

The use of comprehensive practical skill competitions in cultivating the innovative abilities of surveying undergraduates

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ABSTRACT: The objectives of college surveying and mapping skill competitions include developing the practical ability of undergraduate students and heightening their awareness of the importance of innovation. The status of Chinese national undergraduate competitions on surveying and mapping skills are described. The case of Henan University of Urban Construction is used to analyse the effect of competitions on practical skills, and on such achievements as the learning motivation of students and the quality of classroom instruction. Experience shows that skill competitions nurture the learning of students of surveying and mapping engineering, as well as the cultivation of outstanding talent for the development of an innovation-oriented country.

INTRODUCTION

In China, information surveys are an important orientation in the field of surveying and mapping, with the aim of providing society with comprehensive geographic information services [1]. Currently, 80 per cent of the information involving human activities is related to geographic information [2].

With the development of China's economy, society has adopted increasingly higher standards for the quality demanded of surveying and mapping, which in turn requires college graduates to have excellent practical abilities and creativity [3].

An increasing number of colleges and universities have begun attaching great importance to practical skill competitions, because such events encourage, promote and assess the innovative and operational ability of students. They serve as an effective platform by which to improve students' capacity for technological innovation, hands-on ability and teamwork, all of which nurture learning [4].

Nationwide undergraduate surveying and mapping skill competitions have been held in China three times since 2009. One of the authors of this article was honoured to guide students in all three competitions and achieved excellent results. For the past five years, practical skill competitions have been the main approach to exploring the acquisition of skills in the training system. Hence, surveying and mapping skill competitions are seen as a platform for cultivating innovation in students.

SURVEYING AND MAPPING SKILL COMPETITIONS

National Surveying and Mapping Skill Competitions for College Students

From 30 July to 2 August 2009, the First Nationwide Undergraduate Surveying and Mapping Skill Competition was held in Henan Polytechnic University. It was co-hosted by various universities, the Surveying and Mapping Education Guidance Committee of the Chinese Ministry of Education and the Chinese Society for Geodesy. A total of 128 players and 32 tutors from 32 colleges with surveying and mapping secondary master stations throughout China, joined the competition.

From 17 to 19 July 2012, Beijing University of Civil Engineering and Architecture hosted the Second Nationwide Undergraduate Surveying and Mapping Skill Competition, with 350 players from 51 universities.

From 18 to 21 July 2014, Henan University of Urban Construction hosted the Third Nationwide Undergraduate Surveying and Mapping Skill Competition, with about 300 players from 75 universities.

Following are the events of the three competitions:

- Traversing:

A survey traverse is a sequence of lengths and directions of lines between given points on the earth. It is obtained by a field angle and distance measurements and is used to determine the positions of the points. The angles are measured using transits, theodolites or total stations, where the distances can be measured with steel tapes or electronic distance measurement instruments.

Traversing takes the form of a closed-loop traverse composed of two unknown and two known points. As shown in Figure 1, points A and B are known points, P1 and P2 are unknown points, and the total length of the four edges is about 1.0 km. The teams should be able to measure four traverse angles and four traverse legs within the required time. Based on the known data, they should calculate the plane co-ordinates of the two unknown points within the scheduled time. The result of the angle observations, length observations, and plane co-ordinate calculation should meet the accuracy requirements.

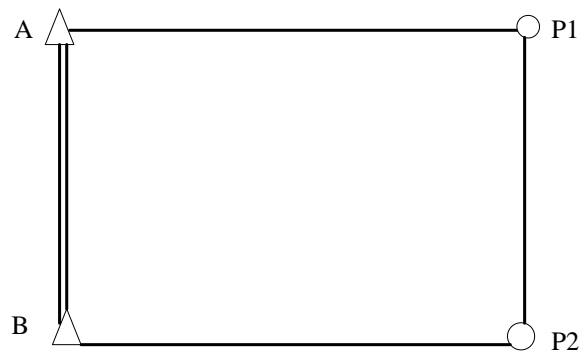


Figure 1: Traversing.

- Spirit levelling:

The most precise and most commonly used method to determine elevations is direct levelling or spirit levelling, which involves directly measuring the vertical distance.

