

Application of Tool Empowerment in the Teaching Process of Thermal Power Plants in the Era of Artificial Intelligence

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Abstract: The Thermal Power Plant course involves a wide range of energy sources, including the utilization of coal, gas, nuclear energy, and other energy sources, and introduces the theoretical and practical knowledge of using various energy sources to generate high-temperature and high-pressure steam to drive steam turbines for power generation. The course design can not only help students better understand and master the design principles of thermal power generation systems, but also cultivates their ability to analyze, design, and solve problems. Traditional teaching methods cannot stimulate students' interest in learning and help them better understand principles and methods. In the era of artificial intelligence, various intelligent tools can be widely applied in the teaching process of courses to enhance students' understanding of knowledge, interest in learning, mastery of technology and comprehensive problem-solving ability.

Keywords: Tool Empowerment; Thermal Power Plants.

1. Introduction

The Thermal Power Plant course is an important course on power engineering, which introduces the theoretical and practical knowledge of using various energy sources to generate high-temperature and high-pressure steam to drive steam turbines for power generation. This field involves a wide range of energy sources, including the utilization of coal, gas, nuclear energy, and other energy sources. Through this course, students can gain a deep understanding of the basic principles, techniques, and practical operation of thermal power generation systems. At the same time, the curriculum design of thermal power plants is a very important practical link [1]. Through the course design, students can apply their theoretical knowledge to comprehensively design, analyze, and simulate the operation of a specific thermal power generation system. This can not only help students better understand and master the design principles of thermal power generation systems, but also cultivates their ability to analyze, design, and solve problems.

The thermal power plant course plays an irreplaceable role in the cultivation of students majoring in power engineering. It not only provides basic theoretical knowledge of power engineering, but also provides solid practical experience for students' future career development.

2. Existing Problems

However, there are still many problems in the teaching process of thermal power plant courses that need to be solved urgently.

(1) New power generation technologies are constantly emerging, and the curriculum knowledge system is lagging behind significantly

With the deepening of the construction of ecological civilization, various strict environmental protection regulations have been introduced one after another. In addition to completing traditional functions such as power

generation and heat supply, power plants also bear more social and environmental responsibility. The unyielding pursuit of "energy conservation and emission reduction" has promoted the rapid development of technology in the power industry. In terms of coal-fired power generation alone, from the previous pursuit of "high parameters and large capacity" to the current "clean coal", "multi-generation", "renewable energy coupling", "smart power plant", "carbon capture and storage", etc., it has enriched the connotation of thermal power generation and expanded the scope of thermal power generation. The application of various new technologies in modern power plants is endless, turning many "impossible" into reality and subverting the cognition of traditional thermal power plants [2]. In the new situation of continuous emergence of new technologies, the traditional thermal power plant curriculum resources and knowledge system have obvious lag and narrow caliber, which cannot meet the requirements of "new engineering" education concept for diversified, innovative and leading talent cultivation.

(2) Thermal power plants currently focus on classroom teaching, with weak practical teaching links. The lack of organic connections between classroom and practical teaching links affects teaching effectiveness.

The practical teaching links closely related to the thermal power plant curriculum mainly include cognitive internship, operational internship, and curriculum design [3]. The teaching links in this curriculum system are relatively independent, with classroom teaching as the mainstay. The practical teaching links are weak, and there is a lack of organic connection between classroom and practical teaching links, which affects the teaching effect. For example, the internship content tends to be formalized, the participation of experienced teachers is low, and there is a phenomenon of students' "looking at the scenery" during the internship. The curriculum design topics are single, and students have the phenomenon of copying each other, which is not enough to support engineering education. These problems lead to

students being unable to truly experience and accumulate practical experience in the practical teaching links, greatly reducing the promotion effect of classroom teaching, and the students trained are obviously lacking in engineering thinking and innovation ability.

(3) Advanced teaching methods and teaching tools have not yet been organically incorporated into the teaching process of thermal power plants, which restricts the improvement of teaching quality and talent cultivation quality.

Under the current teaching model [4], many students are still accustomed to passive acceptance of knowledge, with poor learning initiative, lack of interest in the curriculum, overly calm classroom responses, and insufficient interaction with teachers. Some advanced teaching methods and teaching tools have not yet been organically incorporated into the teaching process of thermal power plants, which restricts the improvement of teaching quality and talent cultivation quality.

3. Tool Empowerment Applications

3.1. Solution Proposals

The advent of the era of artificial intelligence has brought many opportunities and challenges to college students' learning. Students need to actively respond to changes and continuously improve their abilities and qualities to adapt to the future development needs of society. As college teachers, we should follow the trend of the times and technological progress, and use advanced technology to assist students in their learning.

