Research and Practice on Curriculum System of Water Conservancy Engineering Majors Based on the Oriented Working Process

Cui Zhencai
Shandong Water Polytechnic,
Rizhao, Shandong, China
e-mail: cuizc@sina.com

He Xiaoke, Hu Jinling, Xiaohan
Shandong Water Polytechnic,
Rizhao, Shandong, China
e-mail: hhexk@126.com

***Abstract*—The thesis analyzed the importance of curriculum system construction of water conservancy engineering based on the oriented working process; It developed the orientation and connotation research in water conservancy engineering with the help of Delphi method, It sorted on the importance of water engineering jobs through comparison of fuzzy binary method, then determined the professional talent location in water conservancy engineering; It transferred water conservancy engineering from "three stages" to "three production process". It determined the typical work task matched for professional posts in production process by practice expert interviews; It determined 16 typical work tasks through school enterprises cooperation and summarized 6 action areas in accordance with the principles of professional talent growth from typical work tasks to action areas, from action areas to learning area processes; It deconstructed and reconstructed the courses based on the working process oriented, It converted 6 action fields to 12 study fields, so as to form a scheme of learning area curriculum; It converted learning objectives and learning content in learning field into didactics and methodology, It constituted a number of learning environment in learning field; which has achieved good results in the practical application in our college.**

Keywords-oriented working process; water conservancy engineering; curriculum system; application

I. INTRODUCTION

Curriculum system refers to a system under the guidance of certain educational value, with various permutations and combinations of the course elements, to enable elements of each course in a dynamic process to target uniformly the achievements of curriculum system [1] . Whether the course system is reasonable or not has direct relation to the cultivation of talents specifications. At present, the majors of water conservancy engineering in higher vocational colleges are still not fully divorced from the traditional "basic course-specialized fundamental course-professional course" three- floor curriculum system. So the talents in the school are not adapted to the professional posts in enterprise. Therefore, it is imminent for majors in water conservancy engineering in higher vocational colleges according to different regions and the characteristics of each school to construct curriculum system based on the oriented work process in accordance with the working process and training target during professional jobs. [2]

With the formally start "national model vocational colleges construction" in China since 2006, according to the talent training target of higher technical ability, the demonstration colleges on the basis of further study and reference to international advanced vocational education concept, and on the basis of the schools with China's national conditions , with the aid of the school-enterprise cooperation platform, innovated development mode and method of course system, constructed the courses based on the oriented working process and used in practice, which laid solid foundation for innovations in higher vocational type characteristic education, reforms in professional talent training mode and teaching quality improvement in higher vocational education [3][4]. But the course development based on oriented working process is a very complicated work, which has extremely strong professional and scientific characters. Nowadays, though, we have more specific curriculum reform direction, can draw lessons from successful examples in the method, due to the nature of the differences between professional--industrial, such as the different regions, the curriculum system researches based on the oriented working process in water conservancy engineering majors of water conservancy colleges and universities have just started, and they didn't form of a unified course standard. The course system practice based on the oriented working process in water conservancy engineering majors is almost blank. Therefore, it is significant to construct curriculum system based on the oriented working process in the water conservancy engineering majors and to use it to guide practical practice.

II. PROFESSIONAL DIRECTION OF WATER CONSERVANCY ENGINEERING MAJORS AND RESEARCH ANALYSIS OF THE CONNOTATION

Wherever Times is specified, Times Roman or Times New Roman may be used. If neither is available on your word processor, please use the font closest in appearance to Times. Avoid using bit-mapped fonts if possible. True-Type 1 or Open Type fonts are preferred. Please embed symbol fonts, as well, for math, etc.

According to the current and three-year development of the water conservancy industry and the talent demand for water conservancy in Shandong province, using the questionnaire of Delphi method, we successively researched in Shandong Hydraulic Engineering Corporation, Water Conservancy Engineering Construction & Supervision Company of Shandong, Rizhao Reservoir Management Office and other 14 units, comprehensively analyzed the

research results. Professional direction of water conservancy engineering majors and the basic connotation can be summarized as: (1) They are for small and medium-sized water conservancy projects, irrigation and water conservancy projects, water supply project planning and design, construction, supervision and operation management in the town in Shandong province; (2) They are for domestic hub projects in regional water conservancy, integrated river basin management water conservancy projects, cross-regional water transfer projects, the construction of river regulation projects and operation management.

In addition, combined with a survey of graduates who graduated from water conservancy engineering nearly three years, the ratios of the graduates according to the above (1) and (2) are 87.6% and 12.4% respectively.

In order to explain the work importance of the graduates who are engaged in water conservancy engineering objectively and scientifically, we utilized the dual relative comparison test of the fuzzy mathematics and the concept of order dual comparison test. Please see table 1about the importance of the sort results on engineering design, construction, and supervision and operation management skills carried out by the actual employers and industry experts.

