Massive open online course · Multimedia information reform

1 Introduction

Computer aided design is called CAD for short, and it is also called electronic CAD when it is applied in the field of electronic circuit drawing. Electronic CAD is a fundamental engineering subject for electronic and information-related majors at the entrance level. It is also a practical course that emphasizes both theory and practice in order to develop students' practical ability to draw electrical circuits. It is one of the training plan's primary fundamental courses. To meet the requirements of the talent training scheme for the electronic drawing ability of this course, to serve the specialty, and to allow more students to learn this course better, and to adhere to the talent training goal of "applying what you have learned" in our school, we have built an electronic CAD course based on three learning stages, improving the practicality and advanced application of the course. The course places a strong emphasis on student growth, continually innovates, and moves forward.

Z. Zhan et al. (Eds.): ICBDIE 2022, AHCS 5, pp. 630–638, 2023.
https://doi.org/10.2991/978-94-6463-034-3_64

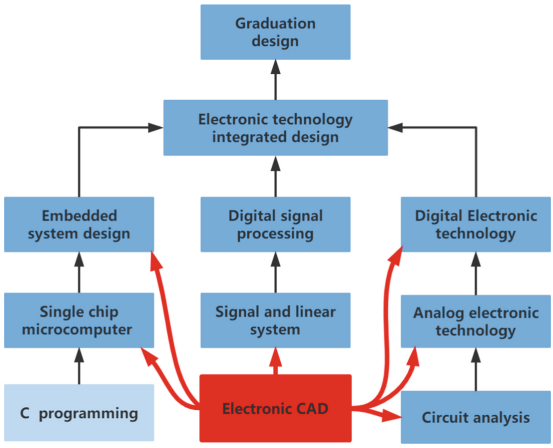

Fig. 1. The Important Position of Electronic CAD Course in the Curriculum System.

This course will serve as a basic operation course and provide support for many important follow-up courses. This is the author's research on the course structure of electronic specialty, which shows the importance of electronic CAD course as shown in Fig. 1.

As can be seen from the accompanying graph, the relevance of this course is undeniable, and efforts to improve the teaching quality of this course have evolved into a significant research project that requires ongoing development.

Our teaching team proposed a set of curriculum reform plans for the electronic CAD course in order to address teaching challenges such as operations that appear simple to learn but are difficult to implement in practice, students lacking a hardware foundation, and a mismatch between theory and practice. We've been building a robust foundation for teaching resources since 2019; in 2020, we'll expand the course materials, rearrange the knowledge system, and improve the course's practicality, difficulty, and advanced application. We transform the original data into a project-based knowledge system for teaching. Scientific research projects by teachers, entrepreneurial materials, project competitions, and the ideological and political component of the curriculum are all examples of extended curricular resources. In 2021, we cooperates with Li Chuang Circuit Technology Co., Ltd. to improve the teaching content of the course and implement the integrated teaching method of "computer-aided drawing board making-debugging" to solve the problem of students' drawings not being synchronized with the actual hardware used in the course.

When the research results after the teaching reform are compared to the prior teaching data, it is clear that the teaching reform was a success, as it increased students' interest in learning and practical application of the course, as well as having a certain promotion value.

2 Existing Problems of Traditional Teaching in Curriculum Implementation

Students enrolled in this course are in the early stages of professional course study, and they essentially lack a professional course foundation, making it difficult for them to fully comprehend some drawing skills during the learning process. Furthermore, in a traditional electronic CAD classroom, lecturers demonstrate in front of the class while students witness the process. Although the technique appears to be straightforward, students may forget important operation specifics during the real operation. Students want to go over what the teacher stated in class again, but they are unable to do so. This type of teaching method frequently yields double the results with half the work.

The class's original teaching content is simply stacked according to the substance of the knowledge points explained. Students can only grasp the information points they have gained after studying, but they lack the engineering practice capacity to relate the taught topic to the real engineering operation frontier [2]. At the same time, because students did not receive real engineering instruction or work on printed circuit boards, the circuit diagrams they created lacked a certain level of logic in their layout and wiring.

From the standpoint of the entire teaching process, the teacher is the commander, and the students merely study and follow the lecturer's operations step by step. Students' engagement in thinking and contact with teachers is minimal throughout the process, and the teaching impact is unsatisfactory.

