Exploration on the Course Construction of Ocean Optics

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ABSTRACT

Ocean optics discusses the light transmission in seawater, which is a specialty course combining optics and ocean study, and the core course of relevant professional directions. This paper introduces its learning goal and contents. Meanwhile, it also discusses adding study project lecture series and investigating study to realize scientific research back feeding traditional learning. This would further inspire students' interest, cultivate students' innovation and practice ability, and enable them to lay a solid foundation of professional theory.

Keywords: Ocean optics, course construction, specialty course

1. INTRODUCTION

With the development of globalization, the strategic position of ocean in the construction of social economy is becoming more and more significant. Recently, ocean scientific research has become a hot research area in China. Ocean University of China is a famous university with the characteristics of ocean research, where, ocean optics, as one ocean specialty course with the combination of optics and ocean research, is the core course of the optical related major.

Ocean optics studies the light transmission in seawater, the optical properties of seawater, the light propagation rules in ocean and the use of optical technology to detect the ocean etc [1, 2]. It is one branch of optics, and also a cross subject of optics and oceanography, which has great significance on ocean ecological environment, ocean physical process and global climate change research [3]. However, for optical related major, ocean optics course is a young one comparing with traditional core courses such as geometrical optics and physical optics. This means it should have broad development space, and the course construction work should be of great significance for the development of optical related major.

2. LEARNING GOAL AND CONTENTS

Ocean optics learning goal is to face senior students in optical related major, to teach them basic optical theory knowledge in ocean, and to cultivate talents in the field of ocean optics. Specifically, it makes students grasp the commonly basic concepts in ocean optics, optical properties of seawater and basic radiative transfer theory of light in seawater. And meanwhile, it makes them to know about the inversion methods of ocean optics, the application of ocean optics in cross subject

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study.

Ocean optics focuses on the entire light transmission process in seawater, and therefore, the theory of ocean radiation transmission is core [4]. Its basic physical parameters are based on photometry and radiology. As transmission medium of light, seawater contains complex ingredients such as suspended particulate matter, phytoplankton and colored dissolved organic matter etc., which all have affection on light absorption and scattering, and thus affect ocean optical properties. Surely, ocean optics is a course inseparable from application and practice. Through the practice task arrangement, let students think actively, operate personally, deepen the understanding of important knowledge points. Therefore, this course is to strengthen the foundation of knowledge by theory learning, and to deepen understanding by practice training. It includes 32 hours theory learning and 16 hours practice teaching. Table 1 below shows the basic theory learning content and its corresponding practice training, where, the main contents are seawater composition, optical properties, the radiation transfer theory and the inversion problems of ocean optics.

Table 1 Content of ocean optics course

Theory learning	Practice training
Basic concepts of ocean optics	
Seawater composition and optical properties	Pretreatment of field spectrum data
Radiation transfer theory	Light field simulation in seawater
The inversion problems of ocean optics	Ocean color satellite product processing and classical inversion algorithm implementation
Seawater visibility and underwater imaging etc.	

When learning theory, teachers need to realize that, as a professional course, students usually know little about ocean optics before starting this course, and therefore, we should pay more attention to enriching learning means, and helping students to understand ocean optical knowledge structure faster. Normally, optics courses are suitable for the usage of multimedia animation courseware, and ocean optics is no exception, but related resources are insufficient. Thus, we would make the multimedia courseware of vivid animation based on teaching content and students' actual situation. And meanwhile, we would introduce professional ocean optical simulation software to improve the understanding of the abstract radiative transfer theory of ocean optics.

3. EXPLORATION OF RESEARCH PROJECT LECTURE SERIES

As ocean optics is interdisciplinary, which covers extensive research field, it will help to broaden the students' knowledge and vision field, to mobilize students' study enthusiasm greatly if related scientific research project lecture series is involved. The lectures will be given by invited professional mentors, who would explain related technical knowledge for students combining with their own scientific research projects, the latest research results and the international research

performance etc. The introduction of specific scientific research work would effectively stimulate students' learning enthusiasm and promote students to better grasp ocean optics theory. The topics choose of the research series would consider not only classic projects, but also latest ones. The theme of the scientific lecture series and its link to ocean optics learning is shown in table 2.

