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Research Article

Analysis of the Learning-oriented Teaching of Masters in Water Conservancy Engineering

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Abstract

Closely adhering to the principle and teaching link of the learning-oriented teaching method, the teaching process of the master's "prompt, self-study, suspicious, intensive, drill, summary" is proposed, and it is introduced into the teaching of the master's degree in hydraulic engineering. Through the implementation and application of the graduate students of the 16th and 17th grade hydraulic engineering majors, remarkable results have been achieved.

Keywords

Learning-Oriented Teaching Method • Hydraulic Engineering • Master's Degree • Teaching • Practice

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Postgraduate education is an important stage in the training of senior talents. Research ability is an important indicator to measure the quality of graduate education. Course teaching is the foundation of postgraduate education. The curriculum teaching of graduate students is not only simple knowledge learning and inheritance, but also focuses on research and innovation, accumulating professional knowledge and improving professional quality for follow-up postgraduate research activities (Jiang *et al*., 2018; Dai and Wang, 2018; Wu and Dong, 2017). At present, At present, there is a simple extension of undergraduate knowledge in postgraduate education in China. There are still many similar courses at the undergraduate level in the postgraduate stage. The actual teaching content is only extended from shallow to deep. The teaching method is similar to that of the undergraduate course. Usually lectured in the classroom, supplemented by discussion. Looking at the postgraduate training model of famous universities in foreign countries is more based on the independent and free educational concept. The interaction between "teaching" and "learning" is very strong. The teachers and students are not a constant teacher-student relationship, but there is a dynamic role exchange. Enable students to integrate multidisciplinary knowledge in analyzing and solving problems (Lederman, 2010; Han, 2017; Zheng, 2001; Wyiie, 2010). Using the learning-oriented teaching method, students can deeply understand and master the theoretical knowledge, greatly stimulate students' self-study and research interest, and achieve very good teaching results. Through the introduction and implementation of the "learning-oriented" teaching method for the graduate students of the 16th and 17th grade water conservancy projects of North China University of Water Resources and Hydropower, it can be found that "learning-oriented" teaching can greatly enhance students' enthusiasm and initiative, stimulate students' self-study potential, enhance students' comprehensive ability and practical application level, and improve teaching quality.

Professional Introduction

Master of Water Conservancy Engineering has solid theoretical knowledge and professional skills (Shi *et al*., 2012; Shangguan *et al*., 2017), understands the history of water conservancy projects and the development trend of international water conservancy projects. The master of water conservancy engineering is a high-level engineering and engineering management talent with a certain sense of innovation. They have solid theoretical knowledge and professional skills, understand the history of water conservancy projects and the development trend of international water conservancy projects. They can use advanced technologies such as resource optimization configuration, sustainable development, information and computer technology to solve the problems of water conservancy project planning, surveying, design, construction, management, technical research and other issues.

The discipline of water conservancy engineering of North China University of Water Resources and Hydropower was founded in 1951. It was granted the master's degree in 1978 and the doctoral degree in 2013. It is a key discipline of Henan Province.

For many years, the discipline has insisted on the research of hydrology and water resources, hydraulics and river dynamics, hydraulic structure engineering, port and coastal engineering, urban water engineering and management under the background of water conservancy engineering construction, efficient utilization of water resources and water ecology and water environment management. It has distinct characteristics in water

resources optimal allocation and safety management, water and sediment River regulation, hydraulic structure optimal design theory and new construction technology, water disaster prevention and restoration, Urban Affairs Engineering and water ecological civilization, etc. There are 80 members in the water conservancy engineering discipline, including 27 professors, 30 associate professors, 60 doctoral degree personnel, 1 special professor in Henan Province, 2 provincial outstanding experts, and 1 new century innovative talent in the Ministry of Education, 3 academic and technical leaders in Henan Province. The discipline has 2 academician workstations. They employ Academician Wang Guangqian and Academician Xia Jun of the Chinese Academy of Sciences; Academician Wang Hao and Academician Wang Fuming of the Chinese Academy of Engineering are specially appointed academicians to guide the discipline work.

