



Thoughts on Online Teaching of STM32

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Abstract

With the rise of courses such as MOOCs, more and more courses are joining online platforms, which enable the sharing of learning resources and promote comprehensive and lifelong learning. This trend is unstoppable. How to carry out the online course construction of STM32 in vocational colleges is the focus of this article. This article first introduces the problems in online course teaching, and then statistically analyzes the root causes of the problems from students. The main problem lies in the inability to concretize the development results and effects of STM32. The theoretical knowledge of STM32 is obscure and difficult to understand. Practical projects are tedious. Firstly, without simulation software, we attempted to solve the problem of physical objects being unable to be simulated from multiple perspectives. Then, we attempted to visualize theoretical knowledge to make it easier for students to understand. Finally, during the learning achievement detection stage, we used simulation games to stimulate students' interest in learning.

Keywords

Simulation; STM32; online teaching; teaching quality

In previous years, the school organized online classes. This is my first experience with online teaching. At that time, the course required hardware practical operation, and the teaching quality was seriously decreased under the online course mode. However, with the rise of online teaching such as MOOCs, how to ensure the quality of online teaching is the goal of this paper.

The mainstream STM32 teaching is to explain the theory, especially the register function of each module, which is difficult and boring for students to understand (Chen Ming, Li Zhen, & Xie Jinyun, 2024). At present, this course adopts project-based teaching, which is a better learning method at present. When setting up project-based teaching, this course takes STM32 hardware modules as the unit and sets a requirement task for each module. It first leads students to analyze problems, then guides students to use STM32 hardware to realize functions, and then introduces the working principle of each module to students after the overall function is realized. This teaching method is more purposeful. In the early stage, students may not understand the operation principle of each module of STM32, but their curiosity will motivate them to be interested in theoretical knowledge, and at the same time, they will correspond to knowledge points with intuitive feelings and doubts, so as to absorb knowledge efficiently. How to integrate project-based teaching into the online classroom is a difficult point. In the second half of the course, it was found that the STM32 development ability of students with strong programming abilities was not ideal, and their performance was far less than expected. It stands to reason that students with strong programming skills will not perform worse in the same type of courses. After communicating with them, the reasons for the problem are summarized as follows:

First, the installation of programming and simulation software failed, resulting in many students being unable to continue to participate in the course. For example, the installation package fails to download, the version is not correct, and

so on, and students are afraid to signal their problems and dare not interact with teachers. The simulation software is not friendly to STM32, and the gap between the running result and the actual result is too large, which leads to the students' inability to understand the principle of STM32 code.

Secondly, the content of the course is difficult and professional, which is the main reason why most students are afraid of it. The difficulty is generally the knowledge of the STM32 collection circuit and C language courses. Most students have a weak foundation of these two courses, let alone cannot understand the operation principle of STM32. The professionalism is reflected in that STM32 is composed of a large number of hardware modules, each module in addition to learning the operating principle, also learns to use several parameters for control. The meaning of the parameter is relatively abstract, and it needs to be combined to achieve the function in actual use, which is difficult for students to understand and apply.

Finally, I was confused about how to apply STM32 in practice. In the practical training stage, the topic is more boring, just a simple change to the class topic. Students can complete assignments quickly, but the content of the entire course has no points of interest, and cannot be smoothly transferred to practical applications.

1. Of all the problems, the first is the easiest to solve

If the software fails to be installed, the teacher can prepare installation documents in advance to describe each step in detail. These alone are not enough, some students hardly use the computer, which leads to problems and various errors in any link during the installation process. In particular, many students have not developed programming literacy. Whether they install software or name folders in Chinese, almost most programming software only supports English without optimizing Chinese. In the process of programming or preservation engineering, it is easy to make unidentifiable errors, which requires teachers to remind students repeatedly in class to develop good programming literacy and prevent low-level problems in any future discipline or work. Therefore, in the installation document, it is not only necessary to take screenshots to explain the normal installation process, but also to record all the errors and solutions in the installation of students as far as possible.

Online course on how to operate STM32 equipment is the biggest difficulty. At that time, in order to complete the course, I did not carefully study the possibility of adaptation of simulation software. After the end of the course, the author tried many times to find a better simulation software, but after a long time of trying, the problem was still not solved. The main problem was that the simulation software was poorly adapted to STM32, simple experiments in the early stage could be simulated, and the simulation phenomena in the later stage were too different from the actual experiment phenomena, which was easy to mislead students. In addition, the simulation software has too high requirements for computer configuration, and the effect of running the same code on different computers is quite different, even if multiple versions of the simulation software are tried. It seems that the simulation software cannot simulate the STM32 road.

