Research on Teaching Design of Launch Support System Course Guided by System Design Tasks

Jianhua Chen[a], Ming Yang[b], Ji Yan[c], Weigang Li[d]*

Naval Submarine Academy, Qingdao, Shandong 266199 China

[a]cjh0119@163.com, [b]tomorrowyoung@163.com, [c]53072472@qq.com, [d]*qdlwg2008@sina.com

Abstract. Based on the characteristics of a certain launch support system course and the current teaching problems, referring to the constructivist learning design teaching mode, a course teaching mode guided by system design tasks is proposed. The overall teaching ideas and specific implementation process are given, and the issues that need to be paid attention to in teaching implementation are analyzed. This can provide reference for the teaching reform of this course and also have certain reference significance for the teaching reform of equipment courses.

Keywords: course teaching design, launch support system, task traction, system design

1 Introduction

The ship launch support system is one of the important subsystems in the supporting equipment of boats, which is of great significance for ship underwater launch. The course of a certain launch support system is also a core course in the job assignment module of the talent training program. However, due to the involvement of various environmental conditions such as water, electricity, fluid, and gas, as well as the large size of the equipment, it is difficult for the current practical teaching equipment to fully have the same operating environment and conditions as the actual installation. This makes the teaching of this course mostly adopt a lecture style teaching method, and the teaching effect is not good, which is difficult to meet the needs for talent cultivation in colleges. Therefore, there is an urgent need for teaching reform.

Therefore, based on the characteristics of a certain launch support system course and the current teaching problems, referring to the classic Constructivist Learning Design (CLD) teaching mode, the teaching process of a certain launch support system course is reconstructed and integrated, and a course teaching mode guided by system design tasks is proposed.

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2 Characteristics of the Course and Main Problems in Current Teaching

2.1 Course Features

The main characteristics of a certain launch support system course are as follows: (1) Strong comprehensiveness of content. The course teaching content involves knowledge of multiple disciplines such as mechanics, electronics, and hydraulics, as well as various environmental conditions such as electricity, fluid, and gas. (2) The content involves a large number of equipment. The launch support system is massive and includes multiple subsystems. There are pipelines and valves distributed on each level of the compartment on the ship. (3) The difficulty of learning is high. The content involves a large number of professional terms such as launch, machinery, and hydraulics, making learning difficult.

2.2 Current Problems in Teaching

In traditional teaching, various subsystems in the guarantee system are usually used as teaching modules, and teaching is organized in the order of subsystem functions, structural composition, working principles, and usage and maintenance. Students only passively accept the structural composition of existing systems from the perspective of users and attempt to understand the working principles of the system, but lack the process of actively thinking about the internal logic of pipeline system design from the perspective of designers. They lack deep thinking on system requirements, functions, and specific implementation methods, which means "knowing what it is, but not knowing why it is.". The direct consequence is that students' understanding of the working principles of the system is superficial and not thorough enough. Specifically, there are three "deficiencies": firstly, a lack of in-depth understanding of the functions of each subsystem; Secondly, there is a lack of clear understanding of the interaction between various subsystems; Thirdly, there is a lack of accurate understanding of the significance of each valve component. The lack of students in the above-mentioned aspects will also to some extent affect the subsequent comprehensive course learning and the formation of job competency. Therefore, reforming the teaching mode of this course has important practical significance.

2.3 Introduction of Constructivist Learning Design Teaching Mode

As a branch of cognitive psychology, constructivism can be said to be a cognitive theory, and more importantly, a philosophy of learning. It can be traced back to the German philosopher Kant, who pointed out that individuals can only use the basic cognitive principles of internal construction to organize experience and develop knowledge; While constructing and creating the world, humans are also constructing and creating themselves[1]. From this perspective, constructivist philosophy has gradually been applied in fields such as education and psychology. As important scholars of constructivist education, Dewey, Piaget, Bruner, and others have proposed different forms of constructivist teaching theories [2-3]. Their core ideas mainly include emphasizing student-centered learning, students actively exploring and constructing knowledge, and emphasizing the "four characteristics" of the learning process (initiative, autonomy, sociality, and situational). The constructivist teaching philosophy believes that only when students think about the teaching content and construct their own understanding, can learning truly be achieved [4]. The process of learning is the process of students constructing individual and social meanings. Therefore, the teaching process should focus on how to enable students to construct their own understanding in the process of completing tasks [5].

