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Proposal for teaching reform of ship fluid mechanics

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ABSTRACT. *《Ship Fluid Mechanics》 is an important professional foundation course for ship and ocean engineering. Almost all subsequent courses related to ship principles and dynamic performance of offshore structures are based on it. It is a course of difficult and comprehensive knowledge according to students' reflection. Therefore, this paper aims to carry out reforms and attempts from the teaching methods to improve students' devotion and enthusiasm and make it easier for students to understand and master.*

KEYWORDS: *Ship fluid mechanics, teaching method, teaching reform*

1. Introduction

In the training program for undergraduate students majoring in ship and ocean engineering, "Ship Fluid Mechanics" is an important professional foundation course [1] and the basis for further study of ship principles and other courses. For a long time, due to the high conceptual abstraction and high mathematical foundation requirements, the ship fluid mechanics course is difficult to teach and difficult to learn. Ship fluid mechanics has the following basic characteristics [2]: the theories are closely related, the system is completed, highly logical and abstract. This course focuses on the basic equations of fluid mechanics and their applications, such as hydrostatic equations, differential equations of motion, Bernoulli equations, and N-S equations. Many students in the teaching process reflect the difficulty of the course, often with fear. Therefore, from the reality of the students, we propose a new concept to introduce the teaching reform content to improve students' interest in learning, hands-on ability, and innovation ability. The strategies include the arrangement of teaching content, the improvement of teaching methods, and the optimization of teaching means..

At present, the teaching of ship fluid mechanics faces four challenges. First, the discipline of fluid mechanics has entered a new period of development. The main features are that the analytical methods of fluid mechanics become more advanced,

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the ability to deal with flow problems is more powerful, and the understanding of fluid motion is more profound. The combination of fluid mechanics and engineering technology is no longer limited to simple cooperation between professions, but enters Multidisciplinary integration phases [3]. In order to adapt to these changes, the teaching system and content must be adjusted and updated accordingly. New research results need to be fully demonstrated by means of network means. Second, the compress of the class. Under the premise of ensuring the basic content and appropriately increasing the extended content, it is required to make the teaching content more scientific and reasonable. The narrative should be accurate, which is conducive to students' independent learning and can strengthen the various of auxiliary media forms. Third, with the development of information technology, current students are not investing enough in this course. The main features are poor preparations before class and poor participation in class. Students with poor grades do not even listen to class. Few students actively answer teachers' questions or take the initiative to ask questions to teachers. Sometimes they can only understand the course knowledge by asking other students. Plagiarism is often detected in the homework after class. The arrangement of assignments is generally for overall. There is no assignment for individual, leading to that students who are not active in learning frequently plagiarize the other students' homework. Fourth, the students' mathematics foundation is poor. The relevant basic mathematic knowledge is not solid. Besides, the levels of the students are uneven. It is difficult for the teacher to clearly realize the mathematics foundation of the students. Therefore it is difficult to accurately control the depth of teaching in explaining the equation derivation. While the interpretation is detailed, the teaching time is limited; while the interpretation is shallow, it is hard for some students to understand. Faced with these four challenges, it is necessary to make changes to the teaching methods of ship fluid mechanics and improve the teaching effectiveness. Therefore, this paper attempts to reform from the teaching method, improve students' devotion and enthusiasm for this course, and make it easier for students to understand and master the knowledge.

With the launch of the “Excellent Engineer Education and Training Program” by the Ministry of Education in 2010, aiming to focus on cultivating students' engineering and innovation capabilities, the institute has developed a training plan for the “Engineer of Excellence” program for ship and ocean engineering in accordance with the new requirements and developed the syllabus of the course. The "ship fluid mechanics" teaching content, the teaching methods and assessment methods are reformed to cultivate students' engineering ability.

2. Ideological plan of reformation

Optimize the teaching content, pay attention to the relationship between the previous and the following courses. The textbooks we selected are the classics commonly used by shipbuilding colleges in China. For instance, the “Fluid Mechanics” edited by Liang Zhang and Yunbo Li and published by Harbin Engineering University Press [4]. From the perspective of the entire teaching and training process, "ship fluid mechanics" is a course that inherits the past and the

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future. Our University optimizes the teaching content of the course according to the "Excellent Engineer Education and Training Program", and incorporates the matrix method and the finite element method of plane stress into the follow-up professional course "Design Method of Ship Structure". The aim is to guide students from the perspective of the whole professional knowledge development and fully understand the role and status of each course. Instead of learning each course in isolation, the courses are correlated, so that students can grasp the professional knowledge in the process of learning and will not forget immediately.