Training objectives

Cultivate high-level engineering and engineering management talents who master the solid theoretical foundation and systematic expertise of the discipline, understand the scientific frontiers and development trends of the hydraulic engineering discipline, have basic knowledge and expertise with the appropriate subject direction, have the comprehensive ability to undertake scientific research tasks in the direction of the subject and solve complex technical problems in the direction of the subject , have a certain sense of innovation.

Specific requirements include: (1) Mastering the basic theory and professional knowledge of natural science, social science and engineering technology required by the corresponding professional direction of water engineering discipline. Possessing the professional skills of theoretical analysis, numerical computer test, etc. Having a strong interest in the direction of the major, and be able to find, recognize and solve problems. Having the ability to undertake scientific research, design, construction, technological innovation and promotion in the corresponding professional direction. Having a certain sense of innovation and innovation ability. (2) Mastering a foreign language. Being able to read professional literature and write scientific papers skilfully. Having a certain ability to listen and speak. (3) Physical and mental health, law-abiding, good academic ethics, consciously safeguarding academic integrity, and abide by academic norms.

Academic literacy and academic ability requirements

The academic literacy of a master's degree in water conservancy engineering includes: Mastering the basic theories and expertise of natural sciences, social sciences and engineering techniques required by the discipline of water conservancy engineering; professional skills in theoretical analysis, numerical computer and experimentation; strong interest in water science; ability to identify problems, recognize problems and solve problems; engaging in water conservancy engineering design, construction, technological innovation and promotion; compliance with laws and regulations, good academic ethics, consciously safeguarding academic integrity, abide by academic norms, strictly obey the state's laws and regulations on intellectual property rights and classified management.

The basic academic abilities of a master's degree in water engineering include: (1) Continuous learning ability. Ability to continue learning, through course learning, special lectures, academic discussions, literature reading and engineering practice, to learn new knowledge, new methods and new skills needed to promote the development of disciplines and engineering practice. (2) Scientific research capabilities. Fully understand the systemic and complex nature of water conservancy engineering disciplines, master basic research methods such as theoretical analysis, numerical calculation and experimental measurement, understand the development of the frontiers of disciplines, have a certain sense of innovation and innovation ability, can put forward new problems and solve problems. (3) Engineering practice ability. By participating in scientific research practice, teaching practice, production practice and other activities, cultivate practical capabilities such as survey, investigation, planning, design, technology development and production management with strong adaptability. (4) Academic communication skills. Good academic communication skills, including written communication skills (writing research plans, work reports and academic papers), verbal skills (for academic reports, presentations, technical defences etc.) and communication and collaboration skills. Have at least one foreign language and be able to use a foreign language for basic academic communication. (5) Teamwork ability. Have a good overall situation, hard work, good at development, good at cooperation. Love water conservancy, have a strong sense of national identity, social responsibility and historical mission.

Training mode

The postgraduate training adopts the guidance of tutors, the combination of tutors and subject group training. The emphasis on the overall advantages of the disciplines in the intermediate links to improve the overall quality of students. The tutor is fully concerned about the political thinking, business study and physical health of graduate students. Through the words and deeds, the graduate students' research ability and personality cultivation are simultaneously improved.

Curriculum

The master's degree program of water conservancy engineering is divided into two parts, the degree course and the non-degree course. In addition to the course study, there are also part of the practice link.

Degree programs include public compulsory courses, basic theory courses and professional basic courses. Among them, the public compulsory courses are for the whole school, the basic theory courses and professional basic courses are selected by the students under the guidance of the instructors in combination with the subject research direction. Requiring a total of no less than 17 credits for the degree program, 4 credits for the practice session, and no less than 36 credits for the total credits.

The main courses include: numerical analysis, mathematical statistics, water resources system analysis, river dynamics, advanced fluid mechanics, elastoplastic mechanics, structural dynamics, ecological hydrology, environmental water science, GIS and its applications, finite element and its program design, Matlab and its

application, reservoir optimization scheduling, hydrogeology, water environment assessment and protection, advanced hydraulic structure, higher soil mechanics, hydraulic structure seismic analysis, computational fluid dynamics, hydraulic simulation, engineering sediment.

