Teaching reform plan for hydraulic and pneumatic transmission courses based on experimental platform

Peiming Peng[a*], Yuehua Sun[b], Lianyao Tang[c], Hui Yang[d]

Guangdong University of Science and Technology, Dongguan, China

[a*]aeensor@163.com, [b]1580774753@qq.com
[c]448795465@qq.com, [d]1446908340@qq.com

Abstract. This paper proposes a teaching reform scheme for hydraulic and pneumatic transmission courses based on experimental platforms, aiming to solve the problem of separation between theory and practice in traditional teaching. By incorporating modern teaching concepts and introducing advanced laboratory facilities, the program focuses on enhancing students' hands-on, innovative and problem-solving skills. The reform takes the compulsory courses of mechanical and electrical majors as the core, adopts the teaching mode of combining theory and experiment, and adjusts the final grade evaluation method to experimental assessment. This move aims to better meet the needs of the cultivation of applied talents, and encourage students to take the initiative to learn by optimizing the experimental design and using the existing experimental resources of the school, in order to improve students' understanding and mastery of the course content.

Keywords: experimental platform; hydraulic and pneumatic transmission; Pedagogical reform.

1 Introduction

In 2014, China proposed a strategy to strengthen the cultivation of applied talents, aiming to guide a group of ordinary undergraduate universities to transform into applied universities[1]. Talent training has also gradually shifted to applied talents. This kind of talents can not only master professional theories and skills, but also meet the needs of enterprise production, construction and scientific and technological research and development. Therefore, the cultivation of applied undergraduate talents has also become a key factor in promoting China's economic development. As an important aspect of higher education reform, applied colleges and universities cultivate applied talents with practical skills and technologies as their main goal. In this context, students need to shift from passive learning to active learning, and be able to innovate in practice and effectively play the role of applied talent training classrooms. However, in universities with mechanical majors, the training of applied talents faces a series of problems, such as the mismatch between talent training and enterprise development needs, and the dis

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connect between university graduates and the actual needs of enterprises. These problems highlight the need for major reforms in the existing education system and talent training model to better adapt to the needs of social and economic development[2].

Therefore, in order to meet the society's demand for applied talents and achieve the talent training goals of our school, it was decided to reform the teaching model of the "Hydraulic and Pneumatic Transmission" course[3]. By changing the paper examination to experimental operation as the final examination format, it can not only help students learn theoretical knowledge more easily and effectively, but also significantly improve students' professional practical ability and innovation ability[4].

2 Analysis of the Current Situation of Hydraulic and Pneumatic Transmission Courses

2.1 The importance of hydraulic and pneumatic transmission course reform

The classroom is the main place for teaching and educating people, and it is an important link in implementing talent training programs and improving students' practical abilities [5]. Traditional teaching and examination methods mainly rely on lectures and test papers, which restrict students' bold and innovative ideas and ignore students as the subject of learning to a certain extent [6]. Therefore, after students begin to enter the workplace, they cannot effectively combine professional knowledge with corporate practice, and lack practical ability. Carl Rogers, a representative figure of humanistic psychology, elaborated on a learning-centered education view, and “learning-centered” is also the mainstream development concept of higher education [7,8]. Therefore, the final exam reform model based on the experimental platform helps improve students' practical ability and innovative thinking by introducing more practical teaching links, so that students can better understand and master knowledge.

2.2 Course objectives and course structure of Hydraulic and Pneumatic Transmission

"Hydraulic and Pneumatic Transmission" is a compulsory course for mechatronics engineering majors, which plays an important basic role for students studying courses such as mechatronics, mechanical manufacturing, programmable control, and graduation projects. According to the latest talent training plan based on the OBE concept, the teaching content of "Hydraulic and Pneumatic Transmission" is 40 hours, including 6 hours of experimental teaching. Through a combination of theory and practice, students can realize the application of hydraulic and pneumatic transmission knowledge in engineering. Practical applications.

2.3 Introduction to Hydraulic and Pneumatic Transmission Laboratory

The "Hydraulic and Pneumatic Transmission Laboratory" is one of the unique laboratories of the School of Mechanical and Electrical Engineering of our school. It has 5 comprehensive experimental benches and several hydraulic and pneumatic components, covering basic, design and comprehensive experiments. As shown in Table 1 below, the experimental table is shown in Figure 1 below.