Simplify the process of lectures of complex derivation and proof. For complex formula derivation or proof, it is possible to focus on the analysis ideas and then directly give conclusions, encouraging students to self-learn after class according to their actual situation. For example, when explaining the series solution of rigid plate bending, the equation of the curved surface that tells the students that the four sides of the free support plate are curved can be written in the form of a double triangular series. The curved surface equation of the bending of a pair of free support plates adopts a single triangular series and then is substituted into the bending differential equations and use Fourier series expansion to solve the undetermined constants. The specific calculation process allows students to self-learn after class. In this way, the students can accurately grasp the idea of the series solution of the rigid plate bending, so as not to generate fear and avoid the frustration of learning confidence.

Closely combined with professional knowledge background and pay attention to induction and summary when teaching abstract mechanical analysis methods guiding students to closely combine professional knowledge and explain analytical methods in detail. For example, when the solution method is used to solve the problem of equally spaced continuous beams with rigid loads fixed at both ends, the student is reminded that the actual structure is the deck or bottom longitudinal of the ship structure, and then the mechanical analysis method is explained. At the same time, it is explained to the students that the design and calibration of the longitudinal bones in the project is based on this method. Usually, we need to pay attention to summarizing, and cultivate students' engineering concepts. After learning the stability of the pressure bar, remind students to note that in the analysis of longitudinal bone strength, the selected calculation model is a single-span beam with rigid fixation at each end. In the analysis of longitudinal stability, the calculation model is a single span beam that is freely supported at both ends in each span. Tell students about such an engineering concept that when the same object is in different problems, the calculation model is different. For example, when explaining the example of the rib cage, the calculation results of the bending moment at the ribs indicate that the rib strength check is considered safe regardless of the deck load. With this example, students are given an engineering concept: it is not a dangerous state that takes into account all the external loads that may be structurally affected.

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3.Reformation of teaching methods

Reasonable use of classroom teaching methods The use of blackboard and multimedia in the teaching process has been controversial. Reference [5] points out that both multimedia teaching and traditional blackboard teaching have their own advantages and disadvantages. It is recommended to adopt blackboard when explaining calculation and formula derivation. Reference [6] believes that the teaching of "fluid mechanics" should be based on multimedia and traditional teaching. At the beginning of the teaching process, all the board writing is used. The students have a good effect. First, the explanation can be combined with the blackboard, and the analysis methods and solving steps are explained step by step. Teachers and students can interact effectively; students can keep up with the progress of teaching without feeling tired. However, the time of using the blackboard writing has become very tense. In addition, the blackboard writing is not as good as the multimedia effect when introducing engineering background. In the end, we use a combination of multimedia teaching and traditional blackboard teaching. For the introduced engineering examples, multimedia pictures or animations can be used. Students can fully understand in a short period of time, while the traditional blackboard is used for specific analysis and solving process of mechanical problems. In this way, the effective combination of board and multimedia is achieved, and the teaching effect is improved. In addition to the blackboard and multimedia, I feel that the physical model is also very necessary. For example, when explaining the stability of a pressure bar, the teacher can put a simple single-span pressure bar presentation model on the podium and show the instability phenomenon in the process of pressure increase through the physical display pressure bar, which is more realistic than the use of blackboard or multimedia photos. Students can also operate themselves during the class. The teacher can work with the lab teacher to make some presentation models and encourage students to participate in the preparation of the classroom teaching model, which deepens not only the students' understanding of the problem but also the ability to exercise hands..

Use heuristic teaching methods. In the classroom teaching we take the engineering example as the entry point, take the “hull component”, “solving the problem”, and “solving method” as the main line, and adopts the heuristic classroom teaching. Introduce engineering examples at the beginning of each chapter, guide students to explore thinking through reasonable questions, promptly propose flexible and diverse thinking questions for important knowledge points, and stimulate students' positive thinking; explore different analysis of the same problem in the same problem to train the students’ divergent thinking.

Increase students' extracurricular engineering work. Select appropriate content from the completed research projects to provide exploratory extracurricular practice and develop students' engineering ability. Combined with the scientific research project "semi-submersible drilling platform pipe support hanger design" to set up extracurricular practice. The pipeline horizontal span calculation is simplified as a continuous beam model using the force theory for analysis. The steel frame structure

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design is simplified as a rigid frame force method or Displacement analysis. Combined with the "intensity analysis of hatch cover strength of super large ore sands", the extracurricular practice was established and the calculation of hatch cover strength was simplified to the analysis of the plate frame force. The calculation of the hatch cover stress was analyzed by the bending theory of the rigid plate. Actively encourage and guide students to use the theoretical knowledge they have learned to solve practical engineering problems.

