

Improving the Comprehensive Ability of Vocational Education Students Through Skills Competitions

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Abstract: Skills competition is an important part of the vocational education system and a booster of teaching quality in vocational colleges. This study explores the role of skills competition in advancing the comprehensive ability of students in vocational colleges from specific cases. Firstly, this paper elaborates on relevant educational policy issue papers. Secondly, the studies of relevant scholars are discussed. Thirdly, the students' work in the Capital Challenge Cup Skills Competition is presented. Fourthly, the preparation process of the competition is used as a case study to explore the improvement of students' abilities in four dimensions. Finally, the main conclusions are summarized. The skills competition is of great significance for vocational institutions to improve teaching quality and talent training mode. Vocational institutions should invest more financial resources and create more policies to support the development of skills competitions.

Keywords: Skills competition; Comprehensive ability; Vocational education; Vocational colleges

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1. Introduction

Vocational education and general education are two different types of education with equal importance ^[1]. Vocational education is positioned to export skilled and applied talents to various industries in society. As China enters a new stage of development, industrial upgrading and economic restructuring have been accelerated. At present, the demand for technically skilled personnel in various industries is becoming more and more urgent, and the important status and role of vocational education is becoming more and more prominent. In April 2022, Chinese government introduced the Law on Vocational Education and emphasized the role of skills competitions in the vocational education system in the form of a law. The document proposes that “the state will provide a platform for technically skilled personnel to showcase their skills and exchange skills through organizing and conducting vocational skills competitions and other activities.” “Vocational institutions should make use of skills competitions to continuously train more high-quality technical skills talents” ^[2]. Various vocational skills competitions are an important supplement to campus education and a platform for talent selection. In 2019, the Ministry of Education issued the notice of “Statute of National Vocational College Skills Competition.” The document proposed that “skills competitions are an important tool to improve the quality of technical skill training, test teaching achievements and lead education teaching reform.” Vocational education should “insist on promoting teaching, learning and reform through competitions.” Vocational institutions should “reasonably draw on

the concepts and standards of the World Skills Competition to cultivate high-quality skilled talents and promote the construction of a skill-based society”^[3].

As a booster for the internal development of vocational education, vocational skills competitions play an important leading role in the process of professional talents training in higher vocational institutions. Therefore, it is necessary to analyze and improve the talent training system from the perspective of vocational skills competition. This paper carries out relevant research work.

2. Research status

An American scholar, Liu ^[4] argues that participation in skills competitions is a win-win situation for both students and teachers. He believes that teachers can enhance their professional competence and thus improve the quality of teaching, while students can consolidate and improve their professional skills and enhance their overall quality. Various skills competitions provide a great help to cultivate high-quality, skillful talents who meet the requirements of modern society. Scholar Wu ^[5] and others have analyzed the problems of digital education and suggested the use of adding a simulation operation competition module within the operating system. Students play games (compete with each other) to complete learning tasks and thus improve the quality of teaching and learning. Japanese scholar Wan ^[6] used a big data approach to investigate the intrinsic relationship between vocational skills and these findings can provide a theoretical basis for other vocational skills research fields, for example, vocational skill training, vocational skill mining and vocational skill identification. Green ^[7], a German scholar, reformed the curriculum based on the core skills theory. He found that highlighting core skills in teaching enhances the integration of academic and vocational learning through teaching experiments. Scholar Zheng ^[8] explained the importance of cultivating applied senior talents from the perspective of the rapid development of the sports market and analyzed the relationship between vocational skills competitions and the cultivation of applied talents. She designed a new system for cultivating applied talents based on vocational skills competition, which provides a reference path for cultivating applied talents in sports economy management. Scholar Li ^[9] analyzed the importance of the “tiered ladder” training mechanism in the context of vocational skills competition, taking the secondary-level electronics students as the research object. Xiao ^[10] studied the optimization of vocational skills competition in the sports industry using various research methods. Scholar Yuan ^[11] studied the role of vocational skills competitions in promoting curriculum teaching reform, taking food service and management majors as an example. She put forward the idea of using the skills competition to promote the teaching content, teaching methods and teaching evaluation of the course. Scholar Lv ^[12] analyzed the methods and ideas of industrial product innovation practice with the case of “industrial product digital design” in the senior vocational skills competition. He believes that skill competitions are important for the curriculum reform and the development of students’ innovation ability.

