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Discussion on the Teaching of Water Resources System Analysis in 'Outstanding Engineer Education Training Plan'

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***Abstract*—Water resources system analysis is one of the main courses of the resource-environment planning and hydrology and water resources engineering majors. In teaching we should consider its strong comprehensiveness feature and meet the society technical ability requirement. In the paper, we suggest some advices and methods to improve the course's teaching quality. The advices are included in both practical and classroom teaching such as using MS Excel, Lingo and Matlab software to solve the practical planning problems, lectures to display students' works and etc..The results show that the measures remarkably improve learning initiative and practical ability of the students.**

Keywords—Water resources; system analysis; college course; teaching improvement

I. INTRODUCTION

Water Resources System Analysis (WRSA), which is in major courses group of hydrology and water resources engineering and other related majors, is concerned with the system analyzing technology and their applications for water resource planning and management based on system theory and sustainable development theory. The course mainly focuses on the topics include water resources planning basis theory, system analysis methods (such as linear, nonlinear, dynamic programming and system simulation method) and their applications. In addition, some new methods (such like genetic algorithm, artificial neural network, etc.) appeared and widely used in recent years will be introduced to students as a necessary supplement. This course aims to give undergraduate students a basic understanding of tools in the emerging field of water resources system analysis for the practicing engineer. It also offers practical experience in using these tools within the water planning and management context.

The contents and learning objectives of Water Resources System Analysis show that the course not only involves theory of water resources system, system analysis and water resources planning but also methodology of optimization, forecasting, assessment and etc.. The course always is taught in year 2 when the students begin their professional foundation courses. For these fresh students, it is clearly the course is a comprehensive and interdisciplinary and not easy to grasp. In 2010, for the reform of higher engineering education, Chinese Ministry of Education puts forward the 'outstanding engineers education training plan', aims to cultivate and bring up a group of strong creativity and strong social adaptation ability of high quality of each type of engineering and technical personnel. For the student in this plan, student's practical ability needs to be further strengthened and well trained for the future practicing engineer. Hence, teaching a Water Resources System Analysis in 'outstanding engineer education training plan' urges a different pedagogy from what is required in teaching a course in a student's major discipline. This paper discussed the present problems in the teaching of the course and developed practical teaching ideas and methods to improve the teaching outcomes of the WRSA.

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II. PRESENT DRAWBACK IN TEACHING

Few previous studies have explored the issues in teaching courses such as Water Resources System Analysis. based on these studies and our a five semester period of teaching experience with the course, some drawbacks were identified by assessing the existed course contents for the applicability, the assessment methods and the grading scheme, and the results of the student survey[1].

A. Textbooks didn't match the updating Teaching objectives

In present using editions textbooks of WRSA in China universities, topics were mostly on mathematical theory of the system analysis. The textbook contents decrease the students' interest and weaken the teaching performance. There was also few textbooks focus on Water Resources Planning. In these textbooks, water resources calculation and evaluation, water resources applications, water resources protection, water conservancy and hydropower planning, and the social, economic, administrative and legal issues related to Water Resources Management, which repeated in the courses of 'Water Resources Management', 'Water Environment Planning' and 'Water Resources Calculation and Evaluation', were included[2]. The topics on system analysis became a subordinate module. No single appropriate textbook was found to cover all the intended topics.

B. Students lacked the learning of practical applications

WRSA involves establishing water resources system analysis models for optimization, prediction, assessment and dynamic programming. Consequently some traditional methods such like analytical method, simplex method and numerical calculation for resolve these models were introduced to students. However, these traditional methods couldn't meet the current needs of water resources planning. A water resources system usually is a huge and complex system and the models are more and more hard to find their satisfy solutions using the traditional methods. Therefore, the content of course teaching should also have some advanced computing methods, which are closely related to computer development and the corresponding software for modeling and solving, for training the student practice skill on complex system analysis for water resources planning and management. Students lacked the learning of these parts of practical applications.

