

# Teaching Reform of Civil Engineering Based on Discipline Competition

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**Abstract.** The effect of structural design competition on cultivating students' comprehensive abilities was analyzed. The present investigation focused on some items such as innovation ability, practical ability, teamwork ability, study style construction, and so on. The positive influence of structural design competition on the ability cultivation of college students was discussed.

## Introduction

The professional training objectives of civil engineering is application-type undergraduate talents. The important content in training objectives is to cultivate students' practical ability and innovative ability. Practice is the foundation of innovation education. To cultivate the creative ability of undergraduates, it is necessary to build a good practice training platform for them. Disciplinary competition is one of the effective ways to cultivate college students' practical ability and innovative ability[1-2].

Xi'an Shiyou University has trained a dozen civil engineering undergraduates up to now. However, no any structural design competition was hold. If a civil engineering student, want to improve his ability and to increase the practice of exercise opportunities, he can only to participate in "College Students Mechanical Design Competition" , "Mathematical Contest for College Students" and "Mechanics Contest for College Students". However, the "Structural Design Competition" is one of the nine major undergraduate competitions determined by Chinese Ministry of Education[3]. Also, it is the discipline competition closest to the civil engineering specialty. As a platform to train the comprehensive abilities of the students of civil engineering majors, the structural design competition has the innovative educational functions that can not be replaced by conventional teaching[4-5].

## The role of structural design competition

In March 2017, the first structural design competition of civil engineering department of Xi'an Shiyou University was hold. The competition was entitled "Design of Single-Span Simple-Supported Paper Bridge Structure Model". Considering the students' knowledge structure and competition effects, only the third-year university students of civil engineering took part in the competition. During the first paper bridge design competition, the students began from the model of a variety of bridges. According to the model, they combined the knowledge of mechanics, structure and materials, in order to design and manufacture of paper bridges. Then students load the initial design model through experiments. During the experiment, they found that the problems and try to improve the design and test until the final loading test. The complete competition process enhances students' interest strongly in civil engineering. The process is helpful for students to form a developmental knowledge structure and to pursue the indomitable spirit of scientific discovery. Especially, the competition process plays a significant role in creating a good learning environment, promoting the construction of study style and fostering the students' innovative ability, and practical ability[6-7].

### Stimulating students' interest in learning and promote the construction of study style

During participating in the structural design competition, students should plan each component form of the model according to the principle of structural design, select the size of the component by using the knowledge of material mechanics, and design the structure as a whole according to the theoretical knowledge of structural mechanics. In the process of designing the structure and making

the model, the basic theoretical knowledge can be put into application. It let students have further thinking and physical understanding of the course contents such as material mechanics, structural mechanics and civil engineering materials[8].

The competition content is closely integrated with the students' knowledge, so that it makes the competition process become funning and challenging. The advantage of design competition in university level is that it has large coverage of students (the participating students make up 80% of grade level students), the divergent effect of the activity creates a good learning environment. Different aspects of the competition can guide and motivate students' understanding for the importance of learning and enhance students' learning interest strongly. All of them have played a very good role in improving the study style. Both students and teachers felt the harvest and surprise from the competition. It is gratifying to see the spirit and infinite creativity demonstrated by the students in the competition. After the competition, such courses as 《Bridge Project》, 《Concrete Structure Design》 and 《Seismic Engineering of Structures》 have markedly improved in students' attendance rate and learning interest. Guiding teachers also introduced competition-related content into their daily classroom teaching. An effective interactive model, which guided the structural design competition with professional knowledge and in turn promoted the teaching of specialized courses with structural design competition, was formed.

#### **Improving students' practical ability**

By participating in the structural design competition, students can analyze the title of the competition independently, design the process independently, take the initiative to think some problems, apply the knowledge and skills to find the solution for problems. They also direct hands-on calculation, modify their design, and make production, instead of desperation or blindfolded sitting fantasy. The most important feeling for students to participate in the contest is that thinking can be done thousands of times better than once. The students are transformed from passive recipients in traditional education into active implementers who show their talents. The students' independence, subjective initiative and practical ability improved greatly. The perseverance and perseverance of students were trained. It is obviously that the structural design competition is helpful and effective to enhance the overall ability for students.

