Instruction Reform and Practice of Civil Engineering Construction Curriculum

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Abstract

This paper describes the background and the basic idea of instruction reform in civil engineering construction curriculum, and elaborates the "engineering capacity target" for the civil engineering construction. In the light of civil engineering construction process, the relevant "specifications" and construction technology development, we integrated the instruction contents. The instruction activities are carried out by taking the practical project as the study case, in basic order of project construction and operation, where the universality of the construction technology shall be reflected and the application of construction technology is also clearly aimed. The classroom instruction, on-the-spot instruction, seminars, engineering design and other flexible instruction methods are used to have knowledge transformation into capacity output. Students receive the assessment from theoretical learning, independent learning, practice design and many other aspects.

Keywords: Instruction Reform, Engineering Capacity, Knowledge – Capacity, Assessment.

1. BACKGROUND OF INSTRUCTION REFORM

1.1 Advancement of application-oriented, instruction reformation

For over ten years in the past, China has witnessed the rapid development in higher education cause. After several years of practices, survey and analysis, it is concluded that local universities should retain its scientific orientation for cultivating high-level application-oriented talents for the development of local economy. Our university has developed the "local, applied and internationalized" running principal by combination with practical situation. The "local and international" advantages are obvious, while the characteristics of "applied" principle still need be further integrated and refined.

1.2 Modular tuition reform

We should draw on the successful experience of modular tuition from the German University of Applied Sciences, and subvert the traditional instruction concept of "knowledge-infusion" with the new "capacity output" mode for the purpose of cultivating the professional talents. On the premise that the professional competence is definite, it can be reifiable as the element of learning ability, which is then improved and integrated into the competence unit. With appropriate knowledge unit, these competence units make up a knowledge body, called the "module". A number of related modules organically match with each other to construct the traditional specialized curriculum system based on disciplinary knowledge transform into a modular system based on the professional competence.

1.3 Requirements of community

More than 70% of civil engineering graduates from our university have been employed to construction units. From the perspective of job qualifications, current and previous employers have different requirements for employees to a certain extent, however the significant difference is that: the previous employers recruit graduates on a preferably selective basis by combination with its own business development and expansion, on demand or when they cling to the concept of talent reserves; the current employers choose graduates in the principle of assessing what they can do, based on their own development benefits. They consider the independent-working spirit as the most basic condition. Today, the corporate training costs have been transferred to the universities, otherwise, the employment of graduates will become thorny in the current job market (Chen and Sun, 2009).
1.4 Instruction situation of civil engineering construction

Civil engineering construction is one of the most important foundation curriculums of civil engineering major. As far as the curriculum itself is concerned, it involves the application of engineering materials; work implementation technology and quality requirements; construction program; construction management and more.

Some contents and many illustrations in textbooks are also very old-fashioned, cannot fully reflect the realistic change in engineering construction, that is to say, there may be a big gap between the instruction and practical production.

In a broad sense, although the multimedia technology is used, the instruction mode is also planar, but the construction work is three-dimensional, thus resulting in a big gap between the engineering capacity of students and the requirements of the industry (Deng, 2011).

2. CONCEPT OF INSTRUCTION REFORM OF CIVIL ENGINEERING CONSTRUCTION MODULE

2.1 Building knowledge-capacity body

In order to achieve the goal of cultivating applied talents, we should cultivate engineering talents with good “engineering capabilities” and focus on the “competence cultivation”, and by combination with prepositioned curriculum instruction to determine what we impart in this curriculum. The knowledge and the competence are incorporated to build the Knowledge-capacity body, also called the module, with the basic idea, as shown in Figure 1. Such module, which takes the engineering capacity as its core, is the basic instruction monomer in the talent cultivation activities.

2.2 Positioning engineering capacity

Instruction objectives, i.e. the engineering capacities, are defined as follows: (1) master the operations of various links in routine construction process; (2) master construction quality standards and specification applications; (3) prepare the conventional branch project, sub-project construction programs (4) Independently prepare the construction management plan for general units; (5) leader of general construction on the site in accordance with the design documents of the construction organization, assist in the management of the construction site.

Instruction requirements: master the principles of construction technology and construction organization; know well the quality inspection and inspection standards; have a good understanding of contents and requirements of the construction project documents.

