On the “Integrated Platform-Ability Module” Practice Teaching System—Cultivation of Engineering Practice Ability of Civil Engineering Specialty

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ABSTRACT

This paper proposes integrated platform - ability module practice teaching system based on the, constructs the ability training module, discusses the teaching organization and teaching methods to ensure the good operation of the integrated platform - capacity module practice teaching system, and puts forward three reasonable combinations.¹

KEYWORDS

Professional certification of civil engineering, quality education, knowledge connotation, integrated platform - ability module, practice teaching system, civil engineering specialty

INTRODUCTION

With the development of economic construction, the demand of the applied talents in civil engineering presents a series of new characters: 1) the transformation from gradual cultivation mode to “plug and play” mode, which shortens the fusion time between the theoretical knowledge and engineering application for graduates;

2) the transformation to the comprehensives and innovation ability of solving problems under multi-technology, multi-procedure and multi-factor situation. For better serving society and to meet the demands of development, Ministry of Housing and Urban-Rural Development proposes 13 knowledge and ability needed for the graduates of civil engineering, which includes engineering knowledge, problem analysis, design/development solution, research, usage of modern tools, engineering and society, environment and sustainable development, professional norm, individual and team, communication, project management, and lifelong learning[1].

The ability can be classified into three levels: practical ability, engineering application ability and innovation ability. For engineering applied talents, there exists an important characteristics different from other kind of talents, which is solving actual problems with knowledge and skill, and developing new construction method and technology[2].

From quality education theory, quality is the basis of ability, ability is the manifestations of quality, and the magnitude of ability is determined by the quality[3]. The human quality still includes quality on science, humanistic and social history, besides of physiology quality. Different quality combination causes different ability with different practice application in which ability solves problems and obtains knowledge. The formation of quality is from the connotation of knowledge by impartation and practice application, which causes different quality.

Based on the profession evaluation requirement of civil engineering, the course system includes mathematics and natural science, engineering basic courses, professional basic courses, professional courses, practice link(experiment, practice, course design and innovation training), and graduation design.

For the process of knowledge connotation, the knowledge of mathematics and natural science is obtained by impartation; the engineering basic courses include mechanics, drawing, measurement and computer technology, the knowledge of these courses is obtained by impartation; the professional basic and professional courses include concrete structure, steel structure, civil engineering construction, cost of construction engineering, project management for civil engineering and experiment technology, etc. These courses are more comprehensive, and the knowledge of these courses is obtained by impartation and practice application. That means there not only needs the impartation of theoretical knowledge, but also needs the practice in practice link, and the two methods must be combined effectively.

The traditional personnel training mode emphasizes the impartation of theoretical knowledge and neglects the effective combination with practice link, which causes the deficiency of the cultivate training on ability about comprehensive application, design application and innovation[4]. In this mode, the practical teaching is attached to theory teaching, and its content is limited to the verification of theoretical knowledge. Thus, building the practical teaching culture system of civil engineering adapted to professional programmatic accreditation is of is of significant importance.
CONSTRUCTION OF “INTEGRATED PLATFORM - ABILITY MODULE” PRACTICE TEACHING SYSTEM

According to ability training objectives, the practice link includes four levels of confirmatory, comprehensiveness, designing and innovation, which respectively corresponded to basic practical ability, comprehensive application ability, design application ability and innovation ability.

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Based on the demand characters of the applied talents in civil engineering, the practical teaching culture system should pay more attention to the comprehensive application ability and design application ability in application-oriented institutes. Thus, this paper integrates the original practical teaching system, and proposes integrated platform - ability module practice teaching system, its structure is shown in TABLEI.

Construction of Integrated Platform - Ability Module

The core of the system is ability module, ability modules in different levels compose platform. During the construction, the ability demand is the guidance, and the engineering application ability training is the main line. Firstly, the ability points of original practical teaching system must be extracted, decomposed and classified based on the professional theoretical knowledge system and classification of different levels of ability. Secondly, the ability points of single course or multi-courses must be combined with the principle of carefully chosen and broaden. And for the last, the practice link(experiment, practice, course design and innovation training) must be designed based on the principle above-mentioned to compose different levels ability training module. The combining practice platform includes subject foundation practice platform, engineering practice teaching platform and innovation practice platform.
THE SUBJECT FOUNDATION PRACTICE PLATFORM AND ABILITY MODULE

This practice platform includes practice teaching of all professional basic courses and a few professional courses with low comprehensiveness, which trains the basic practical ability, basic comprehensive application ability and design ability. The ability module includes confirmatory practice module, single course comprehensive ability module and single course design ability module, which is less than 40% of class hour and credit in the whole system, and the confirmatory practice module is less than 15%.

The confirmatory practice module is the confirmatory practice link which is necessary and difficult to integrate for related course theoretical knowledge, such as the mechanical properties experiment of steel bar in civil engineering construction.

The single course comprehensive ability module is constructed with courses, mainly includes the comprehensive practice ability module which combines the knowledge and ability of the course, such as the GPS comprehensive measurement experiment in engineering measurement.