#### **Enhancing students' innovative ability**

Structural design competition is an effective way to develop students' abilities. From the beginning of the contest, students must submit a completely new work within the stipulated time. Based on the existing theoretical knowledge, the students must design the components and analyze the structure of the test model from the perspective of improving the bearing efficiency of the structural members, and put forward corresponding solutions according to the analysis results. If the students encounter difficult problems, they must learn the related new knowledge and understand new methods. Through the process of continuous improving their model and testing it, a new and good structural model with satisfied capacity was designed at last.

The process of competition simulates the whole construction process of "Feasibility Study - Project Design - Manufacturing - Testing - Improvement - Acceptance" for an actual project, which can promote the synchronization of knowledge, ability and quality for students. The works Students submitted by students are not exactly the same. Some structural models had new style with vitality and imagination. For all participating students, the spirit of active learning independent access to knowledge and ability to innovate have been exercise greatly.

#### **Developing teamwork skills**

Cooperation is the cornerstone of the team project. The present structural design competition is not only the test of individual ability of students, but also the challenge to the ability of the team collaboration. By collective discussion, reasonable division of labor, tacit cooperation, students could conceive and designed a good performance and unique structural model. For every student, his ability of teamwork experienced a good exercise. It also play a good role to train students to overcome difficulties and meet the challenges.

In addition, teamwork is not only reflected in the students, Guiding teachers also play an important role in this process. They need to communicate with students from time to time. They

should to support and correct the divergent thinking of students from the professional point of view. They should play a pilot role. Structural design competition is indeed playing an important role in cultivating the teamwork skills of undergraduates.

### **Providing a basis for training program revision**

The success of the "First Structural Design Competition" of the Department of Civil Engineering has also greatly touched teachers. The original intention of the competition was to provide students with an environment and opportunity to participate in the practice. However, the result of the competition far exceeded our expectations. The process of the competition not only made students have a profound understanding for the structure design principles, but also greatly stimulated the students interest in learning, effectively improve their overall ability. The process of competition improved and enhanced student's actual skills, innovative ability, competition awareness, psychological quality, and so on.

The effect of the competition made us recognized the importance of practice, thus prompting us to make relevant adjustments to the training program of civil engineering in the year 2017. he item of "structural design innovation and practice" was added. In the project list of second class, "structural design competition" item was an added.

### **Lay a good foundation for participating in high level competition**

In July 2017, Shaanxi Province organized the "First University Students Design Competition in Shaanxi Province". The topic of the competition was "Structural Design and Manufacture of Aqueduct Support Systems." Based on the previous structural design contest in our university, we selected the students who won the first prize of competition to take part in the design competition of in Shaanxi province. In previous structural design in our university, these students won the first prize with 87.212kg still outstanding performance. Their paper bridge weighs 238.2g and the load-bearing ratio reached 366.1. After careful preparation and good play, the students won the second prize of the provincial competition. This stimulated students' professional pride and self-confidence effectively.

The high-level provincial structural design competitions promoted students to exchanges with other university students and learned more specialized courses. Their practical ability, innovative ability and teamwork ability have been greatly enhanced.

### **Feedback survey**

In order to know students' views on the structural design competition, a questionnaire survey was conducted. The results are shown in Table 1.

Table 1 High and low settings of predictor variables

item	well	better	general	Poor
Cultivate students' practical ability	92%	7%	1%	0%
Cultivate Students' Consciousness of innovation	90%	8%	2%	0%
Improve students' ability to cooperat	94%	6%	0%	0%
Improve self-learning ability	85%	10%	5%	0%
Improve style of study	95%	5%	0%	0%

From the data listed in the table, it can be seen that by participating in the structural design competition, most of the students agree that the competition is better in the items of enhancing cooperation, innovation awareness and practical ability. Participants generally believe that the competition not only enriches the students' after-school life, but also exercises their ability to collect information, to solve practical problems and creativity. At the same time, discussions and exchanges during the competition also enhance the friendship between students and the ability to unity and cooperation.

## Conclusion

A training mechanism of practical ability and innovative ability based on "structural design competition" was built. It enables students to master the basic knowledge solidly and accumulate some experience in solving practical engineering problems. Especially some abilities can get very good exercise such as practical ability, innovative ability, teamwork ability, and so on.

Innovative education system for college students promotes the interaction between the first classroom and the second classroom. It plays an important role in establishing a multi-level innovation system for university student with the participation of both teachers and students. A better discipline competition platform should be advocated to increase the chances of students participating in the capacity of innovation and entrepreneurship, so that such training models are sustainable and have some commonality.

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