TABLE I. DUAL COMPARISON SORTING TABLE ON THE IMPORTANCE OF VARIOUS POSTS

x_j / x_i	**1 (construction)**	**2 (supervision)**	**3 (design)**	**4 (management)**
1 (construction)	0.5	0.8	0.85	0.9
2 (supervision)	0.2	0.5	0.8	0.85
3 (design)	0.15	0.2	0.5	0.8
4 (management)	0.10	0.15	0.2	0.5

According to Table 1 tectonic posts important degree μ_{ij} matrix:

$$\mu_{ij} = \begin{bmatrix} 0.5 & 0.8 & 0.85 & 0.90 \\ 0.2 & 0.5 & 0.8 & 0.85 \\ 0.15 & 0.2 & 0.5 & 0.8 \\ 0.1 & 0.15 & 0.2 & 0.5 \end{bmatrix}$$

μ_{ij} means x_i makes the dual comparison with x_j, x_i is the important degree of x_j;μ_{ij} means x_j makes the dual comparison with x_i, x_j is the important degree of x_i; i=1,2,3,4; j=1,2,3,4.

Thus relative important degree matrix of each post is normalized as follows:

$$\alpha = \begin{bmatrix} 1 & \frac{0.8}{0.2} & \frac{0.85}{0.15} & \frac{0.9}{0.1} \\ \frac{0.2}{0.8} & 1 & \frac{0.8}{0.2} & \frac{0.85}{0.15} \\ \frac{0.15}{0.85} & \frac{0.2}{0.8} & 1 & \frac{0.8}{0.2} \\ \frac{0.1}{0.9} & \frac{0.15}{0.85} & \frac{0.2}{0.8} & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 0.25 & 1 & 1 & 1 \\ 0.18 & 0.25 & 1 & 1 \\ 0.11 & 0.18 & 0.25 & 1 \end{bmatrix}$$

Take the minimum value of per line, we get x_1(construction), x_2(supervision), x_3(design), x_4(management) the important degree of the post($\vec{w}$) , $\vec{w}$ =(1,0.25 , 0.18,.011).so we can get the order of the importance, they are construction> supervision> design> management .

The vocational ability each post needed is divided into general ability, professional ability and comprehensive ability (including social ability, method ability, etc.) (hereinafter referred to the "three abilities"). The further research (to save space, the composition of the ability is not listed) showed: the needs of different post to "three abilities" are consistent, which have the same importance; In the "three abilities ", the requirement of each partial ability in the same post shares the different proportion; The ratios of each respective proportion in the same ability in different posts are different. At the same time, statistical analysis on graduates in water conservancy engineering in the past three years shows the ratios of the posts in construction, supervision, design and management are about 65%, 16%, 12%, 7%. According to the above analysis, reposition the talents in hydraulic engineering in table 2.

TABLE II. TALENTS POSITIONING IN WATER CONSERVANCY ENGINEERING

Service oriented	**Water industry**			
Employment Department	***Water conservancy project construction companies, engineering supervision companies, county or township water conservancy design institutes (studios), urban or rural water administrations (stations), water conservancy project operation management firms, etc***			
Position and proportion	Construction of water conservancy project (65%)	engineering supervision(6%)	small-scale water conservancy project design (12%)	water conservancy project operation and management (7%)
Post task	technical guidance on construction, check and analysis on engineering materials, the lofting, organization and management in construction site, sort of engineering data, project budget and	to perform party A's management and supervision as a representation of engineering construction, to supervise construction site ,to solve and coordinate technical problems, etc	be engaged in small design of hydraulic engineering program, engineering chart drawing and documents collection and other technology missions in urban or rural water management	reservoir engineering, irrigation engineering, all kinds of hydraulic structure security checks, data collection and analysis, maintenance , reinforcement tasks in the

Service oriented	Water industry			
Employment Department	***Water conservancy project construction companies, engineering supervision companies, county or township water conservancy design institutes (studios), urban or rural water administrations (stations), water conservancy project operation management firms, etc***			
	formulation and tender		department (station)	comprehensive running management departments
Qualification	The builders, supervision engineers, the surveyors, material members, librarians, construction cost members, draftsmen			
Professional service groups	Water conservancy and hydropower construction projects, water conservancy and hydropower engineering managements, urban water conservancies, water management and relevant majors			

III. PROFESSIONAL CURRICULUM SYSTEM CONSTRUCTION BASED ON THE ORIENTED WORKING PROCESS IN WATER CONSERVANCY ENGINEERING MAJORS

A. Research analysis on typical work tasks

A water conservancy project is mainly divided into planning design, construction and operation management three stages. Each stage has its particular work process, the information to be collected, the mission to be accomplished, the method, the organization forms, the ways to check are different, but each other has close contact, the former stage is the foundation of the latter stage, the latter is the continuing and outspread of the former[5]. Therefore, we can think of the "three stages" in water conservancy project as "three production process". Each production process has some corresponding professional posts, such as construction process in water conservancy projects, which mainly contains construction and construction jobs, construction supervisions, quality testing post positions etc. Every professional post contains relatively independent, systematic, associated typical tasks, which have their own processes of work. Through investigation and analysis, the typical tasks of each position are in the table 3.