George Ganon from the University of California, Berkeley and Michelle Coley from California State University, East Bay, introduced a constructivist learning perspective into instructional design and proposed the constructivist learning design teaching model[6-7]. This pattern consists of six basic elements: (1) designing the context. Creating learning situations by describing learning objectives, determining learning themes, and determining evaluation methods. The situational element is the basis for determining the other five elements. (2) Organize a group. Organize learning groups, prepare learning materials and tools to promote meaning generation. Students will learn more deeply and become more interested in group discussions, recording, and presentations. (3) Build bridges. Any learning is built on the foundation of the student's existing knowledge. Building a bridge is to sort out the knowledge that students must possess to achieve their learning goals, and build a bridge between their old and new knowledge, helping them connect new and old knowledge. (4) Planning tasks. Carefully designing learning tasks allows students to participate in the task while solving questions, while teachers add questions in a timely manner to ensure that students continue to think and remain in an active learning state. Learning through different forms of tasks can cultivate and enhance students' sense of learning responsibility. (5) Arrange display. Arrange students to showcase phased learning works or achievements, which can be works made by students, completed connections or assignments, all of which are the results of collaborative thinking and learning among students. Showcasing is of great significance for exercising students' thinking abilities and deepening the interaction and feedback between teachers and students[8]. (6) Guide reflection. Encourage students to reflect on their thinking process through various means during the learning process. Reflection is the last element of the CLD process, but it should be integrated throughout the entire learning process[9-10]. The process of reflection is the process of integrating new knowledge, or it can be an opportunity to design learning strategies for the next learning activity.

The six basic elements of constructivist learning design also explain the organizational process of this learning mode, which has strong operability and provides a good reference for the teaching mode design of this course.

3 Overall Teaching Design of Launch Support System Guided by System Design Tasks

To enhance students' understanding of the working principle of launch support systems, it is proposed to reconstruct the teaching process and carry out curriculum teaching reform guided by system design tasks.

For each subsystem, guide students to think from the perspective of designers and independently design. Through teaching processes such as analysis, design, discussion, improvement, and summary, students will have a deeper understanding of the working principles and functions of the system, a more accurate understanding of the cross effects of each subsystem, and a more accurate understanding of the significance of each valve.

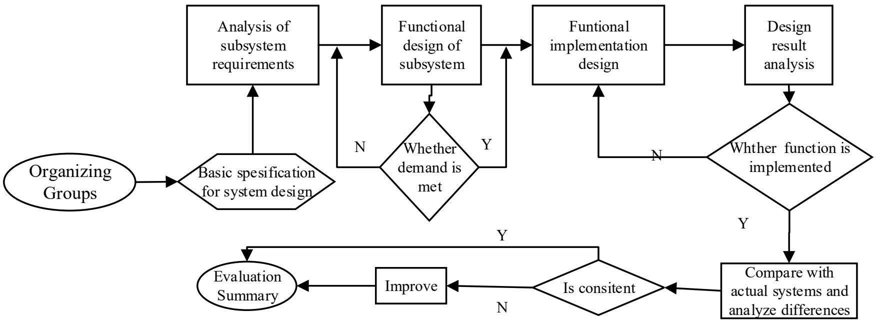

Fig. 1. Overall design of course teaching guided by system design tasks

The overall design is shown in Figure 1. Firstly, introduce some basic knowledge required for system design, and then organize students to complete the subsequent teaching process in small groups. Conduct a system requirement analysis first, then conduct functional design, and verify whether the functions fully meet the requirements. Then carry out specific functional implementation design, including the specific selection and layout of valves, pipelines, etc. After completing the functional implementation design, organize the analysis of the design results to verify whether the aforementioned design functions have been fully implemented. Then compare and analyze the design results with the actual system, and conduct difference analysis and improvement design. Finally, evaluate and summarize the system design tasks. Each of the above steps involves collective discussion and analysis, allowing students to learn from each other, criticize each other, and improve together during the process of discussion and analysis.