Combination of theoretical and experimental teaching. The experimental course “Ship Fluid Structural Experiment”, which was established concurrently with “Ship Fluid Mechanics”, includes the bending experiment of the plate frame, the rigid frame, and the cylindrical bending experiment of the plate. The students use theoretical analysis methods to guide the experimental design, then compare the measured results with the experimental results. This not only consolidates the theoretical knowledge but also exercises the students' practical operation ability. In addition to these three prescribed experiments, students are encouraged to carry out comprehensive design experiments, design their own experimental content, formulate experimental programs, and complete the analysis of results after the experiment, so as to improve students' engineering ability and innovation ability.

Use the network teaching platform. "Ship Fluid Mechanics" has established a network learning platform for ship structural mechanics courses and a website for excellent courses. Students can simulate classroom learning, download learning materials (handouts, courseware, typical exercises, reference materials, etc.), online Q&A, learning exchanges to enable students to learn anytime and anywhere. Students can keep abreast of the key points and difficulties of the course and solve problems in the learning process in a timely manner.

4. Before the course

The total class hours of the "Ship Fluid Mechanics" course of Jiangsu Ocean University is 72 hours, of which 64 hours are theoretical teaching. Each class has 2 class hours and the theoretical lessons totally have 32 class hours. At present, the school's ship fluid mechanics is taught in small classes. The number of students in each class is about 30. Previously, students were required to prepare before class, but the performance revealed basically no preparation. Pre-study is very important for the course of marine fluid mechanics. Only after the pre-study, can the students have a basic understanding of the content that the teacher wants to talk about and find the knowledge points that they do not understand. Gradually understand through the teacher's explanation during the course. Only in this way can the students master the basic knowledge of the course. In order to improve students' devotion in ship fluid mechanics, all the teaching plans of this course will be sent to the students in the first class. Students can learn according to their own learning foundation and interests. In each class a student is assigned. The designated students need to prepare according to the content of each lesson in the lecture plan and give lectures when this part is taught. The presentation can be in the form of multimedia or blackboard writing. In general, the requirements for the presentation are as

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follows: the time should be restricted as 10 to 15 minutes; the sound should be loud, so that all the students in the class can clearly hear it; the writing should be neat, the PPT font size should be appropriate; explain what you think to be the key content; the student should not read the textbook; summarize the difficulties.

5. During the course

For a long time, the course "Ship Fluid Mechanics" has been mainly taught by teachers. However, from the assessment results, the results are not good and students' mastery of basic knowledge is not solid and comprehensive. During the class, few students actively answer questions raised by teachers or actively ask questions to teachers. Therefore, reform attempts are made for the class. Each lesson is divided into four parts: student explanation, classroom discussion, teacher explanation, and summary.

5.1 Student explanation

10 to 15 minutes. Through the student explanation, students could have a general understanding of the content of this class, equivalent to a pre-review with other students. The method also let the teacher realize the students' understanding of the content of the part, which is benefit for the teacher’s following explanations and supplement relevant knowledge points. The performance of student explanation accounts for 40% of the average grades at the end of the seminar.

5.2 Classroom discussion

10 to 15 minutes. According to the content of the student explanation and the difficulties that are summarized, one or two questions are raised for to examine whether the designated student understands and masters the knowledge points. For other students, 2 or 3 questions are raised for discussion. The students' responses are specified according to the student explanation and discussion performance to improve students' attention and enthusiasm. The performance of classroom discussion accounts for 20% of the average grades at the end of the seminar.

5.3 Teacher explanation

According to the student explanation and classroom discussions, the teacher combines with a certain development status and engineering background, make appropriate adjustments to the focus of the content, try to be easily understood, and strive to make each student understand the main points of the course. Only when the knowledge points are all understood, can the students master the knowledge points.

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5.4 Summary

Summarize the main contents of this lesson to further deepen students' impression and understanding of the main content.

6. After class

After class is a stage of the student's consolidation of the knowledge points, which is also important. Therefore, it is necessary to arrange the homework assignments in a targeted manner according to the situation of the students. The layout of the homework is mainly divided into three aspects. The first is for students who have different content points. According to the effect of the content explanation and the answer to the teacher's problem, the amount of work is appropriately increased or decreased. Reward and punishment means are employed to urge students to carefully prepare. The second is for students who answer questions. According to the accuracy of answers, the amount of homework is appropriately increased or decreased. Reward and punishment means are employed to urge students to prepare and listen carefully. The third is for other students. The work is arranged in a unified manner, and the amount of work can be determined according to the performance during the class. Fourth, the completion of homework after class accounts for 30% of the usual results at the end of the seminar.

7. Conclusion

According to the requirements of the "Excellent Engineer Education and Training Program" that aims to train engineering talents, the "Ship Fluid Mechanics" course has been reformed from various aspects such as teaching content, teaching methods, and assessment methods. Good results are expected to be achieved. However, the "Ship Fluid Mechanics" curriculum reform is a process of continuous improvement, supplement, and improvement. Therefore, we will continue to explore and summarize.

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