What are all the advancing effects of skills competitions on talent development? Scholars have conducted studies from different dimensions. However, many studies are more theoretical and lack real cases and statistics. Some suggestions are more idealistic but difficult to apply in teaching. This study analyzes the role of skills competitions in improving students’ overall ability from four dimensions by guiding them to participate in the Capital University Challenge Cup Competition as a case study. The research logic of this paper is shown in **Figure 1**.

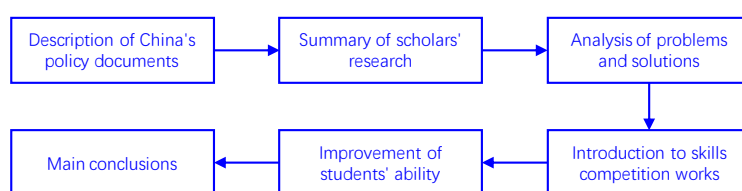


Figure 1. The research logic diagram of this paper. Source: Original figure

3. Problem analysis and solution

This study analyzes the effect of the competition on the overall quality of students by guiding them to participate in the Capital University Challenge Cup Competition. The entry was a precision equipment lifting device. The research team guided the students in the design of the proposal, drafting, prototyping, and writing of the declaration. In order to improve the quality of the work, the teachers and students divided the tasks and analyzed the base deformation under pressure. During the preparation for the competition, the students' overall ability was significantly improved. Firstly, the skills competition required a lot of mechanical design and mechanical analysis skills, so the knowledge they had learned in class was consolidated. Secondly, there were strict requirements in filling out the declaration form, so the students' written expression ability was well exercised. Thirdly, many problems were encountered in the design of the entries, which required the students to analyze their abilities and solve them, therefore improving their problem-solving ability significantly.

4. Skills competition entry

Some students designed skills competition entry under the guidance of the teachers. As shown in **Figure 2**, the precision equipment in the middle is to be lifted. The vertical deflection of the precision equipment must be less than 1° during lifting. Two identical cranes are separated on both sides of the precision equipment. The hydraulic device provides power to the claw through the lever device. The claws on the left and right sides slowly raised the precision device. Obviously, the deformation of the support column (as shown in **Figure 3**) must be considered.

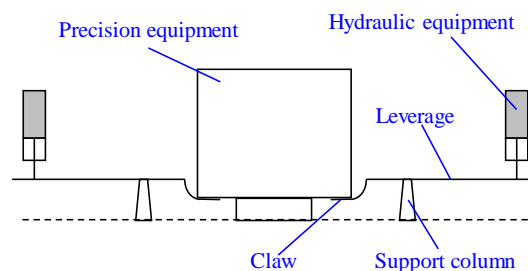


Figure 2. Structure of the skills competition entry. Source: Original figure

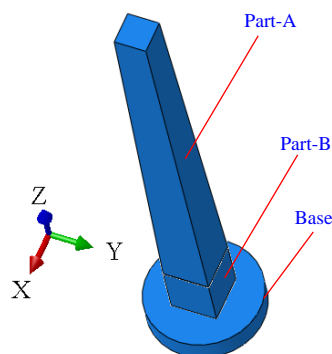


Figure 3. Structure of the support column and its coordinate system. Source: Original figure

The students hoped to test the mechanical properties of the support column. A force of 5 kN is applied to the upper surface of the support column in the negative direction of the Z-axis. The deformation value needs to be tested. The students were hoping for a result less than $30 \mu\text{m}$. To solve the students' problems and promote the progress of the entry, the research team considered using finite element software for modeling and simulation. Besides, the teachers and the students have carried out a division of tasks to quicken the process of completing the entry. The teachers were mainly responsible for finite element modeling and simulation, whereas students were responsible for image production, formula editing, report

writing and so on. With the joint efforts of students and teachers, the problem was solved. The result obtained from the simulation is $14\ \mu\text{m}$, which meets the design requirements. In the process of designing and producing the work of the skills competition, the students' abilities in many aspects were improved.

5. Promoting effect and analysis

5.1. Review the teaching content

If not consolidated in time, students will gradually forget what they have learned in class. In the process of designing and manufacturing the work for skill competitions, the students needed to apply what they had learned, which was very helpful to consolidate what they had learned in class. As mentioned earlier, in order to analyze the deformation of the support column, the students consulted the content of engineering mechanics they had learned. They had to learn again not only the functional relationship between strain and stress, but also the basic calculus calculations. **Figure 4** shows the schematic diagram of calculating the small deformation of the support column that the students established using the infinitesimal method. Through the mechanical analysis of the skills competition works, the students understood some concepts of Engineering Mechanics more thoroughly.