3 Research on Innovative Teaching Reform of Electronic CAD Course

3.1 Establish Comprehensive and Appropriate Teaching Objectives

The goal of the new electronic CAD curriculum is to help students go from knowledge to skills to future growth. As a result, the author expanded the curriculum goals in four stages, using Bloom's notion of learning transition from memory to creation [1]:

- Knowledge and skills: Be able to develop engineering circuit diagrams and send them to the board, as well as understand the fundamental knowledge, basic theory, and basic design process of electronic circuit CAD;
- Methods and Capacity: From the standpoint of engineering demands, drawing the schematic diagram and PCB section of the circuit diagram may present realistic analysis and optimization methods, as well as foster students' ability to analyze and solve issues. Skilled in technique, able to solve practical problems in engineering;
- Thinking and innovation: allow students to create the engineering design thinking mode, driven by project thinking. It may drive students' appetite for knowledge and courage to fearlessly scale the top, and build a strong platform for students to pursue follow-up courses and engage in engineering technology and scientific research of their major, guided by discipline frontier and discipline competitiveness;
- Ideal and Development: Self-study and learning ability improvement; Persist in learning about the link between the information society and oneself; Reserve comprehensive abilities and accomplishments for self-development; Face the issue head-on and

aim for perfection; See the birth and development of the domestic EDA sector, create independent invention, and give knowledge to the motherland's engineering cause from the heart of the country.

3.2 Teaching Platform Construction and Resource Innovation

To address the aforementioned issues with traditional education, we created an online course called "Electronic CAD-Circuit Board Design Comprehensive Practice Course" using Superstar as the platform, which allows for teacher-student interaction, resource sharing, and supplementary teaching. The course is self-edited by the teaching team. Students may grasp the basic electronic circuit layout method and operation abilities through online instruction. This course has been completed by over 300 people, and the online content is being updated on a regular basis.

Our instructional material abandons the traditional method of presenting information points in favor of practical project-based learning, in which each specific knowledge point is incorporated into the project operation so that students instinctively comprehend the importance of each step [3].

Some of the course's project case resources come from teachers' scientific research accomplishments, others from discipline competitions, and still others from the real cases of industrial enterprises in cooperation with the course, greatly enriching the course's resources and making it more advanced, cutting-edge, and practical. In addition, when creating the course, we took into account the ideological and political climate of the period. We are enthusiastic to construct a golden path, aspire to become certified scholars, and grow more new talents with knowledge, ability, and literacy, using education, wisdom, belief, and strength [4].

3.3 Innovative Teaching Process and Methods

This course uses project-based teaching as its main line, mixed teaching as its form, and Superstar learning as its foundation. It can be summarized into three stages and two enhancements, namely practicality and advanced application, from teaching objectives to teaching process to teaching evaluation and feedback.

3.3.1 Platform Self-study and Project Practice

As previously said, students should learn independently using the Superstar platform before class, master basic drawing approaches, and complete project-based homework at each stage on their own to improve their software operation competency and drawing talents. Due to the incomplete nature of traditional teaching, we may watch online video materials several times to expand our comprehension, which can partially alleviate the problem of students forgetting when they look at it in traditional teaching.

3.3.2 Interactive Teaching and Improving Thinking

The traditional teaching style consists mostly of lecturers explaining things to pupils and students passively listening. This teaching reform will turn teaching into two links.

The first step is knowledge strengthening. Teachers swiftly sift out the essential topics of this lesson and underline the most important themes and challenges. The in-depth conversation between students and professors is the second portion. Before class, lecturers choose a few example project assignments from students' homework to exhibit in the smart classroom. Students debate and assess the project based on their own perceptions. Through further comparison and study, students may quickly discover how to generate the greatest picture. The general condition in the class is that students are focused on discussion, teachers are guiding summaries, students and teachers are cooperating, interaction is stronger, and the class is more enthusiastic [5].

