

Study on the Curriculum Reform of Irrigation and Drainage Engineering Based on Establishing Emerging Engineering Education

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Abstract,

In the new period of higher education reform, the new goal and methods of the personnel training were put forward for Colleges and Universities by the construction of Emerging Engineering Education. Irrigation and drainage engineering is the core professional course of agricultural water conservancy engineering, which plays an important role for the personnel training of water conservancy. Based on investigation and analysis of current situation and problems in this curriculum, social needs as orientation, personnel training as target, according technical development to adjust teaching content and student's inclinations to change teaching methods; take full the advantages of agricultural universities to realize interdisciplinary integration with the College, organize students of different professional for complementary innovation; Strengthening the training of school-enterprise cooperation and realization of production, learning and research of seamless, which build broad platform for the improvement of students ' comprehensive ability. Based in Hebei Province, facing the country, to meet the needs of society, has a solid theoretical foundation, excellent professional talents of water conservancy engineering.

Keywords

Emerging Engineering Education, Irrigation and drainage engineering, curriculum reform, teaching method.

1. INTRODUCTION

In the new era of higher education reform, the concept of "new engineering subject" (Emerging Engineering Education) was put forward in 2016. "Fudan consensus [1]", "Tianda Action [2]" and "Beijing Guide [3]" were propounded by discussing deeply which was organized by the Ministry of Education. Its connotation is to set morality as the guide, to cope with the changes and shape the future as the construction concept, to inherit and innovate, to cross and merge, to coordinate and share as the main way, to cultivate future diversity, innovative outstanding engineering talents, strategic. Innovative, systematic, open features [4]. The new goals and approaches of the cultivation of talents were brought forward in the construction of "new engineering subject" for colleges and universities [5]. Colleges and universities should comprehensively comb the teaching contents of various courses and eliminate "water lessons", build "golden lesson", raise the degree of academic challenge reasonably, increase the difficulty of the course, expand the depth of the course, and improve the teaching quality of the course in circular of the Ministry of Education on the implementation of the Spirit of the National Conference on undergraduate Education in Colleges and Universities in the new era in 2018[6].

The large-scale implementation of agricultural water-saving projects and taking agricultural water-saving as a directional and strategic task were emphasized in the Central Government's 2017 NO.1 Document. It is pointed out emphatically that Water Saving Reform of Large and Medium -Sized Irrigation District should be strengthened, field water saving facilities should be improved simultaneously, and modern irrigation districts should be built. It is to implement regional high-efficiency water-saving irrigation and build a number of high-efficiency water-saving irrigation projects. To establish and improve the standard system of agricultural water-saving technology products. Speed up the development of water-saving irrigation technologies and products with complete variety, series of matching sets and reliable performance, vigorously popularize water-saving irrigation techniques such as sprinkler irrigation and drip irrigation, and increase the popularization of water-saving and water-saving techniques such as the integration of water and fertilizer [7].

The subject of farmland and water conservancy engineering was founded in 1946 in Hebei Agricultural University. In 1999, according to the adjustment opinion of undergraduate specialty of Ministry of Education, the specialty of farmland water conservancy engineering was changed into agricultural water conservancy project. A large number of outstanding professionals were cultivated in this discipline. In the new era of socialist construction, there are the transformation from traditional water conservancy to modernization and sustainable development of water conservancy, from irrigated land to irrigated crops, from traditional surface irrigation methods to mechanization and automation, intelligent and networked irrigation methods, from single supplementary irrigation to water and fertilizer integration. In the new era, new requirements are put forward for the talent cultivation of agricultural water conservancy engineering professionals. As a local agricultural university, it is urgent to think about and solve the problem that how to cultivate innovative and outstanding agricultural water conservancy engineering talents [8-10]. Irrigation and drainage engineering as a core professional course of agricultural water conservancy engineering, it is particularly important to study on its teaching content and teaching method.

2. CHARACTERISTICS OF COURSES AND PROBLEMS IN TEACHING

2.1. Characteristics of Courses

Irrigation and drainage engineering [11] is a science that studies the water situation of farmland and the regularity of regional water regime change and its regulation measures, eliminates flood and drought disasters and uses water resources to serve the development of agricultural production. It is an interdisciplinary subject between engineering and agronomy, which involves many subjects, such as soil science, crop science, hydrology, meteorology, hydraulics and hydraulic structures. At the same time, it is a discipline that attaches great importance to the combination of theory and practice. The course covers a wide range of topics, including farmland water status and soil moisture movement, crop water demand and irrigation water use, irrigation methods, irrigation canal systems, irrigation sources and water intake, field drainage, Planning and design of drainage channel system, irrigation drainage management and so on.