Later, a compromise method was adopted to modify the value of one parameter each time, download it to the single chip computer, record the experimental phenomenon, and mark the parameter value for each video (Wei Bingui, 2009). When teaching, whenever students select different parameter values, play the corresponding video, which is equivalent to students downloading the code to STM32, and then observe the experimental phenomenon. By modifying the parameters to observe the experimental phenomenon, understanding the function of the parameters from the changes of the senses, it can reduce the difficulty of learning and improve students' learning interest. This method requires teachers to produce a large number of video materials. In addition, with this method, students' sense of participation in practical exercises will decrease, which is similar to looking up answers after answering questions in class. Of course, the future employment of the STM32 course is still based on hardware development, and contact with hardware equipment is a must. Online methods should be used as auxiliary courses to deepen the understanding of knowledge.

2. The second question is a basic skill that needs to be guided continuously

C language knowledge is not solid and is a common problem for most students. However, this course cannot lead students to continue learning C programming syntax from scratch. After several years of teaching, I basically know the common technical difficulties of C language for students, such as the definition of global variables and the inclusion of header files. In other words, the advanced and difficult points of C language commonly used in the course of STM32 can be systematically explained to students after the course begins. In the later teaching, as long as the students have talked about it once, they will basically use these knowledge points skillfully and write high-quality code.

Consolidate students' programming knowledge and skills in practical code development. However, there may be very few students who lack even basic programming knowledge, such as difficulty defining variables. This group of students may need to take a comprehensive C language course. There are also ways to coach these students. Students who have

strong learning abilities and can complete class tasks ahead of time will be given one-on-one explanations to strengthen their programming ability and STM32 knowledge. Of course, teachers should also constantly supervise the communication between students, on the one hand, exercise students' verbal expression ability, on the other hand, correct students' mistakes.

After using the STM32 microcontroller in the previous teaching, it was found that the effect was not particularly ideal, and many students felt confused about the task requirements and the final effect in the hands-on programming stage. In the end, the STM32 microcontroller physical object plays a comprehensive role in displaying and strengthening sensory cognition, and the biggest problem for students is that they feel abstract about the STM32 operation process. Therefore, combined with the teaching experience of these two years, it is found that the main problem of students is that the essence of each module of the STM32 microcontroller is not understood thoroughly. These problems are reflected in the weak foundation of electronic circuits, the inability to understand the flow process of electrical signals in the internal circuits of each module of STM32, and how electrical signals are converted into codes in hardware circuits. The internal circuit of each module of STM32 is very complicated, involving analog circuit and digital circuit knowledge. How to show the operation of electrical signals to students without expanding professional knowledge too much has become a major difficulty.

Until a chance to find the STM32 series of open courses on the Internet, which use the form of analog animation to show the STM32 microcontroller to the author inspired. The electrical signal change process can be simulated in the form of animation so that students can understand how the control commands in the code operate in the STM32 circuit. In the later teaching project, the author applied to make the simulation animation of each module of STM32, hoping to improve students' understanding through intuitive circuits. In addition, the AR three-dimensional simulation animation is done for the STM32 microcontroller, so that students can understand the structure of the STM32 microcontroller more comprehensively. In addition to animation in teaching projects, mainstream media platforms: TikTok, Bilibili, and other industry authorities have produced demonstration animations, which are very realistic to show the operation process of electrical signals in the circuit and the resulting logical changes. The audience of these animations is mainly Xiaobai, of course, our students are also "Xiaobai" when they just get acquainted with circuit knowledge. These animations not only help students understand knowledge but also help them understand knowledge. Let students be more interested in circuit knowledge and no longer afraid of hardware analysis.

But how to strengthen the understanding of STM32 from the whole sense, there is no good way at present. Most of the students with good STM32 academic performance buy STM32 microcontroller physical objects and practice programming in the dormitory. This will increase the burden on most students. The author recommends that students do exercises after class or implement their ideas with code, and then download the code to STM32 in the practical part of the class, and modify the errors in the code according to the experimental phenomenon. That is, write code outside of class, and make full use of hardware in class to check where your code problems are. Of course, many students are relatively poor in consciousness, and often write code in the classroom, and so on after the completion of the coding almost the end of the class, cannot burn code verification errors. In this respect, teachers need to strengthen the guidance of students.