3.3.3 Exercising and Surpassing Yourself

You will never get it unless you do it yourself. Learning electronic circuit sketching in an electronic CAD course is far from sufficient. Students should be taught the whole circuit production process from drawing to delivery, plate manufacture, and welding via extensive experience. Students will be able to create circuit boards and execute hardware circuit design on their own after completing this course. Students can utilize the coupons offered by Lichuang EDA for college to manufacture printed circuit boards in Jialichuang when they have finished sketching, and then solder and troubleshoot circuits on the printed circuit boards they have drawn. Students can learn and master the use of electronic drawing software and gain professional knowledge of the entire circuit design and manufacturing process, cultivate students' patience, sense of excellence, and awareness of fearlessly climbing the peak, and meet the needs of this educational reform through this type of teaching.

4 Teaching Evaluation and Feedback

The key to a closed loop of continual improvement in education is evaluation. This course's learning evaluation uses a process and objective twofold assessment technique. When teaching objectives are integrated into the assessment of the learning process, each learning target has a varied percentage in various learning processes. Teaching may be tracked, feedbacked, assessed, and improved using this evaluation approach [6].

4.1 Curriculum Assessment Method

The assessment material has evolved from a single final evaluation to a process and objective double assessment that may thoroughly and objectively evaluate students' achievement in course learning [8]. First and foremost, in terms of teaching objectives, the four levels of curricular objectives are spread throughout the implementation process of each instruction according to various teaching forms. Second, in terms of the teaching process, the overall score will be decided by a combination of process and result assessments, with the process assessment score accounting for 70% and the final result evaluation score for 30%. Course study, course discussion, stage project performance, comprehensive integration project, and so on are all part of the process evaluation. This section will feature the assessment findings of the final hardware works shown by

Table 1. Curriculum scoring method and benchmarking relationship with curriculum objectives. (drawn by the author)

Number	Project	Proportion	Corresponding curriculum objectives
1	Platform learning	10%	(1) Knowledge and skills
2	Course discussion	10%	(1) Knowledge and skills (2) Methods and capabilities (3) Thinking and innovation (4) Ideal and development
3	Project operation	20%	(1) Knowledge and skills (2) Methods and capabilities (3) Thinking and innovation
4	Integrated training program	30%	(1) Knowledge and skills (2) Methods and capabilities (3) Thinking and innovation (4) Ideal and development
5	Final result exam	30%	(1) Knowledge and skills (2) Methods and capabilities
Total		100%	Goal-oriented, traceable, feedbackable, evaluable

students in terms of practicality, intricacy, and aesthetics; Results The uniformity and correctness of the provided circuit diagram are fully assessed, and the final assessment is based on the final computer drawing results. The curriculum scoring method and benchmarking relationship with curriculum objectives may be found in Table 1. This multi-faceted evaluation system may fully awaken students' learning passion while also cultivating their craftsman attitude of excellence.

4.2 Closed Loop Feedback Teaching

We can track, feedback, evaluate, and enhance instruction using the above assessment methods, resulting in a continual closed-loop teaching system. The concrete realization process is as follows: through process teaching evaluation, we can grasp students' learning status in real time during the teaching process, and adjust the teaching scheme, teaching methods, and progress in accordance with students' current learning status, thereby improving the teaching effect in a stepwise and steady manner [7]. It is clear that in this teaching reform, a greater emphasis on process assessment is required.

4.3 Effectiveness of Curriculum Reform

Students' enthusiasm in learning this course has increased significantly as a consequence of the course's ongoing development, and the course's results have improved significantly as a result. Figure 2 shows a comparison table of students who passed the course in the previous three years. This course has produced several exceptional course works, and students have also performed well in the field competition. Some students have made the decision to pursue professional work in circuit design, circuit sketching, and other similar subjects in the future.

According to the survey, 94% of students have a positive attitude toward developing drawing skills, cultivating their learning abilities, and motivating their excitement and interest in specialized courses. Figure 3 depicts the results of the survey. In addition, throughout the course reform, the college's director and the department's teacher both attended the class and praised and evaluated the course's creativity and reform.

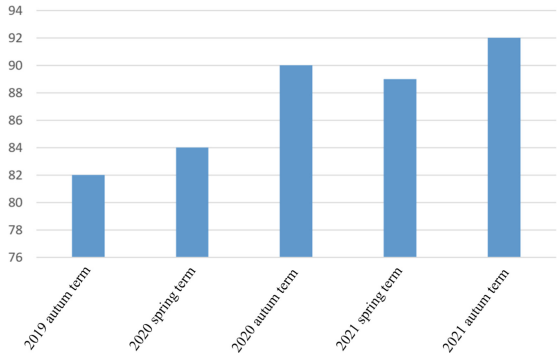

Fig. 2. Pass rate in recent 3 years.