2.3 Preparation of knowledge contents

As we know, the instruction content of civil engineering construction generally covers earth and stone works, foundation works, masonry works, reinforced concrete works, assembly-line method, network planning technology, etc., which involves a lot of knowledge about measurement, materials, mechanics, structure, economy, management, law and many more disciplines (Du and Zhao., 2006). As a practical curriculum, it directly matters with civil works. Based on the state-of-the-art and characteristics of construction technology and management, we should abandon the outdated construction process, construction methods, by making use of first-hand resources
on the project sites, focus on the development of instruction connotation, and integrate contents of the teaching units.

Internal relationship between engineering knowledge and project implementation is analyzed. Textbooks and relevant "specifications" are the explicit carriers of knowledge. The practical project is the recessive carrier of knowledge and "capacity". The implementation of engineering project is the product of the combination of explicit knowledge and recessive carrier. The teacher contents (handouts) come from the textbooks and relevant "specification and construction manuals", and the background information of project. The instruction repertoire depend on civil engineering works for the avoidance of such phenomenon that theory is separated from specification. After adjustment on relevant knowledge contents, the knowledge in the "civil engineering construction module" gets more targeted.

2.4 Rigid requirements for students in their learning process

Great attention must be paid to assessment on students’ mastery of knowledge and development of competence throughout the whole process of instruction. The instruction objectives are referred to schedule the assessment projects and contents in the process. A variety of modes should be adopted for assessment, such as unit exam (test paper), special content design (construction program), learning debriefing (or thesis) and so on (He, 2014). The process assessment actively improves the initiative of students for learning, effectively distracts their learning pressure, thus to have some time to allow for the smooth conversion of knowledge in this process.

3. IMPLEMENTATION OF INSTRUCTION REFORM

For the purpose of achieving the instruction objectives, by taking the diversified instruction methods, we seamlessly integrate the theoretical and on-the-spot instructions, engineering design practices, lectures and other processes.

3.1 Theory instruction of classroom

3.1.1 Instruction bedding

First, students should be directed to read the construction drawings, engineering geological data and relevant engineering materials so that they enable to have a fully understanding of the engineering features, insight into the correlations among various parts of the project, the overall image of space. The teaching contents are transferred to the practical engineering data carrier. In this way, the basic bedding of overall instruction is accomplished (Hu, 2016).

It is certain that the construction drawings are used to describe routes, modes and methods for physical objects of projects. The students are given a slide show and guided to be familiar with the relevant requirements of the relevant “specifications”, the “construction manuals” and project acceptance “specification”, clarify the correlation between civil construction and relevant fields, the normalization and principle of construction, the diversity of construction modes and methods and sustainable development.

The instruction at this stage enables students to fully comprehend the theory content of textbook, the construction connotation, and develop the concept of scientific construction; foster the value orientation of occupation, awareness of professional ethics.

3.1.2 Carrying out instruction around projects

The housing construction is instantiated here. The instruction by units is conducted in the order of house constructions, i.e. earths and stones, foundations, columns or walls, plates, etc. The previous independent steel works, formwork and scaffolding projects are disassembled into all parts with strong targeted process, which not only reflects the universality of construction methods, construction requirements, but also highlights the particularity achieved by the construction method in current project.
The whole instruction program is scheduled in detail to give a prominence to the key points with appropriate details and omissions, that is, the differences between methods, means, requirements and organizations in divisions are reflected, while their common points and the uniformity must also be clarified.

3.1.3 Seminar

The branch project, sub-project construction program should be discussed. Students will take their extracurricular works in the classroom for exchange, learn from each other. In the case of positive interaction between teachers and students, students will better absorb and digest their instruction contents so that students' enthusiasm for learning is aroused.

3.1.4 Diversified instruction methods

Some instruction content can be clearly expressed in words or languages, and explained by writing them on blackboard. Construction process is tangible, and the simple word is just a symbol. It is difficult for students to understand it, for example, the electroslag pressure welding of steel works, students can watch video, animation or pictures, coupled with teachers’ explanation in the process, whereby the students can deepen their understanding of construction technology.