"Learning-guided" Teaching Method

Introduction

The "learning-based" teaching method is a heuristic teaching model that has emerged at home and abroad in recent years (Guo, 2009; Qi *et al*., 2015; Kong *et al*., 2018). Its main idea inherits the "discovery method" teaching method proposed by the famous American educator and psychologist Jerome Sey-mour Bruner in the 1960s. "Learning-guided" teaching method is a teaching method which takes the overall development of students' intelligence and the improvement of students' comprehensive quality as the main line of teaching activities, takes the stimulation of students' self-learning ability, creativity and exploratory as the goal and runs through the whole process of classroom teaching. The traditional teaching system and method emphasizes and highlights the role of teachers one-sidedly. Students are passively accepted under the instillation of teachers' own knowledge, ignoring the main role of students in the process of knowledge acquisition. On the one hand, the "learning-oriented" teaching method inherits the advantages of the traditional teaching method, on the other hand, it further optimizes the position of teachers and students in the teaching process. It emphasizes guiding students to acquire knowledge on their own initiative, putting students'exploratory cognition in the main position of the whole teaching process. Together with the guidance and instructions of the teachers, the students' self-study and exploration ability are promoted by the situation so that both sides of teaching can do their best and get their own way.

Main features

The characteristics of the "learning-oriented" teaching method are mainly as follows:

First, the main body of the teaching process is changed from a teacher to a student, highlighting the position and role of students in the bilateral activities of teaching. Second, shifting the focus of teaching from a teacher to a student to learn independently.

It requires teachers to master the teaching materials in the preparation of the previous period, improves the efficiency of the classroom, guides students reasonably based on the characteristics of students to avoid detours during self-study. Third, visualize and materialize the abstract, boring content in books with examples to improve students' interest in learning , enhance students' understanding of key points and difficulties. Fourth, mobilizing the enthusiasm of students' thinking and exploring their potential by stimulating students' self-learning ability, enhancing the gains of exploration and discovery.

Teaching process

The teaching process of the "learning-oriented" teaching method can be summarized as six steps: prompting, self-study, suspiciousness, introductory, drill, and summary. The teaching process is as follows:

First, prompt. Including teachers reminding students to preview the content of the proposed lecture, revealing it before class, proposing the content and tasks of the lecture, stimulating students' interest and enthusiasm in learning.

Second, self-study. Including students' self-study before class, pre-training and self-study after the teacher's prompts. Students learn about the main content, discover problems and doubt through self-study and pre-reading.

Third, dispelling doubts. The teacher guides the students to discuss with each other or direct counseling to answer questions by asking questions.

Fourth, speak carefully. Teachers summarize the content of this lesson, analyze the key and difficult points of the textbook, give detailed explanation, induction and demonstration.

Fifth, drill., teachers should put forward problems in view of the key and difficult points It is better to combine engineering examples to let students practice, analyze and summarize repeatedly with theoretical knowledge in class and after class so as to increase students' understanding of key and difficult points and to train students' ability to solve practical problems.

Sixth, summary. Teachers evaluate the students' learning situation, review the main contents of this course and summarize the key points, clarify what needs to be mastered, and arrange homework after class and the requirements of the next lesson.

Self-study, intensive lectures and drills are the main links in the "learning-oriented" teaching process, while the prompts, disambiguation, and summary are auxiliary links. Each step is interlocked. The following is an example of the professional basic course "Ecological Hydrology" in the teaching of water resources engineering master's degree course, which analyzes and designs the teaching process and practice of "study-oriented" teaching.

