Exploration on teaching Reform of Basic Experimental Course of Thermal Fluid

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Abstract. The basic experimental course of thermal engineering and fluid is an important basic experimental course for energy power, construction and environmental protection majors, which enables students to master the basic principles and experimental skills of thermal engineering and fluid experiments through the combination of theory and practice, and to cultivate students' innovative thinking and practical ability. However, the traditional teaching mode often focuses too much on the teaching of theoretical knowledge and neglects the cultivation of practical ability and innovation ability. In this paper, we will carry out the teaching reform of the course from two perspectives of "pre-study + classroom", build a pre-study platform before class, and improve the education and teaching methods. Combined with the simulation experiment process, integrate the professional development trend, pay attention to the professional joint cross, improve the practical training and assessment methods, and help to improve the mechanism of the basic experimental course of thermal engineering fluids.

Keywords: thermal fluid experiments, pre-learning, classroom, joint specialization, experimental simulation

1 Introduction

Basic Thermal Fluid Experiment Course is an important practical course in engineering disciplines, aiming at cultivating energy majors to master the basic principles, experimental skills and experimental methods of thermal fluid experiments, and improving students' practical ability and innovation ability. However, in the actual teaching, the course has many problems, such as fragmented knowledge points, the experimental device is not closely connected with the book, the experimental device is difficult to connect with the actual engineering, and the theoretical knowledge and experimental courses are repeated. The reasons mainly include outdated content of teaching materials, single teaching method, insufficient or backward experimental equipment, and insufficient practical experience of teachers. This not only affects the teaching quality, but also restricts the improvement of students' practical ability and innovation ability. Therefore, the teaching reform of this course to improve the quality and effect of teaching is an urgent problem to be solved at present. Meanwhile, with the rapid development of science and technology, the concepts and means of education and teaching are constantly updated. The experimental course is of great significance for improving students' practical ability and analyzing problem ability[1].

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The purpose of this paper is to discuss the problems and reasons existing in the experimental course of thermal fluid foundation and put forward corresponding reform measures. Through in-depth analysis of the problems existing in experimental teaching, combined with actual teaching experience and practical experience, a practical reform program is proposed. Strengthen the connection between experimental devices and books; introduce a variety of teaching methods to enhance students' learning interest and enthusiasm; strengthen the investment in experimental equipment, update experimental devices, and improve the practicality and advancement of experimental equipment; strengthen the teacher training and exchange of practical experience to improve the practical ability and teaching level of teachers, in order to enhance the students' practical ability and innovation ability, and to provide strong support for the cultivation of high-caliber engineering talents[2]. At the same time, for the course, around the construction of virtual experimental platform, the energy equation experiments, local resistance coefficient determination experiments and other fluid mechanics experiments with the help of software Fluent to simulate the experimental process, in order to improve the students' ability to analyze the problem. Join the new teaching concept, new professional development trend and modernized professional joint cross technology, etc., to explore a better teaching mode.

2 Constructing the mechanism of pre-learning in practical teaching

2.1 Constructing the mechanism of pre-learning in practical teaching

Pre-learning stage is an important part of student learning, through the pre-learning so that students understand the content of the experiment in advance, improve classroom efficiency, better enhance the quality of teaching experimental courses, to meet the learning needs of students and development needs. Therefore, before the teaching process, teachers can set clear learning objectives and design corresponding pre-study activities. At the same time, teachers should pay attention to students' individual needs and provide customized learning paths for each student[3, 4]. Through the implementation of the above measures and mechanisms, the basic thermal fluid experimental course highlights the student-oriented teaching concept, and the following measures are taken for better pre-study.

2.2 Building a platform for pre-learning before class

During pre-learning, teachers should clarify the learning objectives of this course, as well as the skills and knowledge levels that students need to achieve, so that students can better prepare and learn. Construct a pre-learning platform to make the principles, steps, precautions, etc. of the experiment into illustrated PPTs and videos to facilitate students' understanding and learning[5]. Provide abundant materials on the pre-study platform, including articles, papers, videos, etc., to help students understand the related knowledge of thermal engineering and fluids. Meanwhile, some authoritative professional websites and books can also be recommended to guide students to actively check and filter the information.

Teachers should establish an effective assessment mechanism to assess students' learning outcomes on the pre-learning platform before class. The assessment results should be fed back to students in a timely manner to help them understand their learning status, identify deficiencies and make learning improvement plans. At the same time, teachers can also plan to

improve their classroom teaching methods based on the assessment results to further improve the quality of teaching.

2.3 Establishment of an online question-and-answer platform

Build an online platform to answer students' questions encountered in the pre-study process at any time to ensure that students can successfully complete the pre-study tasks. With online interactive discussions, teachers can organize group discussions or online discussions for students and encourage them to share their understanding and insights. It helps students to deeply understand the knowledge and practice their communication skills and cooperation spirit[6].

In the process of "pre-learning", teachers should collect students' feedback regularly to understand their learning progress and difficulties. According to students' feedback, they should adjust the teaching methods and contents in a timely manner so as to make the teaching more in line with students' learning needs. Utilize modern information technology, using online platforms, social media and other modern technology tools to assist teaching. Fig. 1 shows an online learning platform for thermodynamic fluids, which can release teaching materials, assignments and quizzes, and interact with students in real time. It improves teaching efficiency and also enhances students' learning experience[7].

