Postgraduate Education Programs in Civil Engineering Based on Application-oriented University

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Abstract. The purpose of this paper is a discussing of the postgraduate education in civil engineering base on the education cognition rule. The author recounted the background of Chinese students’ high school education style in application-oriented university and made a comparison between China and America in order to promote the experiences and learn from each other. An example of explanation of courses and the ways students trained were discussed in this paper. Related to the future of civil engineering field, several suggestions were put forward in the conclusion.

Introduction

As the development of postgraduate education programs in civil engineering, higher requirement increased. At present, much more researchers focus on education theories and rules on primary school and middle schools programs. There are great differences between Chinese and American in teaching philosophy and education programs, which are derived from different historical evolution, cultural background and education system. They pay less attention on high education, especially in postgraduate program. As far as young people choose to study abroad after graduating from high school or even junior middle school, the condition become more serious that high education should train and keep the excellent young people in China. How to retain students, especially to attract foreign students to China, has become a meaningful topic. This subject studied the graduate training scheme, make the analysis and comparison of Chinese and the American in civil engineering field. Two kinds of graduate education of civil engineering specialty has been discussed, investigation and research are helpful in such a field. Hope to be able to break through from the old senses and give suggestion to the present stage.

Backgrounds of Educational Theory

E.I. Thorndike[1] thought that the aim of education is spread the knowledge, it depends on the bonds of situations and responses, and constitutes the thoughts, emotion, action and altitude. M. Wertheimer and W. Kohler[2,3] insisted that right objectives, active study and human being insight may establish the understanding path named “confirmation theory”. In China, educational psychology started two thousand years ago and the points “search and then find, do and then succeed, accumulate and then abundant, practice and then perfect” [4]. As the developing of educational theory in psychology field during hundreds of years, we found that the basic human nature are similar but the way that the education spread may presents in different aspects.

J.S. Bruner[5] thought that the essence of study is not the negative stimulate-response connection, he confirmed that the cognitive structure should be formed positively. And students may combine the new knowledge with the old knowledge actively. This is the way to contribute the knowledge system. The basic professional knowledge and skills has already been brought to the young people during the bachelor time, how to practice and develop may become the new aims to the postgraduate students.
Cognitive Rules of University Students

From the perspective of university students' cognitive rules, undergraduate and postgraduate education should be a process in which the logical thinking ability gradually tends to be mature. Postgraduate education should be another enhancement and systematic training on the basis of undergraduate ability. It should be a correction of this lack, students have made breakthroughs in self-study ability, hands-on ability and complicated engineering problem analysis ability.

Stepping out of the ivory tower, the innovative young people we cultivate are those step with innovative consciousness, innovative thinking, innovative ability and innovative personality. Innovative young people are not only well-developed, but also fully developed. On this basis, young people have made great contributions to social material civilization and spiritual civilization. Therefore, it is necessary to take practical measures from the reality of my major and effectively promote the cultivation of innovative young people.

Three basic stages are contained by the significant procedure: obtain, transfer and commend. Nearly ten to fifteen courses shall be taught and thirty to forty credits shall be obtained during the first year. All the course are prepared for the advance materials and mechanics or some of the higher level calculation methods. Transfer means the ability to change the knowledge to other format rather than keep them in the book or in the mind. For example, the knowledge can be used in solve one complex projects like a finite analysis, more detail data can be acquired. And the most important thing is advanced knowledge obtained during the procedure. Comment is an inspection of transfer. The reasonability of new method which used in solve complex engineering problem will be checked.

Postgraduate Education in Civil Engineering in China

Civil engineering has a long history in China. The earliest civil engineering major was funded in 1895 named Beiyang Xuetang in Qing dynasty. After the establish of People’s Republic of China, the major expanded in different branches such as building structure, road, bridge, tunnel, hydraulic, harbor, oil platform and so on. Students face to the design, construction, project management, project supervision career.

Since the 1990s, civil engineering has become an increasingly important major in the national economy. Amount of graduates have built up a good reputation and achievements in more than 30 years. From the actual situation, the training of applied creative young people is our goal as well as the implementation of quality education key.

In the graduate stage, civil engineering students are generally required to use test method or finite element analysis to solve the internal mechanical problems, dynamic problems, material problems, structural reinforcement and life problems, or to further explore the structural design theory. It is required to cultivate students' logical thinking ability and practical ability, especially in today's rapid development of technology of computer, students are required to be able to match practical engineering problems or basic research with good software and skills. From the perspective of cultivation, our university is still an application-oriented university, and graduate students should have theoretical knowledge and practical ability to analyze and judge.

