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Research and Construction of Student-centered Innovative Experimental Teaching

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Abstract: Experimental teaching is an important part of the higher education work. With the improvement of higher education requirements, laboratory teaching has gradually developed from the traditional teacher-to-student single teaching method to a diversified and open model. The student-centered experimental teaching can make students play a subjective initiative, more creative, and help to cultivate students' lifelong learning habits. The student-centered innovative experimental teaching model was discussed in this paper. And the course of SCM principle and application has been taken as an example to explore and construct this model. Then experimental teaching form, experimental teaching content, experimental teaching process and the final assessment standard under this model was expounded here. According to the teaching form, both partial and full permissions can be opened to students. In terms of teaching content, it is necessary to investigate the experimental teaching content and focus on students in different grades. In terms of assessment, the specific implementation process of the teaching model was given, and the assessment scoring method dedicated to innovative practice teaching was used in the assessment. The whole process demonstrates the effectiveness and popularization of the innovative student-centered experimental teaching model.

Keywords: Opening Laboratory; Student-centered; Innovative Experimental Teaching; Principle and Application of Single Chip Microprocessor.

1. Introduction

The laboratories play a very important role in colleges and universities. It is the main teaching and research battlefield of the higher education, and is also the reflection of the teaching level. With the improvement of university education requirements, laboratory teaching has gradually developed from the traditional teacher-to-student single teaching method to a diversified and open model. In particular, our school promotes and implements the excellent engineer education and training class, which aims to cultivate a large number of high-quality engineering and technical talents with strong innovation ability and meet the needs of economic and social development, so as to serve the national industrial development, construction of innovative country and talent power strategy. Therefore, the reform of laboratory teaching is imperative.

Throughout the development of experimental teaching in recent years, driven by the evaluation of undergraduate teaching level and the construction of experimental teaching demonstration center in colleges and universities, around the goal of talent training, strengthening the cultivation of practical ability and innovative spirit, colleges and universities have gradually increased the investment in laboratory construction, experimental teaching equipment has been greatly updated, and the experimental teaching environment has been significantly improved. The cognition of the function of experimental teaching has been qualitatively improved, and the position and importance of experimental teaching have been gradually highlighted. Laboratory construction and experimental teaching reform have made remarkable progress. Improvements in hardware are bound to bring improvements in software. In recent years, student-centered teaching model has been repeatedly included in the research. In 2019, in order to improve the teaching and learning efficiency of systematic anatomy, they tried to adopt a student self-management teaching model, and the teaching reform results of clinical medical undergraduates were evaluated by questionnaire survey and examination scores [1]. Taking college students' mental health course as an example, XU Shanshan, ZANG Xiaoli, LI Yang, et al explored the influence of establishing a student-centered teaching quality monitoring system on students' learning effect in 2020. A total of 67 college students were selected as the research objects, and a control intervention study was conducted. The results showed that after the intervention, the learning motivation of the intervention group was significantly enhanced, the learning satisfaction was significantly improved, and the evaluation of learning effect was better. Therefore, the student-centered teaching quality monitoring system can be promoted in colleges and universities as a method to enhance the learning effect of students.[2]

For Control Motor course, Xu Jinquan, Guo Hong investigates a novel teaching methodology by combining the student-centered classroom teaching and experiment teaching in 2021[3] In terms of classroom teaching, they take the student as the main body, and pay attention to the basic theory. The results show that their teaching method can stimulate students' enthusiasm and initiative, strengthen students' understanding of the course, and improve students' ability to analyze and solve problems. Chen Yuanyuan think that student-centered art teaching can help students learn independently, exercise their abilities, and improve the distance between teachers and students that year [4]. In 2023, Cao Jinjia, Zhao Jiawei, Xiang dong took ‘Student-centered’ as the breakthrough point, discussed the problems of virtual simulation experiment teaching form with higher requirements for students' participation and exploration ability in the process of education reform. Based on the constructivism learning theory, the paper they wrote criticizes the teaching reform trend of virtual simulation experiment,

and discusses the reasons and importance of attaching importance to the combination of virtual and reality from the perspective of cultivating students' experimental ability.[5]

However, most of the studies are focus on the thinking of the student-centered experimental teaching, or the open exploration of the experiment of a specific course. There are few discussions on the innovative experimental teaching model with students as the main focus, especially the discussion on the experimental teaching construction relying on the network experimental teaching platform, which needs further in-depth research.

2. Discussion on Teaching Model

In the process of exploring the innovative experimental teaching model with students as the main focus, four aspects were discussed according to the teaching form: the instructional mode, teaching process and experimental teaching assessment standard.