C. Other obstacles in course teaching

Because of the rapid development of water resources utilization and protection, a lot of new technology, new design specifications, new theories and new methods for water resources system analysis and water resources planning are emerging. Students did not get enough information about the emerging WRSA issues pertinent to them. Students had limited opportunities to learn about the new things related to WRSA. They lacked simple laboratory experiences to visualize the concepts and field trips to provide knowledge about how water resources planning and management and how related careers develop.

III. TEACHING METHODOLOGY

A. Adding Computing practice experiments

The textbook is still used as the foundation for the course, practical uses and applications of water resources system analysis were added to the course. We designed and collected a group of study cases, and guided students to build the models and solved the models using the popular system modeling analysis software aided by the computer in laboratory. Students were also encouraged to work on a comprehensive simulating-real water resources system decision making problem in teams. After the learning and practice exercises, students should be able to expertly use some modeling and solving software and have basic practice skill on water resources planning. The recommend learning times of this part is 8 lesson hours[3]. See TABLE I.

B. Adjust Lecture contents and methods

We improved the pedagogy with inspire type and collaborative instructor teaching concept instead of 'Instructor teaching-to-student learning' mode. 'Instructor teaching-to-student learning' approach is vertical, where an instructor provides the information, and guides the students in every aspect of the course [4]. However, in the 'inspire type and collaborative instructor teaching-student learning' approach, students are expected to connect the subject with their own experiences, surround searching and analysis. Practical uses and applications of water resources system analysis were added to the course materials. Some topics were taught at the introductory level with supporting practical examples collected by students. With questions and their solutions of the examples, Students presented their works and discussed with the teacher [5].

TABLE I. PRACTICE TOPICS & LEARNING OUTCOMES

Topics	Contents	Times	Learning Outcomes
MS Excel and Lingo	Solve linear programming model using Excel Programming module;Solve linear and non-linear programming models using Lingo|Lindo softwares.	2hr	Students should be familiar with software of MS Excel and Lingo/Lingo, With the capable of linear and non-linear models programming and resolving.
Matlab (1)	Solve linear, non-linear and dynamic programming modelsusingMatlab .	2 hr	Students can use Matlabto solve linear and non-linear Programming, multi-objectives decision making, dynamic decision making.
Matlab (2)	Water system optimization, forecasting and evaluation model based on GA , ANN and Matlab	2 hr	Students can use Matlab, GA and ANN to solve water resources system analysis problems.
Comprehensive exercise	A real-simulating case study on water resousce planning and management.	2 hr	Students should be familiar with the water resource planning, regional water resources optimal allocation model, and the water resources development and utilization and protection optimization.

C. Term paper

A term paper is introduced in a way that will help an individual student to find a water resource related topic that can be connected to the Water Resources System analysis field or to any new methodology in system analysis. The term paper assignment includes a written report and a classroom presentation to fulfill the objective of developing the students' communication skills. In this approach, the lecturers act as guides to the course and the students can contribute significant portion of the course fitting for the student's interests and of study. In the beginning of the course, a term paper guideline is provided to the students. In the middle of the course, students select their paper topics according to the instructors' advices and their own related information collection. In the end of the term, students present their Term papers in the classroom and their work will be evaluated by the instructor. The term paper will increase students' abilities to understand the emerging water issues connected to WRAS and skills for gathering scientific data & report writing.

IV. RESULTS AND DISCUSSION

The Methodology was implemented in gradual steps for three years since 2013 by the author of this paper and the gradual changes have been made since then. The success of

the approach was assessed with the grades, exam performance, term paper and related information collection.

A. Practice Part

With the practice experiment included in the Teaching, Students used computer and software such as MS Excel, Lingo and Lingo to build and solve linear and non-linear programming models. Matlab was used to solve GA based complex to solve nonlinear programming models or multi-objectives decision making problems. Students also learned artificial neural network (ANN) programming to solve the problem of prediction and evaluation in WRSA.