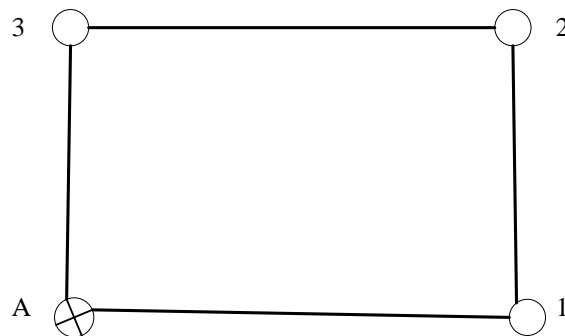


Figure 2: Closed levelling line.

Three unknown points and a known point form a closed levelling line, as shown in Figure 2, with a length of about 1.4 km. The teams use levels to independently finish the fourth-grade levelling survey of a prescribed path within the scheduled time. The elevation of the three appointed benchmarks in the levelling route is then calculated, based on the known data. This must be completed within the scheduled time.

- Digital mapping:

A total station or GPS receiver collects data on ground objects and landform points in a given field region, and a topographic map is drawn using CASS 9.0 software.

In general, the competition area, which is about 200 m long and 150 m wide, with about 250 choppy stride points, is set according to the number of ground objects. The teams are supposed to finish the field survey in about 2 hours and finish drawing in about 1 hour. Each team has one occupied station, one orientation point and one check point. The occupied station, orientation point and check point must be visible from each other. There may be more than one occupied station and they must not block one another. The orientation point and check point can be shared.

Provincial Surveying and Mapping Skill Competitions for College Students

With the development of technology in China, many university departments have considered offering surveying and mapping courses. Aside from nationwide competitions hosted by the Ministry of Education of the People's Republic of China, many provincial education departments and provincial survey agencies have also begun hosting surveying and mapping skill competitions.

The provinces of Henan, Jilin and Shandong have conducted their own surveying and mapping skill competitions, most of which include traversing, spirit levelling and digital mapping competitions. In some provinces and municipalities, a theoretical test is added to the competition.

University Surveying and Mapping Skill Competitions

Many colleges host competitions to build a platform to develop excellent players to attend provincial or national level competitions. For example, Liaoning Technology University has successfully hosted six surveying and mapping skill competitions, Shandong Jianzhu University three, Henan Polytechnic University six and Henan University of Urban Construction, four. Since 2009, Henan University of Urban Construction has competed in six nationwide undergraduate surveying and mapping skill competitions in Henan province and has achieved good results. Table 1 shows the results.

Table1: Awards to Henan University of Urban Construction.

Serial number	Competition	Items	Awards (Prizes)
1	First Nationwide Undergraduate Surveying and Mapping Skill Competition	Traverse survey	First
		Spirit levelling	Second
		Digital mapping	Second
2	Second Nationwide Undergraduate Surveying and Mapping Skill Competition	Traverse survey	First
		Spirit levelling	First
		Digital mapping	First
3	Third Nationwide Undergraduate Surveying and Mapping Skill Competition	Traverse survey	First
		Spirit levelling	First
		Digital mapping	First
4	First Undergraduate Surveying and Mapping Skill Competition in Henan Province	Traverse survey	Third
		Spirit levelling	Second
		Digital mapping	First
5	Second Undergraduate Surveying and Mapping Skill Competition in Henan Province	Traverse survey	Third
		Spirit levelling	Second
		Digital mapping	First
6	Third Undergraduate Surveying and Mapping Skill Competition in Henan Province	Traverse survey	Third
		Spirit levelling	Second
		Digital mapping	First

SKILL COMPETITIONS AND THE CULTIVATION OF TALENT

Practical skill competitions cultivate innovative talent in a number of ways:

- Developing innovative ability:

Surveying and mapping skill competitions reflect students' psychological qualities, their ability to use and understand knowledge, and their spirit of co-operation. In the process, students systematically organise and understand professional knowledge and apply it in the real world [5].

Skill competitions can help students to accumulate knowledge, develop their understanding of new things and, therefore, unconsciously shape new thought methodologies. These competitions can inspire students to undertake innovative activities and to realise the joy of study. Therefore, they strengthen the innovativeness and self-confidence of students.

For instance, in each surveying and mapping skill competition in Henan University of Urban Construction, students have to refer to various data, think independently, and research systematically in designing software and writing a paper. These skills enhance the ability of students to solve practical problems with theoretical knowledge and to develop a strict truth-seeking attitude to learning [6][7].

The Institute of Surveying and Mapping Engineering in Henan University of Urban Construction uses competitions to build the innovativeness of students and to cultivate their holistic qualities. This method has good achievements, e.g. dozens of student research training programmes receive subsidisation every year.