2.2. Problems in Teaching

With the development of production, the progress of science and technology and the shortage of water resources, new goals science are put forward for irrigation. Irrigation technology needs to be improved constantly. Especially, the theory and technology of agricultural water-saving irrigation are developing, and the teaching contents are enriched. It is important to coordinate the contradiction between the reduction of teaching hours and the increase of teaching content. There are other problems in teaching that it is old for teaching content and is

rigid for teaching method, pay more attention to irrigation engineering and less to drainage, pay more attention to Construction and less to Management, pay more attention to imparting of professional knowledge and less to cultivation of quality and innovation ability. Especially, the restriction of the traditional teaching thought and method, as well as the limitation of the teaching conditions, the practical teaching links have not been constructed scientifically, reasonably the complete teaching system of innovative thinking with new techniques, new methods, and multi-disciplinary intercross synthesis. The inculcation-cognitive-verification are mainly teaching methods, lack of comprehensive and research-based teaching practice, lack of innovative thinking guidance, new technology, new methods have not been substantially incorporated into the practical teaching system.

3. CURRICULUM REFORM AND STUDY ON TEACHING METHOD

3.1. Adjusting Teaching Content

Further strengthen the farm construction of farm land water conservancy are put forward by Chen Lei [12] on 16 January 2017 on the National Symposium on Water Conservancy Planning which its topic is "adapting to new normal, implementing new concept, comprehensively speeding up the Development of Water Conservancy Reform and Development in an All-round way" refers to "the 13th Five-Year Plan". The first is to consolidate and upgrade the existing irrigated area. It is important to improve the irrigation area of large and medium-sized irrigation areas, to speed up the modernization of large and medium-sized irrigation areas, to perfect the irrigation and drainage engineering system, to get through the last kilometer of irrigation, and to improve the irrigation guarantee rate and the ability of drainage of waterlogging in farmland. The second is to vigorously develop efficient water-saving irrigation, to carry out large-scale and high-efficiency water-saving irrigation and focus on the construction of high-efficiency water-saving irrigation projects in key areas, such as major grain producing areas, fragile ecological environment areas, and areas with excessive water resources development. The third is to speed up the construction of a number of modern large irrigation areas.

To meet the needs of society for talents and coordinate the contradiction between the reduction of teaching hours and the increase of teaching content, irrigation and drainage engineering is divided into teaching content and expending content. Teaching content includes basic principles of irrigation and drainage engineering, planning and design of irrigation and drainage engineering and management of irrigation and drainage engineering, which are classical contents of irrigation and drainage engineering. Expenditure content comprises water-fertilizer integrated irrigation, research and development of water-saving irrigation equipment, "internet irrigation", modern irrigation district and etc. which can improve irrigation water use efficiency for alleviating the shortage of water resources. At the same, it is the development trend of irrigation and drainage engineering in future. Route map for curriculum reform and implementation are shown in Fig.1.

