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Study on Practical Teaching Reform of Irrigation and Drainage Engineering

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Abstract

Agricultural water conservancy engineering is the first major to pass the engineering education professional certification in Hebei Agricultural University. The 12 graduation requirements of professional certification not only pay attention to the acquisition of knowledge, but also pay attention to the improvement of ability and quality. Irrigation and drainage engineering is the core professional compulsory course of agricultural water conservancy engineering specialty. Strengthening practical teaching is more conducive to the realization of the training goal of applied engineering and technical talents. The current situation and existing problems of the practical teaching of the course were analyzed and it was put forward to coordinate two links which were theoretical teaching and practical courses. The project teaching method is used to organically combine knowledge learning, quality and ability training, and form a complete circular learning chain within the course. Expanding extracurricular practice, relying on scientific research projects, the formation of teachers, graduate students and undergraduate ' tower ' team, students take advantage of spare time to participate in scientific research activities, professional innovation practice and other curriculum practical teaching. It is to provide reference for the improvement of the quality of practice teaching in the future.

Keywords

Agricultural water conservancy engineering specialty; Engineering education professional certification; Practical teaching.

1. Introduction

Hebei Agricultural University (hereinafter referred to as our school) is the earliest department to carry out water conservancy higher education in Hebei Province. Agricultural water conservancy engineering specialty has a long history and is the oldest specialty in urban and rural construction college. The major originated from the department of farmland water conservancy established in 1931 and formed in the department of agricultural and forestry engineering in 1946. It was renamed the department of farmland water conservancy in 1949. The subject was merged into Wuhan Institute of Water Resources and Hydropower in 1955. In 1958, our school reorganized the department of farmland water conservancy engineering. In 1999, according to the adjustment opinions of the Ministry of Education for undergraduate majors in colleges and universities, the major of farmland water conservancy engineering was changed into agricultural water conservancy engineering. In 2020, agricultural water conservancy projects passed the professional certification of engineering education, becoming the first major in our school to pass the professional certification. The graduation requirements of engineering education accreditation list 12 specific requirements of literacy, knowledge and ability, including engineering knowledge, problem analysis, Design/development solutions, research, using modern tools, engineering and society, environment and sustainable

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development, Occupational norms, Individuals and teams, Communication, Project management and Lifelong learning. The 12 graduation requirements of engineering education professional certification pay attention to both knowledge acquisition and ability and quality improvement. Irrigation and drainage engineering is the core professional compulsory course of agricultural water conservancy engineering specialty. Under the background of engineering education professional certification, strengthening practical teaching is an important part of cultivating applied engineering and technical talents with innovative entrepreneurial spirit and strong practical ability.

2. Curriculum characteristics

2.1. Curriculum introduction

Engineering of Irrigation and Drainage is a science to study the soil moisture in farmland, the variation regularity of regional water conditions and its adjustment measures, eliminate floods and droughts, and use water resources to serve the development of agricultural production [1, 2]. The main contents include water situation of farmland and soil moisture movement, crop water requirement and irrigation system, irrigation methods and technologies, irrigation canal system, irrigation water sources and water intake mode, agricultural drainage system and planning and design of farmland drainage, and irrigation and drainage system management. The first part is the theoretical basis, and the latter part is the technical application. Among them, crop water requirement and irrigation system, irrigation method and technology, canal system volume calculation and section design, field drainage ditch design are both key points and difficulties. Through the study of this course, students can understand and master the basic principles of irrigation and drainage, the planning and design methods of irrigation and drainage system and the basic knowledge of irrigation and drainage engineering management, and understand the new technologies and development trends at home and abroad in the field of irrigation and drainage engineering. Students have the ability to engage in planning, design, construction and management of farmland water conservancy projects, and can independently undertake the planning and design and irrigation and drainage management of small and medium-sized irrigation areas.