"Learning-guided" Teaching for Masters of Water Conservancy Engineering

Design of Learning-Guided Teaching

In the process of teaching the implementation of "Ecological Hydrology", teachers play a guiding role. They should design specific teaching processes and links according to the content of teaching materials (Xia, 2018; Yang *et al*., 2016). The textbook "Ecological Hydrology" used by our school is David Harper, Maciej Zalewski, translated by Yan Denghua, Qin Tianling, published by China Water Resources and Hydropower. Based on an overview of the origin, scientific background and fields of ecological hydrology, this textbook analyzes the main ecological hydrological processes of watersheds, aquatic vegetation and animal communities. Facing the

integrated management of water resources and rivers and lakes, the case of eco-hydrological simulation is analyzed. It introduces the research system of paleo-ecohydrology and expounds the present situation and future development trend of eco-hydrology (Liu *et al*., 2011; Shen *et al*., 2016; Zhao, 2009). The main contents include: the rise and research of ecological hydrology, the ecological hydrological pattern and key processes of the river basin, the process and effect of nutrient transfer and transformation, the ecological process of river aquatic vegetation community, the impact of ecological hydrological processes on aquatic fauna, and ecological hydrological simulation, the effectiveness and risks of ecological hydrological models, river ecological hydrology management, paleoecological hydrology, ecological hydrology status and future development.

The course of Eco-hydrology is mainly offered in the Water Conservancy College of our university. The teaching task is undertaken by the professional teachers of hydrology and water resources. The major subjects of the course include hydrology and water resources, hydraulics and river dynamics, agricultural water and soil engineering, port and coastal engineering, water conservancy and Hydropower engineering, engineering management, etc. The course is set for 40 hours, for a total of 10 weeks, 2 lessons per week, each time for 100 minutes. According to the basic process and procedure of "learning-oriented" teaching, the teaching practice of "Ecological Hydrology" can be designed as: 5 minutes for teachers to guide, 25 minutes for students to self-learn, 15 minutes for teachers to solve doubts, and 30 minutes for teachers to speak. Student class discussion for 15 minutes, teacher summary for 10 minutes. Ecological hydrology is a comprehensive course with strong cross-cutting. Its knowledge points are scattered, covering a wide range. It combines with practice. Students need certain basic professional knowledge in learning this course. Therefore, appropriate adjustments can be made according to different contents in specific chapters.

First, a chapter that is general and inductive. For example, Chapter 1, the rise, scientific background and research scope of eco-hydrology, mainly introduces the proposition, research content, development goal and direction of the subject of eco-hydrology. This part of the content mainly focuses on the elaboration, it has strong logicality. The focus of teaching should be placed on the teacher's lecture which is conducive to let students understand the status and development of the "ecological hydrology", the main content of the research, what problems to solve. Professional teachers can guide students to think and analyze some problems of water resources and water ecology in order to promote students' interest in Eco-hydrology when summarizing the current situation, practical problems and solutions of water resources and water ecology in China. Therefore, this part of the "learning-guided" teaching design focuses on strengthening the teacher's "granting" and "speaking", totaling 2 hours. The teaching process includes 10 minutes of guidance and revelation, 60 minutes of intensive lecture by teachers, 20 minutes of classroom discussion by students and 10 minutes of summary by teachers.

Second, the chapters based on basic concepts, principles, and methods. For example, Chapter 2-5,9,14-15. Chapter 2: Ecological and hydrological patterns and key processes in the basin, mainly introducing hydrological patterns, runoff, runoff mechanisms, river processes and types, and quantification of watershed processes. Chapter 3: Nutrient migration and transformation processes and effects, mainly introduces the process of migration and transformation of nutrients such as phosphorus and nitrogen. Chapter 4: Ecological processes of river aquatic vegetation communities, mainly introducing the mechanism of coupling between climate, vegetation, soil and hydrology. Chapter 5: The impact of ecological hydrological processes on aquatic fauna,

mainly introducing the mechanism of coupling between aquatic vegetation in rivers and hydrology of river ecosystems. Chapter 9: Eco-hydrology of the savanna system, mainly introducing the hydrological process of the savannah ecosystem. Chapter 14: Paleoecological Hydrology——Understanding the Status Quo and Predicting the Foundation of the Future, introducing the hot topics and future continuous research hotspots of ecohydrology at the present stage. Chapter 15: Ecological Hydrology - global change affects the status quo and future development, mainly introducing climate change trends, Eco-Hydrological processes driven by climate change. These contents are relatively broad and easy for students to understand, but they require students to collect more extracurricular knowledge. Therefore, in the teaching design, we should give priority to " introduction " and "guiding". The teaching design is 12 hours, 2 in Chapter 2, 2 in Chapter 3, 2 in Chapter 4, 2 in Chapter 5, 2 in Chapter 9, 1 in Chapter l4, 1 in Chapter 15. The teaching process is designed as: 5 minutes for teachers to guide, 30 minutes for students to self-learn, 15 minutes for teachers to solve doubts, 20 minutes for teachers, 20 minutes for students to discuss, 10 minutes for teachers.