2.1. Instructional Mode

According to the teaching mode, the innovative experimental teaching can be divided into partial permission and full permission. Students' partial authority means that students choose the specified experimental projects within the specified time and within the specified point to carry out, and they need to be supervised and guided by teachers during the process. Student full access means that students can choose their interested experimental projects to do at any time and in the laboratory. Theoretically, full open access can better play the subjective initiative of students, mobilize students' interest in learning, and improve learning efficiency. But it has a certain safety hazard, for some experimental equipment is not used properly, but also easy to cause damage. So, part used in the process of teaching the students completely open access permissions and student union way. For the virtual laboratory established in the teaching process of single chip microcomputer, the full open form is adopted, and students can enter the laboratory at any time and place online to conduct experiments. The central laboratory of the college is partially open.

2.2. Content of Courses

The central laboratory of the college is for all teachers and students of the university, mainly for public basic courses and professional basic courses, involving a wide range. In the process of research, to experiment teaching content and emphasis of different grade students make a survey. When the teaching plan is made, the specific experimental content is formulated for students in different grades and different majors, which can not only help students learn the basic knowledge of the major well, but also carry out personalized development for the major, and cultivate students' lifelong learning ability. Taking the ‘Principle and System of Single Chip Microcomputer’ as an example, the software part of the experiment is set up as the students' full open permission experiment, and the comprehensive experiment of the combination of software and hardware is set up as the students' partial permission experiment, so as to solve the practical problem of the serious shortage of laboratory capacity after the expansion of enrollment in our hospital.

2.3. Teaching Process Design

The student-centered innovative experimental teaching process is shown in Figure 1. Summarize the teaching process, and laboratory management system, all staff should obey the arrangement of the management and abide by the regulations of the laboratory, take good care of instruments and equipment, keep the room clean and quiet, fire alarm, to ensure the lab safety. The experimental time can be arranged by telephone or online. Before the trial should be check if equipment is complete, the work is normal, and make computer registration, if any problem should be timely report to management; Read the instructions carefully before using equipment, carefully check lines; At the end of the experiment, the connected line should be removed, the power supply of the instrument and equipment should be turned off, and the equipment can be sorted out and put in place before leaving. Without permission, shall not move or disassemble instruments and equipment at will, damaged instruments and equipment should be compensated according to the price, laboratory equipment in principle not to borrow.

2.4. Experimental Teaching Assessment Standards

In terms of evaluation, by adopting the method of innovative practice teaching specialized examination score. The experimental score is composed of five major items: experimental attitude, experimental ability, mid-term examination and final examination.

2.4.1. Experimental Attitude

The students should observe the rules and regulations of the open laboratory. The experimental hours should meet the basic requirements of the course. Before they do the experiments, they should preview the relevant theory and experimental content in advance and understand it, then design the experimental scheme. Ensure that each student will be inspected 2 to 3 times during the course. After the mid-term examination, students who have not been inspected should take the initiative to apply for examination. Random spot check method is used as a method of examination, and the score ratio was 10%.

2.4.2. Experimental Ability

The students should actively analyze and solve the problems encountered in the process of experiment. Experimental report must be well written. They may analyze the experimental results, and answer questions after class. The score of the experimental report is the examination score of this part, accounting for 20% of the total score.

2.4.3. Mid-term Examination

The mid-term examination is used to check the degree to which students have mastered the basic requirements in the course syllabus, the operation of instruments and equipment, the abilities of experimental design, basic experimental circuit and experimental completion quality. The score of the teacher's on-site inspection and acceptance of this part of the situation accounts for 30% of the total score

2.4.4. Final Examination

According to the requirements of the final examination, students would complete the design of two experimental questions in writing, one of which is a basic question and the other is a comprehensive design problem. Then they would be asked to set up the basic experimental circuit. The teachers check the students’ experimental design, the experimental results and the operation of the equipment. Teachers make on-site evaluation and acceptance, and give the score of this part, accounting for 40% of the total score.