Table 2 Research project lecture series

Lecture theme	Link to ocean optics learning
Instruments and technology of ocean optics field measurement	Introduction of field measuring instruments and its operation specifications, such as earth object spectrometer, profile spectrometer and ACS, to promote the understanding of ocean optics properties.
Overview of ocean color satellite remote sensing	Interpretation of ocean color satellite remote sensing mechanism and main ocean color satellite remote sensing related such as MODIS and GOCI, to make students realize the important application value of ocean optics in ocean color remote sensing research field.
Overview of the inversion method about inherent optical properties and apparent optical properties	Introduction of main statistical experience algorithms and semi-analysis algorithms to respond to "the inversion of ocean optics"
Overview of ocean atmosphere correction method	In the process of satellite remote sensing, atmosphere significantly interferes the detection of water leaving radiation. And therefore, the atmosphere correction is an important part of ocean color remote sensing, and this part is the extension of ocean optics course content.
Optical remote sensing monitoring of ocean ecological hazards such as red tide and green tide	Through the introduction of optical remote sensing detection method and status quo, such as red tide, green tide and so on, it is better to show the application value of ocean optics course

At the same time, along with the rapid development of computer and its wide application in education, we can put lectures made into a set of words, pictures, music, animation of the electronic lesson plans, make full use of multimedia teaching means, and achieve better learning effect. In addition, if some students want to learn more other projects, we can continuously adjust project topics as well. And students are encouraged to ask experts directly for interested questions to make the class full of vitality.

4. IMPLEMENTATION OF INVESTIGATING STUDY

The traditional learning method is mainly in the classroom, put too much emphasis on the teaching and grasping of knowledge. As for college courses, especially professional courses, this teaching form lacks of the cultivation of student's learning method and ability, and students lose the freedom space of thinking a lot, which is not conducive for the students to join social work in future. Investigating study is a kind of learning activity that refers to students' active exploration,

which is a kind of learning concept, strategy and method to be widely applied in the study of every subject.

In ocean optics course, students can choose and identify study topics per their own interest under the guidance of teachers, which is similar to the way of scientific research acquiring knowledge actively, applying knowledge into problem solution in research project and completing project goal. By the execution of investigating study, we can make up for the disadvantages of traditional teaching, and cultivate students' innovative spirit and practical ability.

During concrete implementation, the study is divided into four phases: topic selection, data collection, investigating actual execution and achievement exhibition. In the topic selection phase, teacher guides students to know about the study method and the way to carry out the study, and makes their respective study subjects clear. This process can be combined with the study paper achievements of former students and respectively recommend examples per different types (proposed study subjects are listed in table 3). A perceptual understanding on study subjects can help students understand the study methods and strategies. During the data collection phase, teacher uses about a week to guide students to gather relevant information and to further clarify the subjects via the Internet and books. In the investigating actual execution phase, teacher pays more attention to the timely guidance of study methods, frequently discusses with students to make them learn how to read and analyze questions from various views, to make them find core questions, and to inspire their motivation of active study. And also, teacher guides students to make dedicated study plan and scheme and to execute actual study work. In the phase of achievement exhibition, the achieved results of study subjects are shown up in form of class reply.

Table 3 Proposed main study subjects

No.	subjects
1	Ocean optical properties and the temporal-spatial distribution characteristics in typical sea areas
2	The radiative transfer simulation based on Hydrolight
3	The accuracy inspection of ocean color satellite remote sensing products
4	The study of ocean color composition inversion in complex seawater

Since the investigating study requires related research questions as carrier, teacher has to dig and think thoroughly, discuss more with students on the uncertainty of questions and the limitations of existing methods. This makes the original closed study content a bit open, and creates environment of investigating study for students. At the same time, to better promote the implementation of investigating study, students can be divided into several groups, which requires cooperation of group members, and this would inspire more mutual discussion among members to motivate them do better.

5. CONCLUSION

Ocean optics is a specialty core course for senior students majoring in optics related directions, which focuses on the study of light transmission in seawater and cultivates talents in the field of ocean optics. This paper introduces the learning goal and contents of ocean optics. Theory and practice is combined in the study of ocean optics course, the theory learning is to strengthen basic

knowledge, and the practice training is to deepen understanding. It also discusses adding study project lecture series and investigating study to realize scientific research back feeding traditional learning. This would further inspire students' interest, cultivate students' innovation and practice ability, and enable them to lay a solid foundation of professional theory.

REFERENCES

[1] Pan Delu, Li Yan. The development of marine optical remote sensing and the frontiers [J]. Engineering Science, 2003, 5(3): 39-43.

[2] Pan Delu, Wang Difeng. Advance in the science of marine optical remote sensing application in China [J]. Advance in Earth Science, 2004, 19(4): 506-512.

[3] Lu Jinnan. A unique branch of optics: ocean optics. Modern Physics [J], 2010, (5):24-28.

[4] Tang Junwu. The simulation of marine optical properties and color sensing models [D]. Beijing: Institute of Remote Sensing Application Chinese Academy of Sciences, 1999.