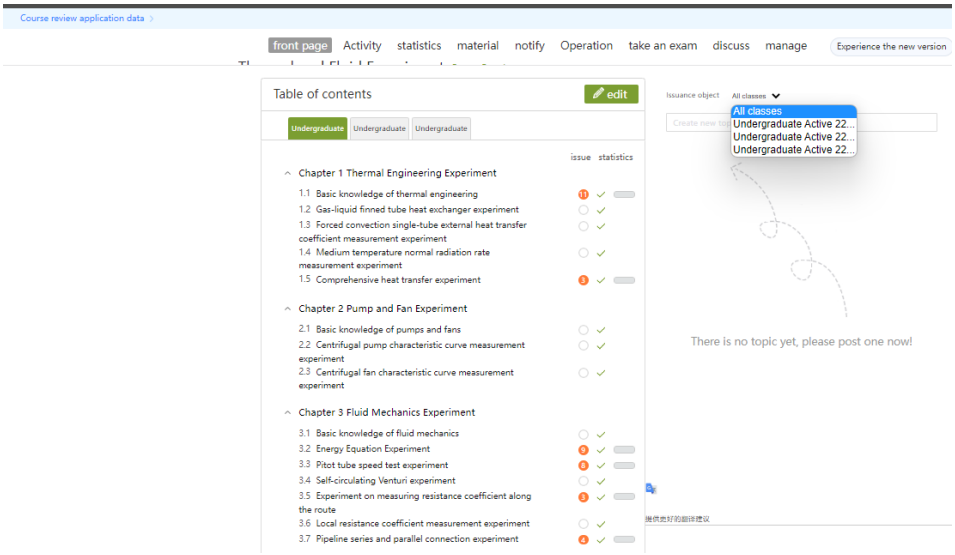

Figure. 1. Thermal fluids online learning platform

2.4 Arranging pre-study assignments

In order to assign relevant pre-study assignments, students are urged to complete the pre-study tasks seriously, provide reference for teachers' classroom teaching, stimulate students' curiosity and desire for knowledge, and make them more actively engaged in learning. In the experimental course on the fundamentals of thermodynamic fluids, students can be allowed to explore the relationship between thermodynamics and fluids, or they can be allowed to study

and discuss some actual cases to enhance their practical and application ability. In order to make students better understand and apply the knowledge they have learned about thermal engineering and fluids, students are guided to design some experiments or projects to exercise their own skills and abilities, and to cultivate their practical ability and innovative thinking. To cultivate independent learning ability, teachers should not only impart knowledge, but also cultivate students' independent learning ability. By guiding students to think independently and solve problems on their own, they help them master learning methods and lay the foundation for future lifelong learning[8].

3 Instructional exploration during classroom instruction

3.1 Improvement of educational and teaching methods

For the basic experiments, students are guided to think about the experimental principles, experimental steps and other issues to stimulate students' enthusiasm for learning and curiosity, and cultivate their innovative thinking and problem-solving ability. Attention should be paid to the introduction of challenging experimental projects, redesigning experimental projects and introducing more challenging experimental content, such as the simulation of complex fluid systems, optimization of thermal equipment. These experimental projects require students to synthesize and apply what they have learned to solve practical problems through teamwork. We use specific case studies to give students a better understanding of the application of experimental principles and methods in practice. At the same time, we also encourage students to find their own cases to analyze and discuss, so as to improve students' learning enthusiasm and initiative[9, 10].

3.2 Implementing teaching and learning sessions

Pre-study stage: Study Pass releases the lab guide, study guide and assessment topics; Students consult the study guide and integrate the relevant theoretical knowledge for the lab project; Students study and master the experimental principles and steps; Students respond to the mastery situation through Study Pass, which is conducive to adjusting the course progress. Classroom stage: Teachers in accordance with the group test students experimental principles and steps; Assessment of students to master the experimental process of attention; After passing the assessment allows students to carry out experiments and emphasize the safety matters; Concerned about the progress of student experiments and check the student experimental data is accurate; Experiments are completed, the students independently analyze the data and the group to send a representative to report on the experimental situation of the group.

4 Construction of virtual experiment platform

Building a virtual experimental platform is an effective way to solve the limitations of traditional experimental teaching. Through the software Fluent and other tools, the real thermal and fluid experimental environment can be simulated, so that students can carry out simulation experiments on the computer. It can solve the problem of insufficient experimental equipment, and reduce the experimental cost and improve the experimental efficiency. At the

same time, the virtual experiment platform provides rich data analysis and visualization tools to help students better understand the experimental results and improve their ability to analyze problems[11].

4.1 Introduction of new teaching concepts

New teaching concepts are introduced on the basis of the virtual laboratory platform. Students can design their own experiments and freely explore problems in the field of thermal engineering and fluids through the virtual experiment platform. Teachers guide and assist to help students solve the problems they encounter. In addition, the project-based learning concept is introduced to collect practical application scenarios from enterprises and scientific research institutions, so that students can improve their abilities in the process of solving practical problems and improve their practical ability by completing practical projects[12].

