

# *The Teaching Reform of Course “Ship Resistance and Propulsion”*

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**Abstract:** In the class teaching of the “Ship Resistance and Propulsion” course, we reserved some after-school practice content for students to improve their hands-on ability and innovation ability. Through the "flipped classroom", students showed their learning results, expressed their views, and the absorption of knowledge points was promoted in discussions and exchanges. Thus, the in-depth reform of teaching strategies was accomplished, the quality of teaching was improved, and the enthusiasm, initiative and innovation of students in the classroom was activated.

## 1. Introduction

Due to the development and advancement of technology, students today are faced with more choices in terms of learning resources. The network resources they can choose may come from Bilibili, Mooc, and teaching websites built by various colleges. In the offline classroom, if the teachers' teaching methods is conformity, or the teaching mode is boring, they cannot grasp the students' enthusiasm, leading to a poor performance for the students in the classroom. In order to improve students' learning initiative and enthusiasm, the reform of course content and teaching methods is particularly important.

In this regard, many teachers have shared their teaching experience. Carolyn[1] pointed out that the effectiveness of teaching reform efforts depends to a large extent on teachers, emphasizing the need for teachers to continue to carry out teaching reform. Dongdong Zhang[2] proposed the reform of the teaching mode of computer majors oriented by engineering ability training, and established a new computer course teaching system through the combination of hardware and software. LiSha Gao[3] proposed the exploration and practice of flipped classroom based on micro-teaching assistants, and established the basic teaching concept of "student-centered" and "personalized education". Yue Chen[4] applied the flipped classroom teaching mode in the course teaching of “Ship Design Principles” , which achieved good teaching results, this teaching mode was also validated in the course “Ship safety and Management”[5] . Flipped classroom is a teaching mode of "student-centered" and teachers are served as an assistant. In this teaching mode, students actively show their learning and understanding of the course, and the teacher supplements the students' deficiencies according to their discussion. The discussion session deepens the acquired knowledge. In this teaching process, the communication and exchange between teachers and students make the

explanation of knowledge points more clear and interesting. In this study, we will also adopt this teaching mode, combined with the practical link of the course, to carry out teaching reform, in order to achieve the desired teaching effect.

## **2. Course description**

"Ship Resistance and Propulsion" is one of the important professional courses of ship engineering, and is a necessary systematic professional knowledge for ship design, production and scientific research. It consists of two parts: Ship Resistance and Ship Propulsion. Through the classroom teaching of "Ship resistance", students are trained to deeply and systematically understand the influence of ship shape on resistance, and the method of resistance calculation. Through the classroom teaching of "Marine Propulsion", students are trained to have a deep understanding of the working principle of propeller and the influence of major factors on propeller performance, and be capable to analyze and solve problems in the use of propeller[6]. This course are equipped with corresponding experimental courses. Through the towing experiment of ship model, students can understand the measurement of resistance. They can develop their practical ability and master the formation mechanism of resistance. However, the number of students participating in the operation of the towing experiment is small, and the experiment is relatively complex, which leads to the problem that students are lack of practice, application and innovation ability. Thus, it is of great importance to reform the class teaching, and increase the practical content in the teaching.

## **3. Reform of the teaching**

### **3.1. Measures of teaching reform**

The theoretical class hours of "Ship Resistance and Propulsion Course" total 48 hours. The original teaching mode is "teacher centered", and classroom questions and interactions are centered on theoretical knowledge points. This mode cannot cultivate students' interest on the course. The initiative and understanding of classroom knowledge is not enough, which leads to a poor teaching feedback. In order to effectively stimulate students' understanding of the teaching content, practical links and thematic discussion courses concentrating on practical projects are set up in class according to the teaching schedule. Before class, students are requested to make ship models and record videos in advance according to the practical content, and record some questions and puzzles in the process. Flipped classroom is applied for discussion in class. The content of the thematic discussion was also gradually deepened. Under the design of this teaching mode, passive learning is transformed into active learning, which stimulates students' subjective initiative, brings students into the situation, and encourages students to actively seek answers to questions.

### **3.2. Content and requirement of practice**

The experimental course was arranged in the teaching process of ship resistance. The specific requirements are as follows:

There are 70 students in the class, they are divided into 7 groups with 10 students in each group. Students in the same group collaborate in the work of video editing, cost accounting, PPT making, PPT report, OAR purchase and so on.

Each student uses waste materials to make small boat models (cans, water bottles, wood, plastic pipes, paper tubes, cardboard paper, foam, etc.). Each group of 10 student uses the same OAR. You can buy one or more OARS for each group, but not necessarily 10 OARS. After the test of one boat

model is completed, it is necessary to take photos and videos of the boat model during the test. Make a speed record, compare the speed of 10 ship models in this group, and analyze the reasons.

Each group submits one video within 60 seconds and one PPT. The presentation time in the flipped classroom is 10-13 minutes, and the contents of the presentation are listed as follows:

(1) Picture of each student's ship model (ship model marked with name in appropriate position), description of material selection and cost. It is necessary to pay attention to cost control, the small tools and propellers bought for making ship model are within the cost range.

(2) Video playback;

(3) Compare the speed of the ship models of the students in this group. Make a comparison chart, for example, take time as the ordinate and list the distance of each ship in a straight line as the ordinate for comparison.