This course is generally arranged in the seventh semester, namely the last semester of the fourth grade of the university, 48 class hours, and 3 credits. The teaching process consists of theory and practice part. Theoretical teaching, which is the 40 class hours, enables students to have a systematic understanding of the course and master the basic concept, principles, planning and design methods of irrigation and drainage systems. Practice teaching includes experimental courses and curriculum design. Experimental course is 8 class hours, including soil infiltration experiment, sprinkler irrigation experiment, micro sprinkler performance test experiment, and drip irrigation experiment. Students verify regularity, emitter performance and irrigation technology by operating equipment, so as to deepen understanding. Curriculum design is two weeks. The planning and design of irrigation and drainage system in M irrigation district are carried out. The approaches and procedures of irrigation engineering planning and design ere understood and mastered. The planning and design report of irrigation district is written. The layout map of irrigation and drainage system in the irrigation district, the longitudinal section map of main canal and typical branch canal, the cross section map of main canal, typical branch canal, bucket canal and agricultural canal, and the cross section map of drainage main ditch, branch ditch, bucket ditch and agricultural ditch are drawn by using CAD software. Curriculum design is a comprehensive practical teaching link after curriculum learning, which is of great significance to strengthen the understanding and application of curriculum theory. It aims to improve students ' ability of farmland water conservancy project

planning and design, and lay a solid foundation for independent undertaking the planning and management of small and medium-sized irrigation areas after graduation.

2.2. The supporting relationship between curriculum practice objectives and graduation requirements

The curriculum practical objectives is to cultivate students to understand the new technologies and development trends at home and abroad in the field of irrigation and drainage engineering, master the planning and design methods of farmland water conservancy projects, and comprehensively use the knowledge they have learned to solve engineering problems, especially the ability to solve complex engineering problems. The curriculum practical objectives mainly support the graduation requirements and the ways to achieve them in Table 1.

Table 1: curriculum practical objectives supporting graduation requirements

first grade indexes	Second grade indexes	ways to achieve
1Engineering knowledge	1-4 : Mastering engineering hydrology, building materials, soil and crop science, water pumps and pump stations, irrigation and drainage engineering and other professional knowledge, and the related problems in the construction of agricultural water conservancy projects can be correctly evaluated and solved	Experimental course, Curriculum design
2 Problem analysis	2-3 : The basic principles of engineering science can be used to analyze the influencing factors for a complex agricultural water conservancy problem, correctly express the key links of engineering problems and their solutions, and prove the feasibility and rationality of the solution.	Curriculum design
3Design/development solutions	3-1 : Mastering Design Methods of Agricultural Water Conservancy Projects to Meet Specific Needs	Curriculum design
	3-2 : Ability to use professional knowledge to design agricultural water conservancy projects and prepare design reports that meet the requirements	
	3-3 : In the design process, the innovation consciousness should be reflected, Different engineering schemes are compared and optimized, and various constraints such as economy, environment, law and ethics can be considered	
4 Research	4-1 : Master the basic principles and methods of engineering experiments in the field of agricultural water conservancy engineering, and carry out scientific experimental design for complex engineering problems	Experimental course

	4-2 : According to the experimental purpose to determine the required parameters and accuracy, can correctly select the experimental instruments and equipment, data acquisition, collection and measurement.	
	4-3 : It has the ability to reasonably analyze and explain the test results, and obtains reasonable and effective conclusions through comprehensive analysis of information.	
6 Engineering and society	6-1 : Understand the principles, policies, laws and regulations related to agricultural water conservancy projects, master relevant norms, procedures, etc.	Curriculum design
8 Occupational norms	8-3 : Understanding the basic requirements of agricultural water conservancy projects for hard work, clear the connotation of basic professional ethics and related laws and regulations, and earnestly abides by in practice.	Curriculum design
9 Individuals and teams	9-1 : Understanding the importance of team spirit in agricultural water conservancy projects, clarifying the role of individuals in the team, and working together with team members。	Experimental course, Curriculum design
	9-2 : be able to listen to others ' opinions and share information	
10 Communication	10-3 : In view of the complex engineering problems of agricultural water conservancy, we can clearly express our views through oral or written forms, communicate effectively with peers and the public, and make reasonable explanations	Curriculum design
12 Lifelong learning	12-2 : Ability to adapt to future development by adopting appropriate learning methods	Curriculum design

2.3. Problems in Practice links

(1) Practice teaching is relatively independent and students ' ability to solve complex engineering problems needs to be improved