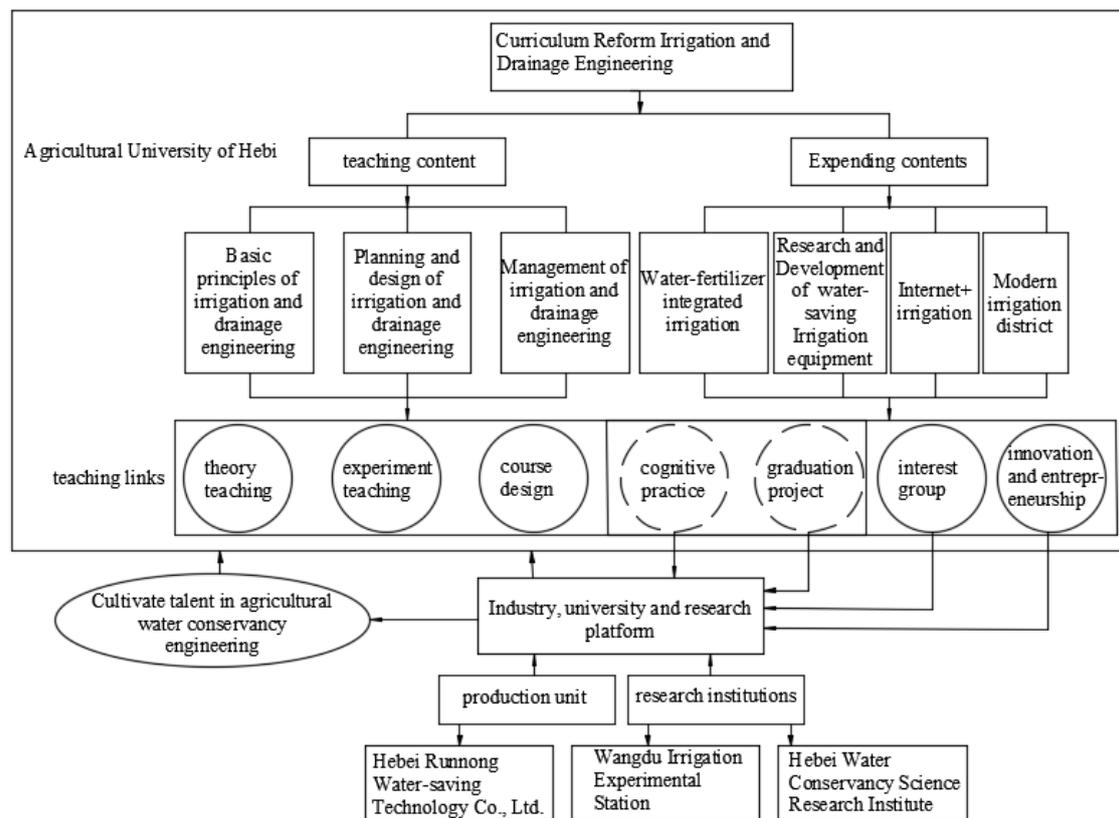


Fig 1. Route map for curriculum reform and implementation of irrigation and drainage engineering

The curriculum reform not only can meet the requirement of nation, but only pay more attention to the talents need of local society. The details are as follows:

(1) Hebei Province is the main area of water-saving and pressure-mining in North China, and is also the over-developed area of water resources. The high efficiency water-saving irrigation project is the focus of development in the future. The sprinkler irrigation, micro-irrigation and pipeline irrigation are the highlighting teaching contents. The students can download various codes and technical specifications related to this course from the teaching network platform, which there are the teaching reform results of "Irrigation and drainage Engineering" video picture library construction project (2015L5). On the one hand, the students can be trained to combine theory with production practice, consolidate the theory, achieve the purpose of applying what one has learned, and then promote the transformation process from knowledge learning to ability improvement, and cultivate approachable water conservancy engineers and technicians.

(2) With the development of modern agriculture, irrigation objects are more diversified; crop growth environment constantly changes, from traditional field agriculture irrigation to leisure agriculture, facility agriculture, ornamental flowers, grassland irrigation, etc. Pipeline irrigation project is more and more widely used. Especially, there are 346.46×10^4 wells for irrigation in Hebei Province, 338275 well irrigation areas and 219.53×10^4 hm² irrigation areas, which are more suitable for the application of pipeline water conveyance irrigation engineering. The content of irrigation projects with low pressure pipe conveyance is paid more attention to explanation by combining engineering examples.

(3) In April 2015, the Ministry of Agriculture formulated and issued the "opinions on the implementation of the Ministry of Agriculture on the fight against Agricultural Non-point

Source pollution", and put forward "one control and two reduction" on the prevention and control of agricultural non-point source pollution. One control means strict control of the total amount of agricultural water with vigorously developing Water-saving Agriculture; the two reductions mean reducing the use of chemical fertilizer and pesticides with achieving zero growth of chemical fertilizer and pesticides. The integrated irrigation of water and fertilizer plays an important role in realizing this target. The integrated technology of water and fertilizer is to dissolve fertilizer in water, with the aid of pipe irrigation system, irrigation and fertilization simultaneously, timely and appropriate to meet the demand of crops for water and nutrients. The effective supply of water and fertilizer to crops was promoted, and the utilization rate of water and fertilizer was increased, thus reducing water consumption and fertilizer use. Water-fertilizer integrated irrigation is one of the important expanding contents.