Table 1. List of main instruments and equipment

Serial Number	Name	Specifications and models	Quantity(unit/set)
1	Hydraulic transmission comprehensive test bench	YZ-02	3 unit
2	Pneumatic transmission comprehensive test bench	QDA-01	2 unit
3	Hydraulic and pneumatic components teaching display cabinet	HC-CQY-8	4 set

YZ-02 Experiment Bench QDA-01 Experiment Bench

Fig. 1. Hydraulic and pneumatic comprehensive experimental bench

3 Teaching Reform Plan for Hydraulic and Pneumatic Transmission Courses Based on Experimental Platform

Applied talents should pay more attention to students' engineering practice abilities and cultivate "ability-centered" talents [9]. Currently, the assessment ratio of this course is: 40% regular grades + 60% final grade. This traditional course assessment method cannot reflect students' practical application ability of knowledge. In order to cultivate applied talents and enable students to transform from "exhibitors" to "curators", the assessment ratio for this course reform is: 40% daily results + 60% experimental assessment results.

According to the laboratory conditions and teaching resources of our school, focusing on the talent training plan, and fully combining the courses and experimental devices learned by students, reasonable hydraulic and pneumatic experiments are designed.

3.1 Hydraulic component understanding experiment

Purpose of the experiment: Master the identification methods and basic functions of common hydraulic components; understand the role of each hydraulic component in the hydraulic system; learn the installation methods and precautions of hydraulic components.

Experimental carrier: hydraulic and pneumatic component teaching display cabinet.

Experiment content: component identification and classification and understanding of component structure and working principles.

Experiment report: including the purpose of the experiment, observation results of experimental equipment, experimental conclusions, etc.

3.2 Hydraulic and pneumatic circuits

3.2.1 Hydraulic sequential action circuit experiment.

Purpose of the experiment: ① Understand the characteristics of pressure control valves; ② Master the working principle, functional symbols and applications of sequence valves; ③ Use sequence valves and travel switches to realize sequential action loops.

Experiment carrier: simulation software FluidSIM and hydraulic transmission comprehensive test bench.

Experimental content: Use simulation software to draw a hydraulic circuit diagram. After the simulation in the software is correct, connect the hydraulic components, think about whether other circuits can be used to realize the function, and analyze the pros and cons. The hydraulic circuit is shown in Figure 2 below.

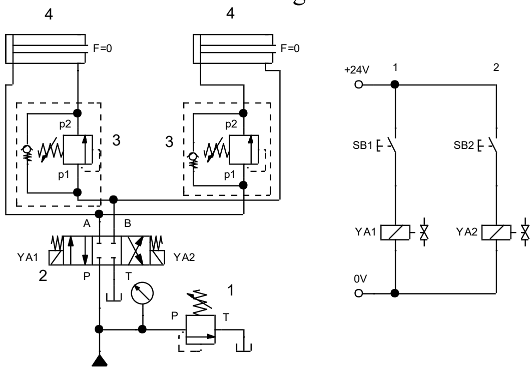

Fig. 2. Double-cylinder sequential action circuit diagram

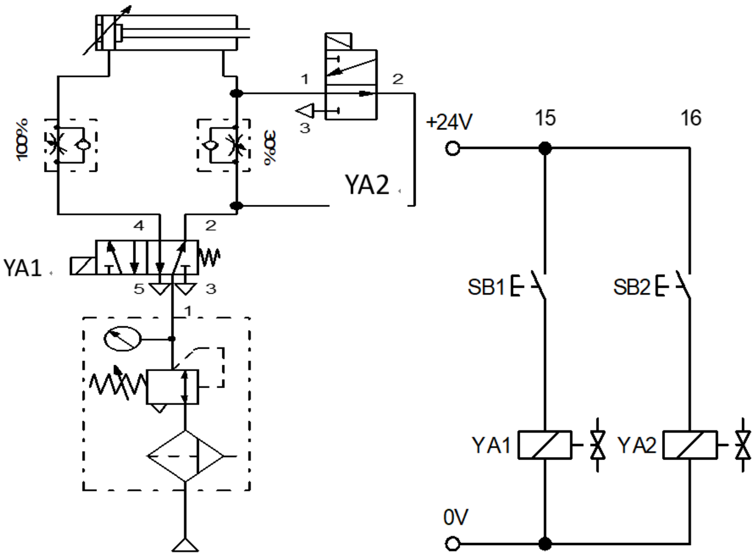

Fig. 3. Cylinder speed switching circuit diagram

3.2.2 Cylinder speed switching circuit experiment.

Purpose of the experiment: ① Deepen the understanding of the basic pneumatic circuit and the composition of a typical pneumatic transmission system; ② Understand the role of the reversing valve in the pneumatic system, and master the conditions for the extension and return of the double-acting cylinder; ③ Understand the working process of the speed switching circuit.