Simulation software: Thermal power plant simulation software can help students better understand the operation process and equipment [4-5] of power plants, including boilers, turbines, generators, etc. These simulation software often allow for 3D modeling and simulation operations, helping students better understand the working principles and operation processes of various systems and equipment in thermal power plants.

Experimental equipment: Experimental equipment allows students to conduct hands-on experiments, including models or key equipment of thermal power plants. Through experimental operations, students can better understand the operating principles of thermal power plants and the measurement methods of related parameters, improving their practical abilities and cognitive levels.

Online resources: Online resources can provide students with more learning content and depth, including instructional videos, case studies, and more. These resources can serve as a supplement to classroom teaching, helping students better understand and grasp the relevant knowledge of thermal power plants.

Engineering design software: Engineering design software can be used for the design and optimization of thermal power plants, such as CAD drawing software and finite element analysis software [6]. These softwares can help students understand the design and optimization methods of thermal power plants and improve their engineering design capabilities.

Data analysis and visualization tools: Data analysis and visualization tools can be used for data processing and display in thermal power plants, such as MATLAB, Python and other programming languages and corresponding data processing libraries. These tools can help students better understand data processing and analysis methods in thermal power plants, and improve their data processing and analysis skills.

3.2. Application Examples

(1) Teachers should focus on cultivating students' autonomous learning ability and critical thinking in teaching, and teach them how to effectively use AI tools for learning and problem solving. At the same time, students should be trained to have the ability to distinguish and select from the massive information. For example, various AI chat tools, such as ChatGPT and ERNIE Bot, are used to assist in collecting materials, such as investigating the current situation of power plants at home and abroad.

(2) Using advanced programming languages to assist in completing various calculations in the course. Python language syntax is concise and clear, and is closer to natural language, making it easier to pick up and learn compared to other programming languages. By explaining algorithms and implementing them using programming, and observing the transformation of result values through changes in parameters, students can better understand the knowledge in a deeper way.

(3) Python has libraries and frameworks specifically for various fields. In thermal system calculations, there are many third-party libraries available in Python, and the following are some of the main ones.

IAPWS [7] is a python library implementing the International Association of Pressure Water Vapor Pressure (IAPWS-IF97) formula, which provides formulas and data for calculating water vapor pressure. The calculation of water vapor pressure is very important in thermodynamics.

Suppose we need to calculate the pressure and temperature of water vapor in a steam turbine in order to understand the operating status and performance of the turbine. We can use the IAPWS-95 equation of state in the IAPWS library to calculate the saturated vapor pressure and temperature. The specific steps are as follows:

Import the IAPWS library and the required equation of state module:

```
from iapws import IAPWS952.
```

Create an IAPWS-95 object and pass in pressure, temperature, and other parameters:

```
iapws = IAPWS95(p=101325, T=370)
```

Obtain the calculation results, such as saturated steam pressure and saturated steam temperature, by calling the object's properties:

```
p_sat = iapws.p_sat  
T_sat = iapws.T_sat
```

4. Conclusion

In the teaching process of thermal power plants in universities, the introduction of tool empowerment can bring the following effects:

(1) Increase students' interest and participation in learning. By using simulation software, experimental equipment, online resources, and other tools, students can be more actively involved in their learning, increasing their interest and participation.

(2) Enhance students' practical ability and cognitive level. By using experimental equipment, simulation software, and other tools, students can better understand the operating principles and procedures of thermal power plants, enhancing their practical ability and cognitive level.

(3) Improve students' learning efficiency and outcomes. By using online resources, numerical simulation software, and other tools, students can more easily access learning resources

and solve problems, improving their learning efficiency and outcomes.

(4) Develop students' innovative and problem-solving abilities. By using simulation software, numerical simulation software, and other tools, students can better understand the optimization and improvement methods of thermal power plants, and develop their innovative and problem-solving abilities.

(5) Improve the teaching effectiveness and quality of teachers. Through the use of tool empowerment, teachers can more vividly demonstrate the relevant knowledge of thermal power plants, enhance students' interest and participation, and improve the teaching effectiveness and quality of teachers.

In short, the introduction of tool empowerment in the teaching process of college thermal power plants can bring multiple effects, including enhancing students' interest and participation, improving students' practical ability and cognitive level, improving students' learning efficiency and results, cultivating students' innovative ability and problem-solving ability, and improving teachers' teaching effectiveness and quality.

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