- Developing research and practical abilities:

Students apply theory to reality when they compete in a professional skill competition. The competition has multiple effects on participants, who apply their extensive knowledge of space and time as they undertake multi-angle and multi-level practice [5]. During the preparation for the skills competition, students have to consolidate their mastered knowledge, learn new knowledge by consulting and analysing documents, and independently solve problems relevant to the competition paper and procedures [6].

The competition tests the basic theoretical knowledge and level of operational skills of students [7]. Such tests can also build the practical ability of students in field data collection and indoor data processing, deepen their professional knowledge, widen their view and, hence, enhance their talent.

- Favourable learning environment:

Competitions promote a favourable learning atmosphere with a combination of understanding basic knowledge and applying it in reality. During a competition, students may recognise that their theoretical knowledge is superficial or they have weaknesses in computer programming skills or in writing scientific papers. This makes them aware of the importance of basic knowledge and its use in their work, study and development. More than 100 students attend the surveying and mapping skills competition at Henan University of Urban Construction, which fosters a favourable learning environment in the school. Results for the final examination for the past five years are shown in Figure 3, which shows a clear progressive improvement.

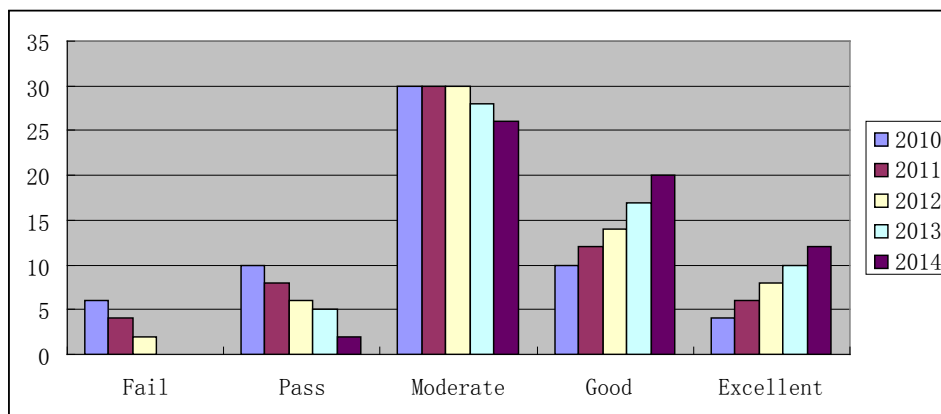


Figure 3: Final examination results for the past five years.

- Fostering teamwork:

Surveying and mapping depends upon practical work. It is necessary to excel in field data collection and in data processing. Teamwork can be cultivated through students competing in skill competitions. To resolve unexpected difficulties that students may encounter during preparation for a competition, students can work as a group to determine solutions. This draws on group strengths, such as mutual encouragement and collaborative reflection.

During a competition, players complete their observations, records and calculation tasks harmoniously. By means of the competition, players realise the importance of co-operation and understand the relationship between the individual and the group. Hence, the players develop teamwork skills and improve their interpersonal communication abilities.

SKILL COMPETITIONS AND SURVEYING AND MAPPING EDUCATION

Surveying and mapping skill competitions are professional matches, during which students can strengthen their operational and practical ability. Hence, these can be a strong supplement to curriculum learning [8].

Through competitions, problems in student practice can be determined leading to the reform of teaching programmes, to improve the practical component. Competing in skill competitions requires competition advisers and judges with profound specialised theoretical knowledge, abundant teaching experience and practical abilities based on experience. Moreover, the competition process requires organisers to have outstanding organisational abilities, a good management system and a favourable location for the competition.

Lastly, skill competitions deepen the relationship between teachers and students and, therefore, improve the content and process of practical teaching, promote academic teaching, and improve the cultivation of innovative talent in surveying and mapping.

CONCLUSIONS

Surveying and mapping skill competitions have many advantages that complement teaching at colleges and universities. They are a guide to the reform of teaching content and curricula, as well as encouraging students to take an active part in professional extracurricular activities.

On this basis, colleges and universities send students to participate in science and technology competitions, to cultivate their innovative and practical abilities. The number of participating students is in the thousands each year. These competitions generate enthusiasm in students and provide an impetus to study. As well, they promote scientific and technical innovation. They foster excellent talent, so as to achieve the building of an innovation-oriented country.

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