Third, the chapters based on theoretical analysis, numerical calculations, and model introduction. For example, Chapter 6-8, 10-13. Chapter 6: Ecological and hydrological simulation of water-scarce area management, mainly introducing the evolution characteristics of ecologically-deficient areas and the modelling methods of simulation. Chapter 7: The effectiveness and risks of ecological hydrological model in water resources management decision-making, mainly introduces the development process of ecological hydrological model, the conceptual framework of ecological hydrological model. Chapter 8: Simulation of nutrient budgets in the restoration of water lakes and rivers, mainly introducing the principles and measures for lake and river restoration. Chapter 10: Correlation of ecological hydrological processes in lake-intensive watersheds. Chapter 11: Water quality management of large rivers in South America based on ecological hydrological methods. Chapter 12: Ecological hydrological analysis of tropical African basin development. Chapter 13: River ecological hydrology management of the distribution of large-scale water storage projects in the former Soviet Union. Chapters 10-13 mainly introduce the actual case introduction in several different ecosystem situations, interspersed in the case to explain the establishment and utilization of several ecological hydrological models, such as the explanation and practice of the HYDRUS model. This part is mainly about basic theory, mathematical model and calculation method. It is the key point and difficulty of "Ecological Hydrology". The content is rather dull, easy to follow the text and insipid. This requires teachers to emphasize that students should learn by themselves first, understand what they are going to learn before they listen to the class and be familiar with it before they can be interested in it.

The practical effect of "learning-guided" teaching

According to the main implementation links and procedures of the "learning-guided" teaching, taking the subject of "Eco-hydrology" as an example, the "learning-guided" teaching practice of the master's degree course of water resources engineering in North China University of Water Resources and Hydropower was carried out. There are two classes for master's degree students majoring in hydraulic engineering in this university, with an average annual enrolment of about 90 students. Eco-hydrology course is offered in the second semester of the first academic year. After two years of practice and adjustment, the application results in the teaching of Master's

Degree of Water Conservancy Engineering of Grade 16 and 17 show that: The total number of absenteeism of grade 16 students was 11. The excellent rate of examination results was 78% and the failure rate was 3.6%. The total number of absenteeism of grade 17 students is 8. The excellent rate of examination results is 84%, and the failure rate is 0%. Compared with the teaching effect of hydrology and water resources specialty of grade 14 and 15, the average number of absentees decreased by 8 times, the excellent and good rate of achievement increased by 25%, and the failure rate decreased by 75%. The quality of the master's degree in water conservancy engineering has been significantly improved, the students have responded well, and the overall score has been greatly improved.

Conclusion

The "learning-guided" teaching method is a student-led heuristic teaching mode. The implementation of the "learning-guided" teaching method in the teaching of master's degree courses in hydraulic engineering is an objective requirement and development trend of modern higher education development. The "learning-duided" teaching focuses on guiding students to master learning methods and skills, cultivating students' self-learning ability, improving students' expression level, stimulating students' inner potential and logical thinking ability and flexibly functioning according to different teaching needs and contents. Through the application and practice of the master's degree teaching in the 16th and 17th grade water conservancy engineering of North China University of Water Resources and Hydropower, the classroom discipline is obviously improved, the students' self-study enthusiasm is continuously improved and the teaching effect is remarkable. It is worth noting that the implementation of the "learning-guided" teaching method needs to combine the characteristics of the course with the basic conditions of the students. At the same time, it needs to be continuously adapted and adapted by both teachers and students to achieve better results.

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