Experiment carrier: simulation software FluidSIM and pneumatic transmission comprehensive experimental bench

Experiment content: Use simulation software to draw the air pressure circuit diagram, think about whether other circuits can be used to realize the function, and analyze the pros and cons. The air pressure circuit is shown in Figure 3 below.

Conducting experiments with hydraulic and pneumatic simulation software can not only provide students with a safe and efficient learning environment, but also help them better understand the working principles and design concepts of hydraulic and pneumatic systems[10]. Through three experiments, we can cultivate practical operation ability and problem-solving ability, deepen the application of hydraulic and pneumatic systems in actual engineering, and lay a solid foundation for subsequent study and work.

3.3 Course evaluation

The specific distribution of course assessments is shown in Table 2.

Table 2. Assessment Contents of "Hydraulic and Pneumatic Transmission"

Assessment objectives	Evaluation index	Assessment score	Grade ratio
Attendance	A. Attend work on time, don't be late and leave early	80-100	15%
	B. Attendance is good, and the number of leave requests is less than 2.	60-79	
	C. The number of leave requests exceeds 1/3 of the courses in this semester.	40-59	
Experi-mental inno-vation	A Able to design two types of circuits to realize functions and analyze the differ-ences.	80-100	25%
	B Software can be used to implement simulation, and components can achieve the required functions.	60-79	
	C Software operation specifications, software can be used to implement func-tional simulation.	40-59	
Group work	A. The experimental operation is standardized, the loop can be completely real-ized, and the experimental report is complete.	80-100	20%
	B. The experimental operation is not standardized, the software can realize simu-lation, the experimental loop is partially implemented, and the experimental report is not specific.	60-79	
	C. The experimental operation was incorrect, the software simulation was only partially implemented, and the experimental report was not completed.	40-59	
Usual grades	Daily assessment	0-100	40%

4 Conclusion

Through this course assessment, students got rid of the disadvantages of theoretical teaching + theoretical examination, so that students gradually changed from academic to application-oriented, and taught around the reality of front-line production. The curriculum reform of hydraulic simulation software combined with experimental operation not only improves the learning efficiency and interest of students, but also enhances the interactivity and practicability of teaching, emphasizes the comprehensive application of basic knowledge, team spirit and academic system, and has a positive impact on the cultivation of students' professional skills and innovation ability.

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References

1. Zhang, SN. (2021) Research on the Integration of Industry and Education in Application-oriented Undergraduate Universities: A Case Study of University A in Y City.
2. Yang, L., Zhao, GF,. Bi, XS.(2021) Research on the path of supply-side reform of the cultivation of applied talents in local universities. Jiangsu Higher Education., 09: 60-63.
3. Park-Gaghan, TobyJ., Mokher, Christine G.; Hu, XY .(2020)What Happened Following Comprehensive Developmental Education Reform in the Sunshine State? The Impact of Floridaâ’s Developmental Education Reform on Introductory College-Level Course Completion. Educational Researcher.,49:656-666.
4. Vähäsantanen, Katja., Eteläpelto, Anneli. (2011)Vocational teachers’ pathways in the course of a curriculum reform. Curriculum Studies.,43:291-312.
5. Duan, SP.(2020). Decisive battle in the classroom, to create a highland for the construction of higher vocational connotation. Journal of Hunan Institute of Engineering., 30: 122-126.
6. Zhao, Z., Wang, D., Li, Q.(2018) Teaching reform of relay protection courses in China-Australia cooperative schools. Science & Technology Vision., 34: 176-177+161.
7. Ma, XX. (2015)The Applied Research of Written Feedback as an Evaluation Model in Biology Teaching in Middle School.
8. Yuan, SD., (2011)The Enlightenment of Rogers' Humanistic Educational Thought on Moral Education.
9. Wu, F.(2016) Exploration on the Current Situation of Talents Cultivation in Independent Colleges and How to Improve the Cultivation Quality. JOURNAL OF HUANGHE S&T UNIVERSITY., 18: 6-10.
10. Hora M T, Holden J. (2013)Exploring the role of instructional technology in course planning and classroom teaching: implications for pedagogical reform.[J]. Journal of Computing in Higher Education., 25: 68-92.