(4) Result analysis, explain which ship model has the fastest speed and the least resistance, and give the reason analysis (this part can be read about the content of influencing factors of ship resistance);

(5) Improvement measures (not necessary, if there are improvement measures, explain; if there are no improvement measures, there is no need to report this).



(6) Other content that should be reported.

## 4. Demonstration of practical results

### 4.1. Practical results

The flipped classroom model was adopted for the students to present their practical results. One student from each group was selected to explain clearly the cost of each group, the speed test results of each ship model and the comparative analysis of speed. Five ship models from one group were taken as an example to express their practical results. Most of the ship models in this group were made of mineral water bottles and milk cartons, and one of them was made of insulation film and cardboard. Table 1 shows the pictures and parameters of the models, and Fig.1-3 shows the sailing pictures of ship models No.3, No.4 and No.5.

Table 1: Pictures and parameters of the ship model

| Number of the ship model | Picture of the ship model                                                           | Parameters of the ship model                                    |
|--------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 1                        |  | Length: 24cm<br>Breadth: 14cm<br>Height: 7cm<br>Mass: 0.15kg    |
| 2                        |  | Length: 20cm<br>Breadth: 17.5cm<br>Height: 7.5cm<br>Mass: 0.2kg |


|   |                                                                                   |                                                                    |
|---|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|
| 3 |  | Length: 22.5cm<br>Breadth: 13.5cm<br>Height: 6cm<br>Mass: 0.1kg    |
| 4 |  | Length: 22.2cm<br>Breadth: 18.4cm<br>Height: 5.9cm<br>Mass: 0.13kg |
| 5 |  | Length: 22cm<br>Breadth: 23cm<br>Height: 6.3cm<br>Mass: 0.2kg      |



Figure 1: A screenshot of the Model 3 sailing video

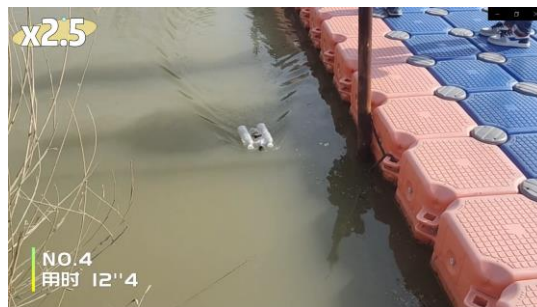


Figure 2: A screenshot of the Model 4 sailing video



Figure 3: A screenshot of the Model 5 sailing video

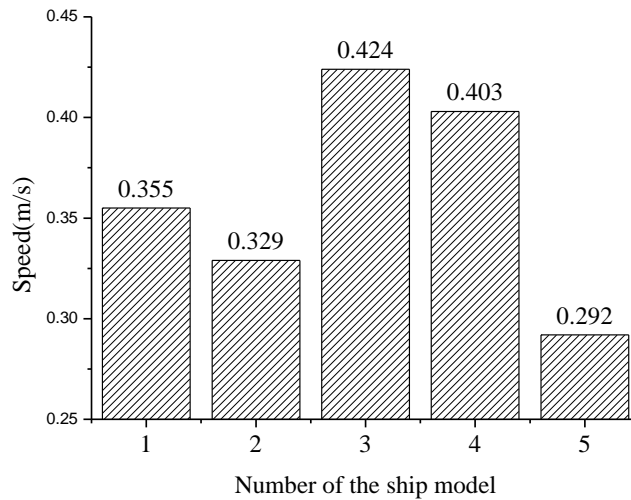


Figure 4: Speed comparison of the five models

Through the students' summary, they found that the speed of the N0.3 ship model was faster than other ship models, and they pointed out in the flipped classroom presentation that the No. 3 ship model is the lightest in weight and has the best shape, so the resistance performance of the No.3 ship model is the best. They also calculated the Froude numbers of the five ship models, and the results showed that the Froude numbers of these ship models were around 0.3, which belonged to medium and high-speed ships. Additionally, they analyzed the ship shape characteristics of No.5 ship model which had the slowest speed, and pointed out that the main reason affecting its speed was the large wet area, which increased frictional resistance, and the hull line shape was not smooth enough.

#### 4.2. Class discussion

After each group of students reported, according to the results of each group of ship model tests, students discussed and summarized the main factors affecting the speed of the ship model, as well as the follow-up improvement measures. The students discussed very intensely and put forward many excellent ideas to further increase the speed of the ship model. It can be seen that this practice has given everyone a very deep understanding of the factors that affect the resistance of the ship model. The process is interesting and interactive, and the enthusiasm of students to participate in the practice is very high. This form of practice can greatly improve the teaching effect.

#### 5. Conclusion

This practice is very necessary to improve the teaching quality of the course "Ship Resistance and Propulsion". This teaching mode will be implemented in class in the later stage, and continuous improvement will be made according to the actual teaching effect, and the teaching effect of the class will be summarized and feedback. Through a round of practice and improvement, the teaching mode will be solidified and the teaching experience will be formed, which will be promoted and applied in the practice of other relevant courses of this major to form characteristics and make contributions to the improvement of teaching quality.

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