In the past teaching process, the theoretical teaching and practical courses of irrigation and drainage engineering are relatively independent, and they are orderly promoted according to the course arrangement plan. The interaction between the two is not close. For students, they passively follow the arrangement of the curriculum plan to carry out learning. For example, students attend theoretical courses, experimental courses and curriculum design according to the curriculum schedule. Students understand the basic knowledge and principles of irrigation and drainage engineering through theoretical courses; Complete the operation of experimental instruments and equipment through experiments, record and analyze experimental data; Complete the planning and design of irrigation and drainage system in M irrigation area

according to the course design task and instruction. This relatively independent teaching link is not easy for beginners to understand or think carefully about the organic relationship between the teaching links of the course and the cultivation of knowledge, ability and quality. The ability of students to solve complex engineering problems needs to be further improved.

(2) Students ' Enthusiasm to participate needs to be improved in Traditional Practice Teaching Mode

The traditional teaching mode of experimental course is to preview the experimental guide book, clarify the purpose of the experiment, the operation rules of the experimental instrument, etc. The experimental teacher guides the experimental process, and students observe, operate and collate data. In the process, students have poor enthusiasm and some students do not participate in the experiment. In addition, this semester students to prepare for the postgraduate entrance examination, job search, etc., practice participation enthusiasm is not high. In two weeks, the irrigation and drainage system layout, channel flow calculation, longitudinal and cross-sectional design, and engineering quantity statistics were carried out for medium-sized irrigation areas. If complete alone, the curriculum design task was heavy, and it was generally completed in groups, with 4~6 people in one group. At the same time, the team members were asked to understand the importance of team spirit in agricultural water conservancy projects, clarify the role of individuals in the team, and work together with team members to complete the curriculum design task. However, insufficient participation of individual students affects the progress of curriculum design or increases the workload of other members of the group.

(3) The single assessment method in practice teaching can not evaluate the teaching effect comprehensively

Experimental courses and curriculum design and other practical teaching links are generally evaluated according to experimental reports and design results. This single result evaluation method cannot comprehensively and accurately evaluate whether students ' knowledge, ability and quality meet the graduation requirements.

3. Practical teaching reform measures

3.1. Based on System Theory Coordinating Curriculum Theory and Practice

Based on the idea of system theory, the two teaching links of irrigation and drainage engineering which are theory teaching and curriculum practice are integrated. Five curriculum projects are elaborately designed, and the two teaching links are organically linked to consolidate professional knowledge and improve the ability and quality of solving complex engineering problems. Combining Penman-Monteith model to calculate crop water requirement with water balance principle to formulate irrigation schedule, a course project to consolidate and deepen irrigation principle was designed. In view of the shortage of water resources and the arduous task of groundwater compression in the region where our school is located, efficient water-saving irrigation is the focus of future development. Three efficient water-saving irrigation projects are designed, including lawn sprinkler engineering design, drip irrigation engineering design and low-pressure pipeline irrigation engineering design. The lawn sprinkler engineering design takes the lawn of the school playground as the irrigation object. On the basis of the teaching of sprinkler irrigation theory, with reference to Technical specification for sprinkler irrigation engineering, students can visit and on-the-spot investigation, use new knowledge and skills to complete the design scheme of sprinkler irrigation engineering, and combine with the teaching link of sprinkler irrigation experiment to verify and improve the project scheme. The fifth curriculum project is formed by combining the curriculum design task with the layout content of irrigation channel planning in theoretical teaching.

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3.2. Applying Project Teaching Method to improve Students ' Enthusiasm to participate

Change the traditional teaching concept, student-centered, results-oriented, using project teaching method, play the dominant position of students [3]. At the beginning of the course, five projects are issued, including the formulation of crop irrigation system, the design of lawn sprinkler irrigation engineering, the design of drip irrigation engineering, the planning and layout of irrigation channels in M irrigation area, and the design of low pressure pipeline irrigation engineering. The students majoring in agricultural water conservancy engineering are free to form groups, with 4~6 members in each group. They are free to choose among the five projects, and each project can be selected by two groups of students at most. Students independently make plans and carry out projects. Students can overcome the difficulties and problems in the project work by communicating within the group, between groups, and with instructors. Teachers and students interact, cooperate with groups, and jointly complete the task. According to the quality of project scheme, class presentation and answer questions to quantify the scores of each group. Project teaching method is holistic, comprehensive and exploratory. Students carry out to design engineering project by using new knowledge and skills while learning. It is a typical student-centered teaching method. It is very important to train students ' practical ability and improve students ' participation in practical teaching.