Current education system of the university entrance examination in China, high school students always endure the big burden of homework and examinations. They devote most of their time to repeat the knowledge by various calculations and recitation, and their ability of training is relatively neglected and deficient.

An Example of the Specific Feature in Application-oriented University

Application-oriented education has developed over thirty years in Zhejiang University of science and technology. Among various high education universities, she should have her own feature and establish her own brand.
The sources of students are bachelor students who pass the entrance examination at the tempest class, and this has been promoted a few within five to six years. That means the level of student are rising. According to the statistics of the nearly three-to-five years graduates, the career of the students are designer and constructer. Except those who pass the civil service examination and those who changed the field, nearly 85% of the graduate are servicing in civil engineering works. As the report said, it took 3 years that one graduate student could work independently and five to seven years to become a manager or supervisor.

Here is the table for the common courses, credits and the application fields, students have the rights to select the correspondent course that connect with the research objectives:

Table 1. Courses and credits in civil engineering postgraduate program.

<table>
<thead>
<tr>
<th>Course</th>
<th>Suggested credits</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical computation Technique/</td>
<td>3</td>
<td>Finite calculation, software, data processing</td>
</tr>
<tr>
<td>Elastic Mechanics/ Computational Structural Mechanics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced reinforced concrete/</td>
<td>3</td>
<td>Durability research, structure life evaluate, non-</td>
</tr>
<tr>
<td>Advanced steel structure</td>
<td></td>
<td>destructive testing, advanced design</td>
</tr>
<tr>
<td>Advanced Soil Mechanics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Deep Foundation Excavation Engineering/Ground Improvement Techniques/</td>
<td>2</td>
<td>Geo-technology skill in tunnel, foundation, surroundings, basement</td>
</tr>
<tr>
<td>Performance and Test Methods of</td>
<td>2</td>
<td>Micro characteristic of cementitous materials</td>
</tr>
<tr>
<td>Cementitious Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Environment Physics/</td>
<td>2</td>
<td>New energy saving technology, sounds, thermal and</td>
</tr>
<tr>
<td>Building Technology Introduction</td>
<td></td>
<td>heating calculation and design</td>
</tr>
<tr>
<td>Building Performance Simulation and Testing Method</td>
<td>2</td>
<td>Skill of tests</td>
</tr>
</tbody>
</table>

Notes: the table does not contain the public courses such as language, literature, mathematics and so on.

**Postgraduate Education in Civil Engineering in America**

The scope of knowledge in civil engineering is more widely in America than in China. Optional classes are prepared for lots of branches in order to meet the requirements of the specific works. This in turn, requires the ability of self-study and self-management.

American teaching system has certain progressiveness and rationality, but due to different cultural backgrounds, especially from the beginning of education system, it is very different from China. The independence and creativity is better but the ability of mathematics and physics is less. Therefore, it has something to learn from, but it cannot be used for reference. We should learn from its advanced teaching concepts, improve the existing training programs, and establish a training system that helps innovative young people stand out. The cultivation system should have relative adjustment space as to the social and talent change requirements, try to protect the cultivation system, structure and mode, and affect its operability. The evaluation of students should be led by promoting and motivating the development of students' innovation ability. The training program should be combined with the teachers. A good training program can bring out the outstanding side of teachers, and the teachers, students should complement each other and make common progress. The establishment standard of the curriculum and the evaluation system of the achievement should take into account the factors such as innovation awareness and ability.

The freedom of project selection is more flexible in American education. If students have their own special subject interesting, they will contact the teacher who is close to this direction. The teacher would give them some advice, and then will also help you make the decision about what to do and how to do. Both specified topic and little research are available, some would focus on a project, some items may be parts of the big subjects such as help doctoral students to complete a small project to meet the needs of a master's degree.

Team research is also a good way to train the students’ cooperation ability and leadership. The team should contain at least one tutor, such as an assistant of the professor, or a doctoral student,
and then the following several master's degree students. They will do experiments together. Some tutors took the project outside themselves and may need the student team to do it together.

Conclusion
As a conclusion, to cultivate a good academic atmosphere and professional quality and to promote the quality of postgraduate students in civil engineering in application-oriented university, professional courses, practical training and advanced research method are required.

The cultivation program should be open to a certain extent and keep close contact with the society, so as to change cultivation methods, grasp the social changes and cultivate innovative in social practice. We should allow full discussion of various academic ideas, respect and encourage students' innovation consciousness and spirit, enable students to learn from each other in a good academic atmosphere, encourage students to take part in academic exchanges in the postgraduate stage boldly, and maintain good contacts with professionals in the industry for common improvement.

References