3.2. Study on Teaching Methods

All teaching links of irrigation and drainage engineering, including theory teaching, experiment teaching, course design, cognitive practice, graduation project, are taken as a whole, which should be arranged harmoniously to achieve the goals of training outstanding engineer. Practical teaching is an important teaching link in higher education and a breakthrough in deepening teaching reform. Irrigation and drainage engineering is a practical and applied science. It occupies a very important position in the cultivation of talents in higher education. Irrigation and drainage engineering as a practical and applied science must rely on a certain number and quality of practical teaching platform in order to cultivate outstanding engineering and technical personnel.

(1) The modern teaching means are organically combined with the traditional teaching methods to solve the contradiction between the expansion of teaching contents and the limitation of school hours. The multimedia courseware is as fine as possible, highlighting the basic theory, engineering planning, design and management of the classical irrigation and drainage engineering, efficiently using the class time, explaining the classical content, and referring to the expansion of the teaching content. With the help of the network teaching platform, we can carry out the second class, upload the information of expanding content under class, discuss in groups, feedback the results of discussion, and solve the difficulties and doubts through the form of micro-class.

(2) According to the first Water Conservancy Census Bulletin of Hebei Province[12], there are a total irrigation area of $449.28 \times 10^4 \text{ hm}^2$ in Hebei Province, which Irrigation district situation are shown in table1. The modernization construction of large and medium irrigation areas and the pipeline irrigation in well irrigation areas are the focus of attention in the future. Base on explanation to the canal planning, layout, calculation of design flow rate, design of vertical and horizontal section, the Design Code for Irrigation and drainage Engineering (GB50288), the Technical Specification for Canal seepage Control Engineering (SL18), the Design Code for Anti-Frost expansion of Canal system Engineering (SL23) and the examples of Water-saving Reconstruction in Irrigation District are sent to the students in advance. The methods of improving the efficiency of irrigation water utilization and the function, structure, advantages and disadvantages of canal lining are obtained by using the form of flipping classroom. The construction of modern irrigation district is completed by students collecting data and discussing in groups.

Table 1. The statistical table of existing irrigation district in Hebei province

Irrigation district type	Division standard(hm ²)	Irrigation district numbers	Irrigation areas (hm ²)
large irrigation district	2.0×10 ⁴	21	75.52×10 ⁴
medium irrigation district	666.7~2.0×10 ⁴	130	41.18×10 ⁴
small irrigation district	3.33~666.7	341816	235.94×10 ⁴

(3) The experiments of irrigation drainage engineering course are divided into three parts: basic experiment, comprehensive experiment and innovative experiment, according to the characteristics of irrigation drainage engineering course, experimental conditions and the needs of students at different levels. The training target of basic experiment including measurement of soil bulk density, soil moisture content, field water holding capacity and negative pressure are helpful to understand the curriculum basic theory, the basic knowledge, grasps the related instrument and equipment use method, Cultivate students' perceptual awareness and stimulate student interest by interest group, spontaneous completion. Comprehensive experiment including experiment of soil infiltration, micro-sprinkler performance, and drip irrigation performance is a compulsory experimental course, which all students in agricultural water conservancy engineering must attend. Innovative experiment mainly coming from teachers' research projects or students own ideas aim to cultivation of students' innovative awareness and the application of professional knowledge to carry out scientific research activities. The basic experiment and explore the innovative experiment are completed through opening the laboratory.

(4) Agricultural University of Hebei and Hebei Runnong Water-saving Technology Co., Ltd. jointly has set up Hebei Water Saving Irrigation equipment Industry and Technology Research Institute, which provides favorable conditions for the cultivation of students' innovation ability and teamwork. In the future, we can strengthen contact and cooperation with Wangdu Irrigation Experimental Station, Ranzhuang Hydrological and Water Resources Experimental Station, Hebei Water Conservancy Science Research Institute, and strive for the completion of graduation design and practice in enterprises, so as to improve students' comprehensive practical ability. The cultivation of innovation ability, build a broader industry, university and research platform.