Comparing the curriculum teaching mode guided by system design tasks with the classic constructivist learning design teaching mode, each link can basically correspond to each other. In this mode, scenario design is mainly achieved by clarifying learning objectives and determining themes. As shown in Table 1.

Table 1. Correspondence With Constructivist Learning Design

Constructivist Learning Design	Teaching Guided by System Design Tasks Design scenario
Design scenario	Design scenario
Organizing groups	Organizing groups
Building bridges	Learning basic knowledge
Planning task	Design task implementation
Arrange display	Design result analysis
Guiding Reflection	Comparative Analysis Evaluation Summary

4 Specific Implementation

4.1 Organizing Group

Organize students into groups and prepare learning materials and tools. Organizing a group should follow the principle of student voluntary participation and teacher guidance in parallel, striving to complement the characteristics of group members and achieve balance between groups.

4.2 Basic Knowledge Required for Learning System Design

At the beginning of the course, considering that students have no concept of a certain launch support system, they will first learn the basic concepts of the launch support system, including its overall functions, system composition, etc. At the same time, learn some basic knowledge of pipeline design for launch support systems, such as the types, functions, and usage scenarios of commonly used valves. Specifically for each subsystem, it includes the main functions of the system, special valves and equipment, and other basic information. In this way, students will have the basic knowledge to design subsystems, laying the foundation for subsequent teaching.

4.3 Analysis of Subsystem Requirements

Requirement analysis is the first and indispensable step in all design. The premise of requirement analysis is a thorough understanding of the system's role, with the aim of transforming abstract role descriptions into more precise application scenario requirements. Students are required to conduct brainstorming in small groups, propose application scenarios for the subsystems, and engage in collective discussion and analysis while fully understanding the role of the subsystems, striving for comprehensive and accurate requirements analysis. Taking the water tank blowing system as an example, analyze its requirements as follows:

1) Before launching, a certain weight of seawater is stored in reserve;
2) After launching, the pre stored seawater is quickly blown out of the ship's hull.

4.4 Functional Design of Subsystems

After clarifying the subsystem requirements, design the subsystem functions corresponding to the requirements, and conduct collective discussion and analysis to verify whether the designed functions fully meet the requirements, striving for comprehensive and accurate functional design. Taking the water tank blowing system as an example, according to the aforementioned requirements, the system should have the following functions:

1) A water tank with a certain capacity and pressure capacity;

2) The seawater injection function of the water tank includes water injection, ventilation, water level detection, water level monitoring, pressure safety assurance, etc;

3) The seawater blowing function of the water tank includes gas supply, drainage, residual water detection, etc.

4.5 Functional Implementation Design

Based on clear functions, each team is responsible for one or several of them, utilizing their knowledge of hydraulic transmission, valve fundamentals, and other aspects to carry out specific functional implementation designs, mainly including the selection and preliminary arrangement of valve components. Note that only the selection of valve type is required here, such as globe valve, electro-hydraulic valve, etc., and specific design of valve parameters is not required.

Taking the seawater blowing function of the water tank blowing system as an example, the specific functions that need to be implemented include:

1) Supply air to the water tank;

2) Discharge the water from the water tank to the outside of the ship;

3) Real time detection of remaining water volume in the water tank.

For the gas supply function, the specific implementation components should at least include the following components:

1) Gas supply main shut-off valve. This valve is used to introduce high-pressure gas from the high-pressure gas main into the cabin, usually with 1-2 main shut-off valves installed throughout the cabin.