3.3. Evaluation of the whole process of practical teaching, refinement of practical assessment programs and scoring principles

With the evaluation of the whole process of practical teaching, the curriculum experiment assessment increases the usual grades, that is, the experimental performance is composed of two parts, namely, the usual grades and the experimental report, and the usual grades includes the attendance of the experimental class and the operation process of the students and, accounting for 30%; Experimental report accounts for 70%. Curriculum design assessment is the evaluation of students ' participation in curriculum design and theoretical knowledge to be grasped and applied. The assessment included four parts, namely, progress plan, CAD drawing, design report and reply, with a total score of 100. Among them, the progress plan accounts for 10%, CAD drawing accounts for 30%, design report accounts for 50%, and reply accounts for 10%. The progress plan includes hydrological calculation, determination of irrigation schedule, canal system planning, design flow calculation, canal longitudinal and cross section design, engineering quantity and project budget, which is 10 scores; CAD drawing includes two aspects of quantity and quality of drawings, which is 30 scores; According to the reasonable design scheme, the formula is selected correctly, the parameters are determined accurately, the calculation results are correct, the report is clear and the layout format meets the requirements, the design report is 50 scores; The reply includes reporting design scheme and answer questions, which is 10 scores.

3.4. Reform practice teaching mode, cultivate innovative talents

Irrigation and drainage engineering is a course with rich theory, wide practical content, obvious interdisciplinary and strong comprehensiveness. Teachers who undertake the course are required to be familiar with the inherent systematic and scientific nature of the course. It is best to have experience in planning and design of engineering projects. At the same time, hire enterprise engineers to guide teaching, promote the integration of production and education, and strengthen school-enterprise cooperation.

Expand extracurricular practice, enhance students ' awareness of society, cultivate social responsibility, stimulate interest in learning and innovation passion, and promote the mastery of professional knowledge and skills. Encourage students to organize open experiments, access to information, determine the purpose and content of the experiment, select experimental

instruments and equipment, hands-on operation and data processing, cultivate students ' ability to organize, communicate and cooperate; Relying on teachers ' scientific research projects, students are encouraged to actively apply for college students ' innovation and entrepreneurship projects. In the process of project development, team members consult literature, design technical routes and write project plans to improve students ' ability to guide practice. Encourage students to actively participate in college students ' innovation and entrepreneurship competition, skills competition, improve students ' vocational skills.

4. Analyses on the Effect of Educational Reform

4.1. Analysis on the Achievement degree of Curriculum Practice objectives

The following formula is used to calculate the achievement degree of curriculum practice objectives

$$p = \frac{m}{n} \times 100\% \tag{1}$$

Where, P is the achievement degree of curriculum practice objectives; m is the actual average score for a course practice objectives, which is the average score of the overall students; n is the expected score of the practical objectives of a course.

Using formula(1), the achievement degree of practical objectives of irrigation and drainage engineering course for agricultural water conservancy engineering graduates in recent 3 years was calculated, and the results are shown in figure 1.

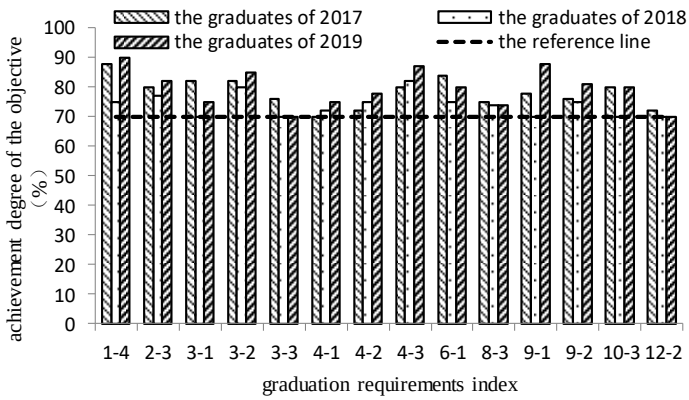

Figure 1: Achievement degree of irrigation and drainage engineering course objectives