The students' performance and grades showed that these practice experiments increase student abilities of using the emerging system analysis software and new merging WRSA methods and deepen their understanding of the WRSA theory compared to the students never had practice experiment in past semesters. It was helpful for student to increase their practice ability and connect the course to the real issues.

B. Lecture Part

Student enrollment in the course increased after the implementation of the 'inspire type and collaborative instructor teaching-student learning' teaching approach. Practical uses and applications of water resources system analysis were added to the course materials to expand the knowledge and the experiences of the students and were helpful for the students to choose their term paper topics. With questions and their solutions of the examples, Students presented their works and discussed with the teacher. This made the students work more than their predecessors for achieving the passing grade, while making them understand the water resources planning and management issues. The students found that the course can be connected to their own interest issue so that they could be actively engaged.

Since no single appropriate textbook was found to cover all the intended topics, supplementary teaching materials were developed by the instructor and colleagues.

C. Term papers

Term papers were assigned to the students in the middle term. Students choose their paper titles and collect materials. Comparison of the term papers of the pre-semesters and post-semesters showed an increase in the diversity of the term paper topics and an improvement in the paper writing. The diversity in the topics was either due to the discussion in the or due to the students' interest in choosing water topics related to WRSA.

TABLE II provides a few term topics that the students picked. The final classroom presentations by the students to their topics see Fig. 1.

TABLE II. TERM PAPER RESEARCH TOPICS

Topics	Topics
Linear programming applied in the water resource systems planning optimization allocation	Optimization allocation of water resources based on operational research
Application of integer planning in optimal allocation of drinking water in the rural area	Irrigation schedule optimization using integer planning
Optimal scheduling of hydro power system based on dynamic programming	Successive Linear Programming Based Optimal Scheduling of Cas cade Hydropower Station
Optimal operation of cascade hyd ropower stations based on ant col ony algorithm	A evolutionary algorithm to short term cascaded hydroelectric sche duling
Usage of Artificial Neural Networks Technique in Water Recoverable Reserve Evaluation	A ANN model applied for reservoir optimal operation
Multi-objective analysis of city water planning	Fuzzy theory and its application in water resources systems
Water Environment Quality Assessment based on Analytic hierarchy process(AHP) method	Optimal operation of reservoir based on particle swarm optimizatio

Fig. 1. Students term paper and presentation

V. CONCLUSION AND FUTURE WORK

Approaches including practice experiments, new lecture contents and method discussed in this paper were used to eliminate or minimize the drawbacks that were found to be learning barriers in the previous pedagogic approach. It was evident from the results evaluation that new methods stimulated students' interest in water resources system analysis, raised awareness about water resources system, provided basic abilities and guided how to resolve optimizing, assessment or forecasting problems in water resources planning and management. In this way, new methods assisted in fulfilling the objective of the course. However, this study was based only on the sessions that the author taught. To assess the full impact of the methods, a collaborative study with the data on the sessions taught by the other faculty should be done.

REFERENCES

[1] Xia Jun. Perspective and ponderaction in hydrological science. Bulletin of National Science Foundation of China, 2000, 14(15):293-297.

[2] Chen Yan, Yu Xiaohua, Yan Caiyun. Course teaching reform of the water resources utilization and protection. Science and Technology Information, 2008: 393.

[3] Huang Jiying. International Case Studies of Practical Education. Research On Education Tsinghua University, 2006, (4): 97-101.

[4] Zhang Liping, Xia Jun, Xu Jianmin.Study on the educational reform of hydrological experiments. Journal of Changjiang Engineering Vocational College, 2001,18(3):36-38.

[5] Cui Yali, Shao Jingli, Liu Mingzhu. Consideration of teaching methods in water resources development and conservation. Chinese Geological Education, 2005(1):77-78.

[6] KPE Ramanitharan. Connect2U Approach to Teaching Introduction to Water Resources Management as a General Education Course. Journal of Financial Crime, 2015, 20 (1): 67-87(21).