2) Blow off valve. For a specific water tank, a manual blow off valve should be installed, which is usually located on the water tank wall. In addition, to achieve automatic control, an electro-hydraulic valve should be installed, which is connected in series with the aforementioned manual valve.

Functional implementation design is the core link of the entire teaching process, and it is also the most difficult part that students feel. It requires students to work together, unite and cooperate, and teachers should provide appropriate guidance when necessary.

4.6 Analysis of Design Results

After the students complete the system function implementation design in groups, organize a collective discussion and analysis. Firstly, each group of students will introduce their design ideas and results, and then other groups of students will evaluate and discuss whether their design results are effective, comprehensive, and whether they have achieved the functions of the aforementioned design. Finally, each group will improve the design based on the feedback and suggestions provided by everyone, ensuring that the design functions are fully implemented.

4.7 Comparison and Analysis with Actual Systems

Compare the student designed plan with the actual system, analyze the differences, think about the reasons for the differences, and objectively evaluate them. If the actual system solution is more reasonable, then improve the student's design plan; If there are any unreasonable aspects in the actual system solution, summarize and propose further improvement suggestions for the actual system solution.

4.8 Evaluation Summary

Students summarize and reflect on the process of completing tasks, and complete self-evaluation and peer evaluation. Teachers evaluate and summarize the process of completing student tasks. The evaluation and summary process can also be carried out after class based on actual situations.

5 Issues to be Noted

Due to the reshaping of traditional classroom processes through the aforementioned teaching reforms, attention should be paid to the following issues in the specific implementation process.

5.1 Flexible Integration of Ideological and Political Elements, Implementation of Moral Education and Talent Cultivation

Course ideological and political education is an issue that must be addressed in all teaching forms of all courses. Compared to traditional lecture based teaching, curriculum teaching guided by system design tasks significantly reduces the amount of content taught by teachers, making it difficult to incorporate many ideological and political elements that are suitable for teaching. However, there are also aspects that are beneficial to the ideological and political education of the curriculum, such as unity and cooperation, collective honor, breakthrough and innovation required in the system design process, and valuable ideological and political elements such as critical thinking, objective rationality, humility and prudence required in the collective analysis and discussion process. Teachers should pay attention to flexible integration in the actual teaching process, and truly implement moral education.

5.2 Accurately Introduce Practical Examples and Implement Them for Military Education

In the comparative analysis stage, attention should be paid to using actual cases from the use and training of military equipment to verify the design ideas, so that students can truly feel the important impact of system design on practical combat. For example, a certain department once conducted a self check operation on an electro-hydraulic valve without closing it, which resulted in accidental entry of seawater into the pipeline, causing adverse consequences. This can confirm the significance of connecting manual valves in series outside the electro-hydraulic valve. Through such training, students will continuously strengthen their concept of thinking from the actual needs and combat requirements of the military.

5.3 Reasonably Control the Teaching Process and Ensure Teaching Efficiency

Compared to traditional teaching processes, the teaching process guided by system design tasks leaves more classroom time for students, but the difficulty of controlling the teaching process also increases. Teachers need to design the teaching process more carefully, effectively predict the factors that may affect the teaching process in each link, and develop effective contingency plans to ensure reasonable control of the teaching process and ensure teaching efficiency. If students may be hesitant and unsure of where to start for a long time during the functional implementation design phase, teachers should provide appropriate guidance. Teachers should fully understand the characteristics of students and make appropriate combinations of students with different characteristics when grouping, in order to help individual students drive the whole group and ensure that the progress of each group is relatively balanced, avoiding situations where individual groups progress significantly slower.

6 Conclusion

The course teaching mode guided by system design tasks fully embodies the teaching philosophy of "learning centered", which is conducive to mobilizing students' learning enthusiasm and improving learning effectiveness. But in the specific implementation process, attention should be paid to integrating ideological and political education into the curriculum, introducing practical examples, and controlling the teaching process. The above teaching design also has certain reference significance for the teaching reform of other equipment courses.

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