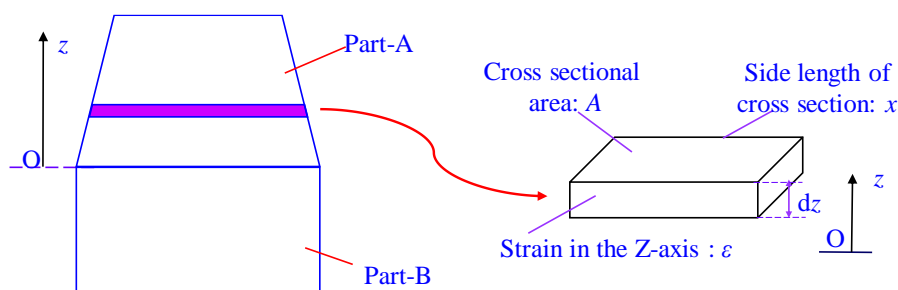


Figure 4. Structure of the support column and its coordinate system. Source: Original figure

5.2. Improve writing skills

It is very important to declare the entries of the skills competition. Under the guidance of the teachers, students write the first draft of the declaration. Since most of the students did not have experience in writing the declaration, the quality of the declaration was very bad. The teachers revised sentence by sentence and explained the reasons for the changes. In this process, the students' written expression skills were improved. The colorful pictures were a plus point for the declaration. The U3 nephogram (as shown in **Figure 5**) was added to the declaration by the students. The redder the color means the larger the deformation and the bluer the color means the smaller the deformation. In **Figure 5**, it can be seen clearly that the deformation of the support column is 1.467×10^{-2} mm. Similar figures and data are important support materials for the skills competition declaration.

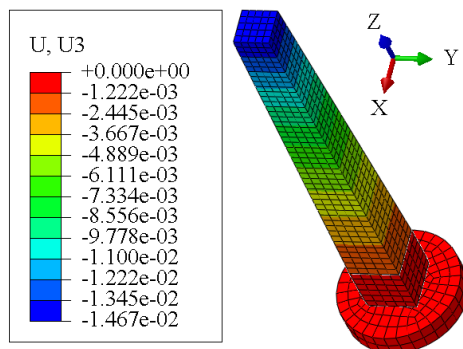


Figure 5. U3 nephogram of the model after simulation. Source: Original figure

5.3. Improve problem analysis ability

The design of a skills competition entry is very different from a traditional classroom assignment. During the design and production process, students will encounter all kinds of problems. It is very important to analyze these problems and come up with reasonable solutions. The deformation of the base will affect the performance and accuracy of the entry. How is the value of the support column deformation determined? By reviewing literature, the students found that there are two ways to solve the problem. One is to do an experiment, and the other is to simulate and analyze. Due to Covid-19 pandemic, the students could not perform the experiments. Even if they can perform the experiments, it would take a long time, which in turn would affect the progress. In the end, the students and the teachers decided to use the simulation method. The modeling and calculations were done by the teachers, while the geometric model and specific simulation data were presented by the students.

5.4. Practice problem solving skills

As mentioned earlier, analyzing the problem is important, but solving it is even more critical. The process of modeling and simulation is not straightforward. Neither the setting of the materialistic properties of the model nor the selection of the mesh type are available in the relevant literature for reference. The students and teachers had to keep figuring out one problem after another. Although they faced many challenges and difficulties, the students overcame them one by one under the guidance of the teachers. Solving real problems is very different from classroom work and this exercise is more meaningful to the students' growth.

6. Conclusions

The current professional talent training system of vocational colleges has its shortcomings and there is a gap between the cultivated talents and the job requirements of enterprises. Vocational skills competitions is a major reform and conceptual innovation of vocational education system. It is of great significance for vocational colleges to improve the quality of education and teaching and to improve the talent cultivation mode. Based on real cases, this paper analyzes the improvement of students' general skills during the competition. The results show that the students who participated in the skills competition were able to consolidate the classroom content and improve their written expression skills. In addition, students' problem analysis and problem-solving skills were exercised.

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Disclosure statement

The authors declare no conflict of interest.

Author contributions

S.W. and F.P. conceived the idea of the study and wrote the first draft of the paper. M.L. revised the format of the article.

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