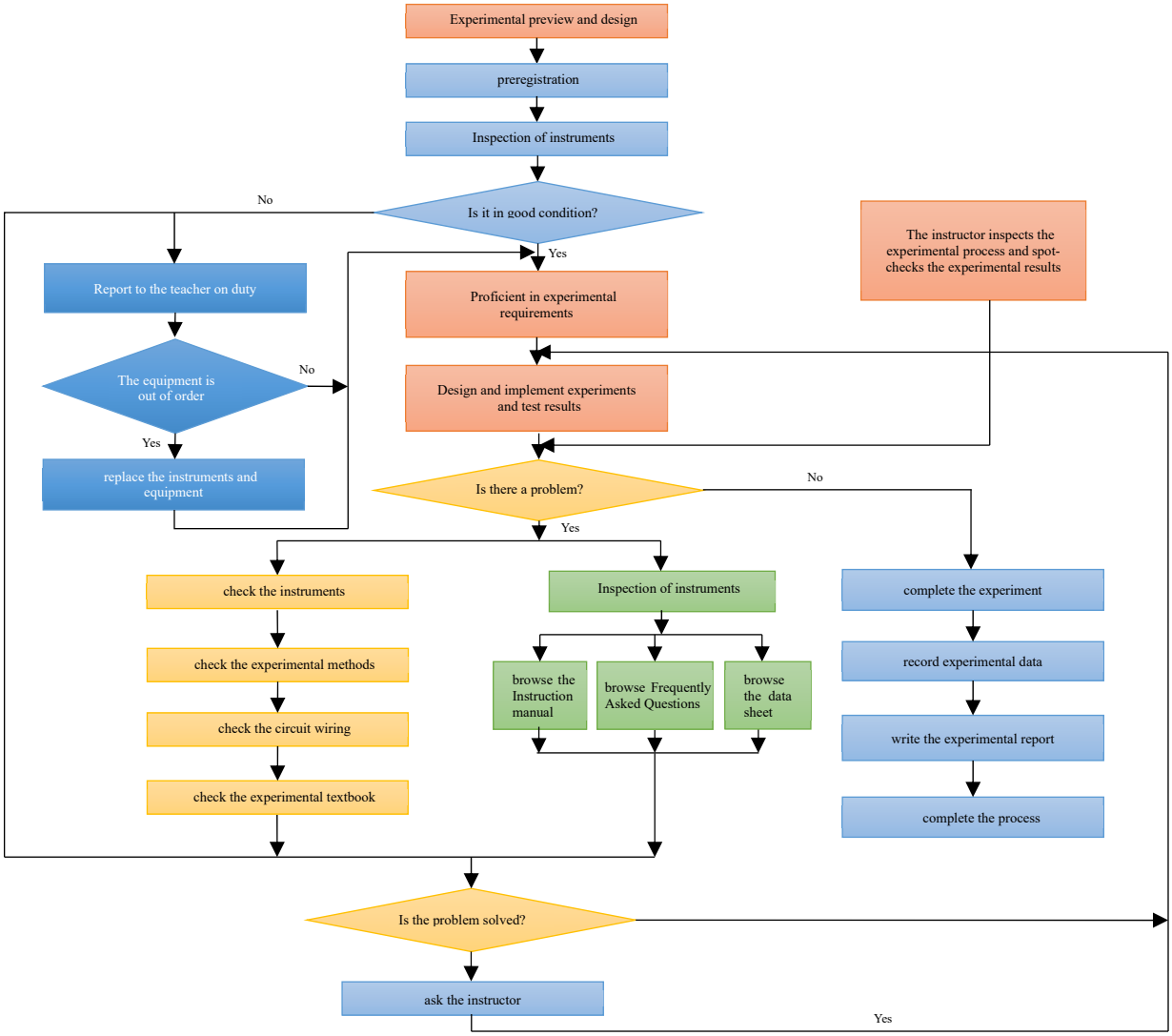


Figure 1. Flow chart of student-centered experimental mode

The experimental courses are graded according to five grades: excellent, good, medium, pass and fail. If the final examination result is not passed, the experimental course will be graded as a failure. Students who won the first and second prizes in the course experiment design competition can be exempted from the final examination. The final scores of the first prize winners are equal to excellent, and the second prize winners are equal to good. The second prize winners can also choose to participate in the final examination, and the experimental course scores can be evaluated according to the final examination scores.

3. Results and Conclusion

Through the course construction team nearly a year of efforts, with the single chip microcomputer principle and application "course as an example the courses of the comprehensive and designing, researching experiment to establish library, to implement innovative experiment teaching, the experiment classes we open are increased year by year to reform experimental curriculum appraisal way, the implement stage and the diversified evaluation methods. The students in our college have achieved good results in various experimental competitions, and their interest in experiments is unprecedently strong. In the future, it is necessary to continue to implement the opening of the laboratory with students as the main focus, continue to implement the innovative experimental teaching model with students as the main focus, overcome the difficulties such as the management of device consumables, debugging equipment, and the shortage of instructors. It is necessary to fully combine the community and discipline competition, so that the experiment can be deeply carried out by the students as soon as possible, and strive for the students to participate in learning, teaching and experimental management, so as to truly achieve the benefit of teaching and learning.

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