All of the above methods try to make students accept STM32 as much as possible, without disgust or fear. The ultimate goal is for students to learn how to use it. How to detect whether students really grasp the development of STM32 also needs careful planning.

3. The third problem requires teachers to bring the development task of STM32 close to life in order to enhance students' interest

The development of STM32 mainly includes sensor development and data transmission in sensor networks. Of course, this course only introduces the basic development of STM32, and it is enough to learn to skillfully use various modules of STM32. There is a problem here, the simple development of STM32 is a little boring. In sensor development, students can know a variety of sensors, and select sensors according to the actual scene to complete the scene development, such as fingerprint, positioning, lighting, etc. These development tasks can correspond to the reality of life, and students' sensory cognition is very strong (Zhao Suling, 2019). Networking is also the case, in smart warehousing, and smart homes, students have both interest and a sense of accomplishment, at the same time, students can understand what they can apply to what they have learned, and it is also helpful for future employment.

How to make STM32 basic development closer to life, think of many ways. For example, the pin module tries to let students flash LED lights at different frequencies, and the timer module allows students to complete the timing of 5 minutes, 10 minutes, or even 2 hours. Basically, each module will design 1-2 application problems for students to train. Students with good programming skills can actively complete the task, but most students need to complete the task under

the guidance of the classroom. From the perspective of students, the task that teachers carefully prepare is still homework, and it is boring homework.

He was later inspired by the Chinese Poetry Conference (Hou Li & Jiao Mace, 2022). In the program, after the host finishes reading the question, the players compete for the right to answer and need to use the buzzer. At that time, it suddenly occurred to me that STM32 could be used to complete the function of the responder. After the successful realization of the responder based on the STM32 single-chip computer, the classroom practical operation is introduced. In class, the students were first shown the short film "Chinese Poetry Conference" and then asked to realize the function of the answering device. After releasing the task, the students were not as calm as before, but very happy. The students discussed intensely the development process and all wanted to complete the function as soon as possible. After downloading the code to verify that there was no problem, the team members also simulated the answering scene in the program, that is, they mastered the development of STM32 and learned the knowledge of poetry, killing two birds with one stone.

Similarly, in later observations, such as the whack-a-mole game or the accurate 10-second free game launched by some stores were converted into questions, and students' interest in participation was obviously strong.

If such topics can be added to the practice sessions of online classes, it is believed that most students will be interested in the development of STM32, which will connect students with the reality of life, stimulate their enthusiasm to apply knowledge to life, and truly apply what they have learned (Chen Ming, Li Zhen, & Xie Jinyun, 2020).

4. Conclusion

For courses that require physical assistance, it is difficult to carry out online courses, especially without the corresponding simulation software, which makes teaching more challenging. However, with the rise of online platforms such as MOOCs, online teaching will be the trend of the times. Therefore, we have to adapt to this change as well. Currently, the courses on STM32 available on MOOCs and other websites are suitable for undergraduate colleges, while vocational students should concentrate on project-based teaching to acquire practical skills. In this regard, the author will continue to explore and strive to present the STM32 microcontroller in a comprehensive and easy-to-understand manner to students from various perspectives. By engaging with students during teaching, identifying the challenges they face, proposing innovative solutions, and continuously testing and refining new methods, we aim to enhance the learning outcomes.

References

- Chen Ming, Li Zhen, Xie Jinyun. Teaching reform and practice of STM32 MCU course under the model of "teaching and practice" [J]. *Equipment Manufacturing Technology*, 2020(9): 84-86.
- Chen Ming, Li Zhen, Xie Jinyun. Teaching Reform and Practice of STM32 microcontroller course under the model of "Teaching and practice" [J]. *Equipment Manufacturing Technology*, 2020, (9): 84-86,100.
- Hou Li, Jiao Mace. Strengthen the ideological and political construction of college curriculum and help the high-quality development of Vocational education: Taking stm32 and Wireless Sensor Network Technology as an example [J]. *Intelligence*, 2022(23): 77-80.
- Wei Bingui. Teaching Project Design of STM32 Embedded Technology Course in Higher Vocational Colleges [J]. *Mass technology*, 2009 issue.
- Zhao Suling. Exploration of SCM classroom Teaching Organization [J]. *Science and Technology Innovation*, 2019, (14): 88-89.