Figure 1 show that the graduation requirements index of irrigation and drainage engineering courses in the graduates of 2017, 2018 and 2019 for agricultural water conservancy engineering majors are all above 70 and the overall training requirements of curriculum practice objectives are reached. The number of students from the graduates 2017 to 2019 majoring in agricultural water conservancy engineering is 31, 32 and 33, respectively. The average scores of students are 80.9, 75.5 and 79.3. The highest scores are 95, 87 and 90, respectively. The lowest scores are 75, 70 and 70. Each group of the graduates 2017, 2018 and 2019 agricultural water conservancy engineering majors can better complete the design tasks. Through the course practice, students ' expression ability and communication and cooperation with others are improved, the importance of team spirit in agricultural water conservancy engineering is understood, the role of individuals in the team is clarified. At the same time, through consulting norms, the ability of self-study is improved and the ability to adapt to future development is continuously improved.

However, some problems have also been found in the course practice. For example, most of the students in the seventh semester are faced with employment, postgraduate entrance

examination and other problems. Teachers remind students to take learning seriously, coordinate the relationship between go to class and postgraduate entrance examination, increase the proportion of usual grades and improve attendance and learning effect. In view of the insufficient participation of individual students in the group, the process supervision and reply are added. Through continuous improvement, the teaching quality of curriculum practice is improved [4,5].

4.2. Adopting Project Teaching Method to Improve Students ' Participation in Practical Teaching

The two teaching links of theoretical teaching and curriculum practice are planned as a whole. Based on the five projects of crop irrigation system formulation, lawn sprinkler irrigation engineering design, drip irrigation engineering design, irrigation canal system planning and layout of M irrigation area, and low-pressure pipeline irrigation engineering design, the project teaching method is adopted to give full play to the students dominant position, mobilize the students learning initiative, improve the students' participation, expand the teaching content, and cultivate the students ability to solve complex engineering problems and team cooperation.

4.3. Expansion of Extracurricular Practice and Continuous Innovation

Relying on scientific research projects, combined with the school tutorial system and the new class teacher system, the ' tower ' team of teachers, graduate students and undergraduates is formed. Undergraduates use their spare time to participate in scientific research activities and professional innovation practice, which improves the awareness and ability of learning innovation and continuously obtains innovative achievements. For instances, ' Zhan irrigation-intelligent irrigation technology co., LTD public welfare poverty alleviation project ' won the copper prize in the ' Internet + ' college students ' innovation and entrepreneurship final competition youth red dream trip in 2019; ' A water-saving irrigation system with labor-saving intelligent measurement and control ' participated in the Sixth National Undergraduate Water Conservancy Innovation Design Competition and won the first prize; 'A new type of intensive water-saving and anti-blocking intelligent infiltration irrigation system ' participated in the first national college students ' agricultural water conservancy project and related professional innovation design competition, and won the third prize. In 2019, students were instructed to apply for five practical patents, including a flower pot for uniform watering [6], a cross-shaped soil moisture sensor [7], and a new type of water-saving and anti-blocking irrigation pipe [8], a new type of automatic infiltration flower pot [9], and an intelligent and labor-saving irrigation system [10].

5. Conclusion

Practice teaching is an important part of course teaching, especially for engineering majors. Strengthening the cultivation of practical ability of irrigation and drainage engineering course, coordinating the two links of theoretical teaching and practical course of irrigation and drainage engineering, adopting project teaching method, organically combining knowledge learning, quality and ability training through five curriculum projects, and forming a complete circular learning chain within the course; By expanding extracurricular practice, relying on scientific research projects, combining the school tutorial system and the freshman class teacher system, a " tower " team of teachers, postgraduates and undergraduates is formed. Students participate in scientific research activities and professional innovation practice in their spare time, and their learning initiative and professional practice ability are significantly improved.

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