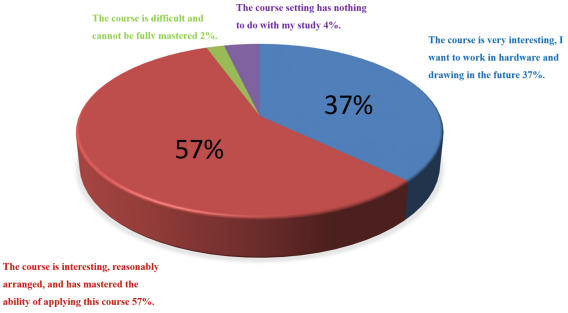

Fig. 3. Investigation on Students' Attitude towards the Reform of this Course.

5 Conclusions

To summarize, the educational method of revolutionary electronic CAD teaching reform consists of three steps: multimedia large-scale open online course learning, intelligent classroom discussion, and thorough practice. On the one hand, an online teaching platform with a wealth of resources has been established, a project-based knowledge system has been rebuilt, computer-aided drawing theory and practical skills can be effectively cultivated, and the integrated practical teaching technology of "computer-aided drawing-debugging" has been realized. On the other hand, process assessment may help to create a closed-loop teaching structure, alter teaching dynamics in real time, and use interactive teaching methods in the classroom, resulting in a high level of classroom passion and a positive teaching effect.

Compared with the traditional teaching methods, the achievements of this course have been significantly improved in recent years, and the teaching evaluation of students and supervisors have shown positive affirmation of this teaching reform. This reform of practical courses for electronic majors creates a new scheme while also providing a better notion for nurturing more practical skills in electronic majors.

This teaching reform is now focused solely on the practice of electronic CAD courses. We can examine the use of this teaching style in other electronic practical courses and expand it to additional scientific and engineering majors in the future.

Acknowledgement. This work was financially sorted by Applied Technology College of Soochow University's third batch of teaching reform research projects in 2021, project number (JG202109).

References

1. Barni, D., Danioni, F., and Benevene, P. (2019). Teachers' self-efficacy: The role of personal values and motivations for teaching. Front. Psychol. 10:1645. doi: https://doi.org/10.3389/fpsyg.2019.01645
2. Chung, T. Y., and Chen, Y. L. (2018). Exchanging social support on online teacher groups: relation to teacher self-efficacy. Telem. Inform. 35, 1542–1552. doi: https://doi.org/10.1016/j.tele.2018.03.022
3. Hampton, D., Culp-Roche, A., Hensley, A., Wilson, J., Otts, J. A., Thaxton-Wiggins, A., et al. (2020). Self-efficacy and satisfaction with teaching in online courses. Nurse Educ. 45, 302–306. doi: https://doi.org/10.1097/NNE.0000000000000805
4. Liu, H., Chu, W., and Wang, Y. (2021). Unpacking EFL teacher self-efficacy in livestream teaching in the Chinese context. Front. Psychol. 12:717129. doi: https://doi.org/10.3389/fpsyg.2021.717129
5. Richter, S., and Idleman, L. (2017). Online teaching efficacy: a product of professional development and ongoing support. Int. J. Nurs. Educ. Scholarsh. 14:33. doi: https://doi.org/10.1515/ijnes-2016-0033
6. Stickney, L. T., Bento, R. F., Aggarwal, A., and Adlakha, V. (2019). Online higher education: faculty satisfaction and its antecedents. J. Manage. Educ. 43, 509–542. doi: https://doi.org/10.1177/1052562919845022
7. Thurlings, M., Evers, A. T., and Vermeulen, M. (2015). Toward a model of explaining teachers' innovative behavior. Rev. Educ. Res. 85, 430–471. doi: https://doi.org/10.3102/0034654314557949
8. Yu, H., Zhang, J., and Zou, R. (2021). A Motivational mechanism framework for teachers' online informal learning and innovation during the COVID-19 pandemic. Front. Psychol. 12:601200. doi: https://doi.org/10.3389/fpsyg.2021.596582