4.2 Integration of professional development trend

With the continuous development of science and technology, the energy field is also progressing. It is necessary to integrate new professional development trends in the course, and energy-based problems in new energy technologies such as solar energy, wind energy and other new energy technologies can be introduced into the course, so that students can understand the latest professional dynamics. In addition, with the rise of artificial intelligence technology, we can also apply advanced technologies such as machine learning to thermal and fluid experiments to help students master new technologies and improve their problem-solving ability.

4.3 Exploration of specialized joint cross technology

In order to better adapt to the needs of the development of modern science and technology, we should pay attention to the exploration of specialized joint cross technology. Cross-integrate thermal and fluid technology with computer science, data analysis and other fields to form a new research direction. This interdisciplinary research method can help students broaden their horizons and improve their innovation ability. In addition, we can cooperate with enterprises and scientific research institutions to carry out research projects together and provide students with more practical opportunities. This mode of cooperation can promote the integrated development of industry-university-research and promote the progress of thermal and fluid technology.

4.4 Reform effects and potential challenges

Through the combination of experimental teaching and practice, students master experimental skills and methods in the process of experimentation. At the same time, a variety of experimental equipment and software are provided for students to choose and use in order to meet the learning needs of different students and cultivate their innovative thinking. The reform of the teaching method requires teachers to update their teaching concepts and improve their teaching ability, so as to better cultivate students' practical ability and innovative thinking, and to send more excellent talents to the society and serve the social needs. Of course, there are some potential challenges in this teaching reform. To realize the combination of thermal fluid experiments and simulation experiments, it is necessary to have certain experimental equipment and students with the operation of simulation software, and how to balance the

ratio of experimental and simulation hours in the actual teaching. By overcoming these challenges, we can better utilize this teaching method to improve students' learning effect and practical ability.

5 Conclusions

By exploring the teaching of the basic experimental course of thermal engineering and fluid technology, measures such as constructing a virtual experimental platform, introducing new teaching concepts, integrating professional development trends and exploring professional joint cross technology can effectively improve the learning effect and practical ability of students. This will lay a solid foundation for students' future development and make positive contributions to the development of thermal and fluid technology. This teaching reform is of great significance for improving students' practical ability, cultivating students' innovative thinking, improving teaching quality, promoting teachers' professional growth and serving the needs of the society, and providing powerful support for cultivating high-quality engineering talents. At the same time, this study also provides a useful reference and reference for the teaching reform of other similar courses.

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References

[1] Gao S., Yanhua M A .Teaching Reform of Fundamentals of Combustion for Energy and Power Engineering Majors in Agricultural Colleges and Universities in the Context of New Engineering Course[J].Asian Agricultural Research, 2023, 15(11):46-49.

[2] Li Y.. Exploration of Reform Strategy of Computer Control System Teaching[J].Foreign Edition: Educational Science, 2022, (2):151-154.

[3] Arabi Y., Sarafan K., Dehkordi A M.. Gas Bubble Diameter and Rise Velocities in Tapered Fluidized Beds: Experiment and Computational Fluid Dynamics Simulation[J].Industrial And Engineering Chemistry Research, 2023, 62(9):4175-4190.

[4] Kou Z., Xu R., Li G., et al. Thermal fluid experimental device development and experimental teaching system reform[J]. Laboratory Science,2018, 21(05):134-137.

[5] Yue S., Zhu Y., Xu L.. Reform and exploration of practical teaching of power engineering and engineering thermophysics specialty in the context of new energy[J]. Guangdong Chemical Industry, 2024, 51(04):169-170+193.

[6] Wen H., Shi G., Fu J., et al. Internship reform of energy and power engineering in the context of "first-class undergraduate program" construction[J]. Modern Business Industry, 2024, 45(03):256-257.

[7] Conn K M , Lovison V S , Hyunjung M C .How Teaching in Underserved Schools Affects Beliefs about Education Inequality and Reform[J].Public Opinion Quarterly, 2022, 86(1):1-28.

[8] Yu J., Dong J., Wang F.. Construction of Practice Teaching Platform System under the Background of New Engineering Science--Taking Energy and Power Engineering as an Example[J]. China Electric Power Education, 2023, (11):77-78.

[9] Shi Y., Liu B.. Exploration of Talent Cultivation Reform of Energy and Power Engineering in Local Colleges and Universities under the Background of New Engineering Science[J]. China modern education equipment, 2023, (19):87-89.
[10] Yin S., Feng Y., Tong L., et al. Exploration and practice of expanding the content and improving the effect of practice link in energy and power engineering[J]. Research on Higher Engineering Education, 2023, (S1):40-42.
[11] Gericke N , Torbjornsson T .Supporting local school reform toward education for sustainable development: The need for creating and continuously negotiating a shared vision and building trust[J].The journal of environmental education, 2022, 53(4/6):231-249.
[12] Anderson S , Uribe M , Valenzuela J P .Reforming public education in Chile: The creation of local education services:[J].Educational Management Administration & Leadership, 2023, 51(2):481-501.