4. TEACHING EFFECT EVALUATIONS

The objectives and teaching effect of the course of Irrigation and Drainage Engineering were analyzed to the graduates majoring in agricultural water conservancy projects of 2018 and 2019, which were 32 and 33 students respectively, by suing both grades and final exam results, 2015 graduates as a control group, which was 30 students. The comprehensive evaluation results are shown in the Fig.2 and Fig.3.

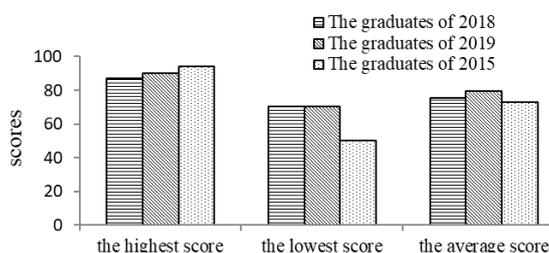


Fig 2. The scores distribution of the graduates

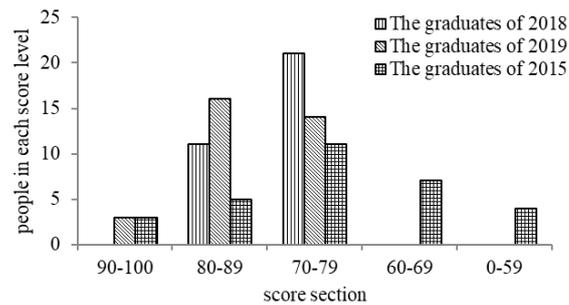


Fig 3. The students distribution in each score level

Fig.2 shows that the highest, the minimum and the average score are 94, 50, and 72.8 before the curriculum reform. The highest score are 87 and 90, the lowest score are 70 and average score are 75.5 and 79.3 for the graduates of 2018 and 2019, which is after the curriculum reform. The average score and the minimum score after the curriculum reform are higher than those before the curriculum reform. In particular, the increase in the minimum score which is from 50 to 70 is particularly obvious. It is concluded that the students in each score level is normal distribution before the curriculum reform and the score of the whole class is above the middle after the curriculum reform in Fig.3.

After Adjusting and reconstructing the teaching contents and improving teaching methods of irrigation drainage engineering, it has been better teaching effect for students in agricultural water conservancy engineering major. First of all, the students are full of interest in the course, actively answer questions, and participate in the whole teaching process. Secondly, after class, students think and design innovative experiments related to professional courses in the form of groups. Under the guidance of their mentors, they participate in the National College students Water Conservancy Innovation Design Competition. They have obtained excellent results: one special prize, six second-class prizes and two winning prizes. Finally, through the investigation of some graduate students, it is shown that the students can accomplish the task assigned by the employment unit well, work hard, be good at thinking and have sense of team spirit.

It can be trended to realize interdisciplinary cross-integration and collaborative innovation in future. Therefore, innovation and entrepreneurship education is integrated the talent training by Organizing students of different specialties, dividing work and cooperating, actively participating in the National College students Water Conservancy Innovation Design Competition, China "Internet+" College students Innovation and Entrepreneurship Competition, Hebei Province College students big data Innovation Application Competition, Hebei college students Industrial Innovation and Design Competition etc.. The students can learn from each other and promote each other in the process of preparing for the game. It not only realizes the integration of intersecting contents among disciplines, but also brings out the sparks of innovation in the process of integration, and at the same time cultivates the students' sense of cooperation and team spirit.

5. CONCLUSIONS

In the new era of higher education reform, in order to train outstanding talents of agricultural water conservancy engineering who can meet the needs of the society and the country, the irrigation and drainage engineering course which is regarded as the core specialized course of agricultural water conservancy engineering is reconstructed and adjusted the teaching content and reform of teaching methods are carried out. The basic theory of classical irrigation and drainage engineering, engineering planning, design and management should be carried forward, and the integrity and systematization of irrigation and drainage system should be attached importance to, the pipeline irrigation should be increased, and the high efficiency

water-saving irrigation project should be emphasized. Absorb modern irrigation district construction, Internet irrigation, and water and fertilizer integration technology, with the times, enrich, and expand the teaching content. Seek innovation, give play to the advantages of agricultural comprehensive colleges and universities, actively integrate interdisciplinary, strengthen the cooperation between schools and enterprises and jointly train, coordinate and share social resources, in order to cultivate outstanding scientific research personnel and engineering and technical personnel who are required by the society, And all-powerful talents to build a broader platform.

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