TABLE III. SUMMARY FORM OF TYPICAL TASKS

Post	Project construction	Project supervision	Minor project design	Operation& management
Type tasks	(1) construction line (2) organization and design plans, security plans, quality and technical proposals (3) charter preparation, single project schedule and human, material, machine utensils and equipment planning (4) quality evaluation of the sectional works	(1) quality supervision (2) supervision of construction scheme, quality and technology (3) schedule of project and supervision of human, material, machine utensils and equipment (4) supervision of unit project quality	(1) planning and designs of farmland irrigation and drainage engineering (2) designs of small brake, dams and levees, hole, groove (3)CAD engineering drawings	(1) maintenance and repair of all kinds of dams (2) use and management of the spillways (3)the maintenance and management of the culvert pips and tunnels (4) management of channels and the channels buildings (5) embankment management and emergency rescue

B. Research and construction in area of action and study

In accordance with the process from typical tasks to the action area, from the action area to the area of study, according to the demand of specialized professional abilities to the professional talents, principles of talents growth and theory- practice integration, through the school-enterprise cooperation, it transferred the 16 typical tasks to 6 action areas. With the guidance of work process , the course deconstruction and reconstruction, it transferred 6 action areas to 12 learning areas, to form the curriculum plan of study field(the study field is abbreviated).

C. Learning situation carrier and learning situation division

According to the specific work contents of study field, the thought "from the simple to the complex", the teachers design each teaching project with course experts in the field of learning, so that the students participate in teaching actively, cooperate with each other, and are good at listening and to express their views clearly and accurately in the teaching project. At the same time, they design every learning situation according to the cognitive regularity. "Project" is the carrier of the learning situation, learning situation is the embodiment of "project", the two constitute the whole area of learning.

Then, we clear the ability request, goals and contents, assessment and evaluation, teaching methods and the basic requirements for students and the abilities of the teachers in learning situation, the purpose is to lay the foundation of theory-practice integration teaching.

IV. APPLICATION

To realize the training of "three abilities", the teachers developed courses in 7 general learning areas (to save space they are abbreviated). There are altogether 520 period hours, the theories are 312 hours and the practice is 208 hours. Expanded learning areas are divided into general learning expanding and professional skill expanding areas (courses of study area are abbreviated). There are three models for students to choose in professional skills expanding areas. The students both can " be required" and" be optional ". Although preparations of the teaching resources should be increased, it is welcomed by the students since it provides more favorable conditions for autonomous learning and personality development.

In order to use this result, we innovate and practice such a talent training mode "multiple directions, live module, openness, several rounds of school-running". “Multiple directions " mean we set concentration training on water conservancy project construction, water conservancy supervision, and small and medium-sized hydraulic engineering design, water conservancy project management, and other directions before the school-running timely according to the requirements of society, industry, enterprise and students' employment, intent and specialty (the training materials on school-enterprise cooperation are abbreviated); "Live module" means learning area modules, post training modules and the corresponding teaching contents and time arrangement can be regulated flexibly according to the requirements of enterprises and industries; "Openness" means the process of talent training is a whole , comprehensive and a school-enterprise cooperation process ; "Several rounds of school running" means many times of school running combined with the different courses of the professional fields and the sixth term. It is proved that this model promoted the achievement of abilities and goals in each area of study powerfully.

V. CONCLUSION

Whether the curriculum system in water conservancy engineering majors based on the oriented working process is scientific, advanced and applicable or not, it depends on the professional direction, informative connotation and work research, and the proper method and scientific statistics results and integration; "typical" general, forward-looking typical work; experience and knowledge of the experts; It also depends on whether the learning areas and learning situations are in accordance with the basic rules of education. Whether it conforms to the growth pattern of vocational talents mainly depends on the course experts’ knowledge, ability and education experience.

The courses based on the oriented working process takes working process knowledge as the main content, set up the integrated corresponding relationship between learning and working, solve the problems of the “dual separation between theory and practice, studying and working ". But, the implementation of the curriculum system is vital. Only by building up a scientific talent training mode can it ensure the organization of teaching based on the work process, outstand "task centered" and "situation centered". Therefore, the courses based on the oriented working process and scientific training mode exist side by side, either one should not be suppressed.

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