3.2 On-the-spot instruction

The main method of on-the-spot instruction is situational on the project site. According to the instruction content, we work out the schedule for on-the-spot instruction, and confer the situational instruction as planned and targeted in stages on the project site, the "intramural training center", where the teaching units include earth and stone works, foundation works, column (wall) works, beams and plates, masonry works, decoration works, and the main contents to be explained cover the construction process, the key construction methods, the construction and quality management, the guiding ideology for developing the construction program, the project management organizations and responsibilities.

3.3 Instruction of engineering design

The practical instruction for engineering design is divided into two parts.

3.3.1 Construction design of project units

According to the contents of the teaching units, as required for data in the overall project, the class designs with different sizes of workloads are arranged, in this way, what students learn can be purposively digested, understood and applied. On this basis, it is easy for students to have an overall recognition on the contents, instruction objectives of civil engineering construction modules, for example, when giving students a lecture about the earthwork units, the engineering drawings and construction design requirements will be handed out to them. After the class, students should submit their earthwork construction program for the project; another example is an integral construction of houses. Students should submit their construction programs about concrete beams, plates, columns and other sub-part projects, scaffolding, as well as corresponding quality acceptance requirements after class.

3.3.2 Integral construction design for project

On the basis of (1) project unit design, the units are organically combined and perfected to form a construction organization of a unit project, which is equivalent to the previous curriculum design. This facilitates students have an overall cognition about instruction content and objectives from point to surface, and from the surface to the body of civil engineering construction (Liu and Yan, 2011).

3.4 Lecture

It focuses on the modern construction conditions, new processes, construction technology development prospects,
construction management and other contents. Those experienced engineers and technicians, managers, researchers from the construction units, scientific research institutions are invited to attend the lectures (Wang and Liu, 2017). The contents mostly involve many typical issues occurred in engineering practice, among which some will be likely to be encountered by students after graduation. Special lectures not only extend the students' horizons, enrich the teaching contents, but also receive a good effect.

3.5 Assessment

Students must accept the assessment on 3 items after they pass up the "modules".

3.5.1 Written examination

In recent years, the propositions are generally given in accordance with the "National Requirements for Qualification of Qualification Primary Registered Construction Engineer", which will help students learn in line with the industry specifications.

3.5.2 Independent learning

It includes "(1) project unit design", and other contents required for self-learning.

3.5.3 Engineering Design

It aims at "(2) the overall construction design of the project". The instruction framework is shown in Figure 2.

![Instruction framework](image)

**Figure 2.** Instruction framework

3.6 Focusing on social resources

Civil engineering construction curriculum is related to strong practicality. With the rapid development of the construction technology, the textbooks become outmoded, so that it totally depends on teachers. The instruction conditions sometimes fail to match the goals and effects of talent cultivation. In order to better improve students' practical abilities and carry out knowledge transformation and application well, we must take advantages of community forces and resources to improve the construction of internship and training bases of relevant construction units and develop a reasonable course of practical training instruction.

4. CONTEMPLATION ON THE CONSTRUCTION OF HANDOUTS (TEXTBOOKS)

The current textbooks lay emphasis to the unithood, systematicness and integrity of the knowledge structure in the content arrangement. Today, our instruction model is to organize the contents around the project implementation. In the competence-oriented pedagogic activities, knowledge updating and replacement are also a dynamic process and there is no suitable textbook in current time (Zhang, 2012). Textbooks, relevant
"specification", engineering data are taken as students’ references for learning, the benefit of which lies that students can have all-around comprehension for construction by reading a wide range of different materials; the disadvantage of which is that standardized management is hardly implemented. The compilation of textbooks suitable for training "engineering capacity" is also more and more urgent.

5. CONCLUSION

The instruction reform practice of civil engineering construction curriculum aims at training students with good "engineering capacity", integrates the teaching contents around the output of "engineering capacity", further to build the knowledge-capacity body. A diversified and colorful instruction methods are adopted by laying stress on training student engineering capacity in order to meet market requirements. The theory and practice can be combined in an effective time, thus reducing the costs of employment and work of students, and improving their engineering specialty competence (Zhou et al., 2009). After several years of instruction practice, we have achieved an ideal effect and good feedback from the employer. How to participate in instruction content planning, how to transform students' learning into productivity, and how to assess students' engineering accomplishment? these still require an in-depth exploration and practice.

REFERENCES