The single course design ability module is constructed with courses, mainly includes the comprehensive practice ability module which combines the knowledge and ability of the course, such as the filling and tamping experiment in soil mechanics.

THE PROFESSIONAL PRACTICE TEACHING PLATFORM AND ABILITY MODULE

This practice platform includes practice teaching of professional courses with high comprehensiveness and multi-courses, which trains the engineering comprehensive application ability and design application ability under multi-technology, multi-procedure and multi-factor situation. This platform is in 3-4 academic year. The ability module includes multi-courses comprehensive practice ability module, multi-courses design ability module and professional application software practice module, which is about 40% -45% of class hour and credit in the whole system.

For multi-courses comprehensive practice ability module and multi-courses design ability module, there exists two kinds of combination. The first is the combination of the comprehensive and design practice ability module which combines the knowledge and ability among the courses in one semester, such as civil engineering bidding course design in which the related knowledge and ability of the courses in one semester as budget of civil engineering, engineering economy, civil engineering construction, civil engineering bidding, etc. the second is the combination of the comprehensive and design practice ability module which combines the knowledge and ability among the courses in different semester and different academic year, such as construction practice in which the related knowledge and ability of the courses in different semester and different academic year.
year as civil engineering construction, building architecture, civil engineering materials, engineering mechanics, etc.

For the professional application software practice module, the current professional software is used to train the practice application ability, the related module includes budget of civil engineering software practice, PKPM practice, etc.

This kind of module is constructed beyond the original practical teaching system, in which the arrangement of related courses is considered adequately.

THE INNOVATION PRACTICE PLATFORM AND ABILITY MODULE

The innovative practice of college students is an important part of the undergraduate teaching quality and teaching reform project promoted by the state. It aims to explore and establish a teaching model with the core of problems and topics, to initiate innovative experimental reform with undergraduate students as the main body, and to mobilize the initiative, enthusiasm and creativity of the students. With innovative practice, the undergraduate’s innovative thinking and innovation consciousness can be stimulated, the way of thinking and solving problems can be grasped gradually, and their ability of innovation and practice can be improved.

The innovation practice platform includes single subject innovation ability module and multi-subject innovation ability module, which is about 15% -20% of class hour and credit in the whole system. This platform is in 3-4 academic year.

The single subject innovation ability module is constructed by teachers of civil engineering. Teachers organize the practice link to train the innovation ability combined with industry demand and their research direction, such as research on recycled concrete.

The multi-subject innovation ability module is constructed by teachers interdisciplinary. Teachers organize the practice link to train the innovation ability combined with different industry demand and their research direction, such as research on pollutants in green construction.

Teaching Organization and Teaching Methods

In order to ensure the good performance and effect of the integrated platform - ability module practice teaching system, three reasonable combinations should be highlighted in the teaching organization and teaching methods.

THE REASONABLE COMBINATION OF INTERNAL SCHOOL ORGANIZATION AND PRACTICE TEACHING OUTSIDE SCHOOL

The module project under the professional practice teaching platform is of strong practical application, which can be carried out in the form of the combination of the internal school organization and the outside school practice. For example, the students take the form of the work assistant of actual working post under the guidance of the technicians outside school.
THE REASONABLE COMBINATION OF TEACHER’S GUIDANCE AND THE STUDENT’S INITIATIVE IN MODULE PROJECT

The use of module project under the subject foundation practice platform is mainly the verification of the basic knowledge and the cultivation of the basic ability. In this part, teachers are the dominant and the students participate.

The module project under the professional practice teaching platform are comprehensive, some of which involve multi-courses in the subject, and many related professional teachers can be invited in collaboration with students, and the way of practical theme design is carried out with the students.

The module project under the innovative practice platform can be designed by the teachers, which comes from the open practice theme in the scientific research projects related to the courses or research direction of teachers. Firstly, students do the practical theme design independently according to the subject direction. Secondly, teachers determine the feasibility and science of the practical design, and then the students design and implement the project. Finally, teachers evaluate the practical results.

THE REASONABLE COMBINATION OF VIRTUAL TECHNOLOGY AND PRACTICAL OPERATION

The actual operation of the students' participation in the project can deepen the perceptual knowledge and play a significant role in cultivating the ability. However, under the condition of insufficient education funds and limited investment in education, the reasonable combination of virtual technology and practical operation should be adopted. In view of the big investment and time consuming in the ability module project, the practice of virtual technology such as simulation and multimedia can be considered, such as the virtual construction technology in civil engineering construction.

CONCLUSIONS

The training of the professional ability of civil engineering needs the integration of the practice teaching link training and the impartation of theoretical knowledge. This paper proposes integrated platform - ability module practice teaching system based on the professional certification. During the construction, the ability demand is the guidance, and the engineering application ability training is the main line. Besides, this paper constructs the ability training module, discusses the teaching organization and teaching methods to ensure the good operation of the integrated
platform - capacity module practice teaching system, and puts forward three reasonable combinations.

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