Scientific and Social Research
2023, Volume 5, Issue 2

Experimental Research on Introducing Skills Competition-Based Content into Classroom Teaching

Shang Wang[1]*, Xuelei Wang[1], Mengjie Li[2]

[1]School of Automotive Engineering, Beijing Polytechnic, Beijing 100176, China

[2]School of Art & Design, Beijing Polytechnic, Beijing 100176, China

***Corresponding author:** Shang Wang, wangshang@bpi.edu.cn

Abstract: The goal of talent training in vocational education is to deliver skilled talents to the society. Skills competitions act as a platform for students to showcase their abilities. In this paper, skills competition-related content was incorporated into the teaching of the Engineering Mechanics course. The teaching experiment was carried out in a class of 40 students and the teaching quality was evaluated in the form of questionnaires. The results show that skills competitions can draw students' attention and improve the quality of education. Therefore, more skills competitions should be organized to improve teaching quality.

Keywords: Skills competition; Experimental research; Teaching; Vocational colleges

Online publication: February 17, 2023

1. Introduction

Vocational education is an important component in China's modern education system. In recent decades, vocational education has delivered countless skilled talents to all sectors of society, which has strongly supported the rapid development of economy. In the context of industrial transformation and upgrading, the demand for skilled talents in various industries is increasing, thus increasing the importance of vocational education. Vocational education aims to nurture high-quality skilled talents. Therefore, the students' practical and hands-on ability is very important. They are not only the necessary skills for enterprise jobs, but also the focus of talent training of vocational education. Various skills competitions are not only an important complement to classroom teaching, but also an important platform for students to improve their hands-on skills [1]. The Chinese government attaches great importance to various skills competitions. In 2022, the government amended the Vocational Education Law, which emphasizes the role of skills competition. The law requires vocational colleges to "continue cultivating more high-quality skilled personnel through various skills competitions" [2-3].

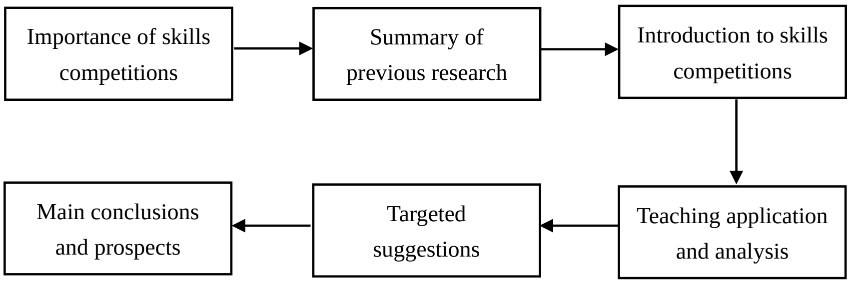

Figure 1. The research logic diagram of this paper. Source: Original figure

In what ways can skills competitions improve the quality of vocational education personnel training? This issue has become a hot topic among scholars. Therefore, this paper attempts to expound on this topic. The research logic of this paper is shown in **Figure 1**. Firstly, this paper explains the importance of skills competition for vocational education personnel training. Secondly, the results of relevant research are reviewed. Thirdly, a typical skills competition entry is introduced. Fourthly, the entry is applied to the classroom teaching of Engineering Mechanics. Fifthly, questionnaires are administered to assess the quality of teaching. Finally, the main conclusions and prospects are summarized.

2. Research status

Scholars have carried out research in different fields. Japanese scholar Wan [4] 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. Maia [5], a British scholar, believes that skills competitions can improve the attractiveness of vocational education. He conducted 110 interviews with contestants of a skills competition. Based on these data, he analyzed the potential contribution of skills competitions in revitalizing British vocational education. Scholar Zheng [6] 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 skills competition, which provides a reference for cultivating applied talents in sports economy management. Scholar Li [7] 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. Wang [8] believes that the construction of training bases in vocational colleges should fully consider the needs of skills competitions. Zhu [9] believes that the important indicators of talent training in higher vocational education are skill level and practical ability. The vocational skills competition rules reflect the latest demand of the industry and enterprises for highly skilled talents. Scholar Li [10] believes that skills competitions are the propellers of the reform and development of vocational education and can promote the teaching reform of higher vocational colleges. He discussed the advantages of vocational skills competition in terms of professional curriculum teaching, quality of teachers, training base construction, and many more. Di [11] believes vocational skills competitions have a positive impact on the teaching of vocational colleges. He found that the vocational skills competition can effectively improve students' innovative ability and practical skills. Scholar Gong [12] summarized the positive effect of nursing skills competition on the teaching of nursing in vocational colleges. He believes that skills competition is conducive to optimizing talent training programs and promoting the reform of teaching models and methods.

The scholars mentioned above have studied the skills competition from different majors and fields. These studies all show that various skills competitions have played a positive role in improving the quality of talent training in vocational colleges. However, there is a lack of cases in which the content of skills contest works is applied to classroom teaching. This article has carried on the related research work.

3. Case analysis

3.1. Introduction to entries

To participate in an innovative design competition, a few students formed a team and designed a finite element model to test the bending data of a beam.

The traditional test method is shown in **Figure 2**. The base was first fixed, a section of the beam was then fixed to the base, while another section of the beam was in contact with the indenter. Under the action of motor or hydraulic press, the indenter exerts a downward force (in the negative direction of Y-axis). Several strain gauges (as indicated in **Figure 2**) were attached to the upper surface of the beam to measure the stress in different areas.

The traditional experimental scheme has obvious disadvantages. For example, it is time-consuming, has limited data (depending on the number of strain gauges), and has some risks. The students designed a finite element model to simulate the bending experiment. The geometric dimensions of the finite element model are consistent with **Figure 2**. The base and indenter are designed as an immutable shape in the model. The beam is made of aluminum alloy. The length of the beam is Z = 300 mm. The width of the beam is X = 20 mm and its height is Y = 10 mm. The distance between the indenter and the base in the Z-axis direction is Z_1 = 290 mm. The finite element model is shown in **Figure 3**. Different colors represent different displacement sizes (the redder the color, the greater the U3 value). According to the stress nephogram, students can easily understand the stress distribution of the beams under external forces.

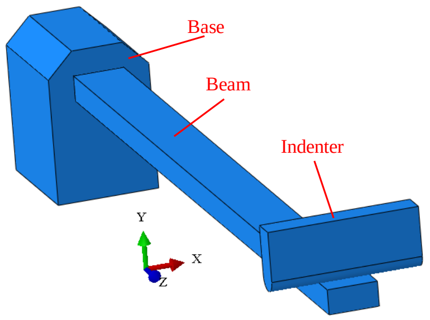

Figure 2. Geometric model of beam bending experiment. Source: Original figure

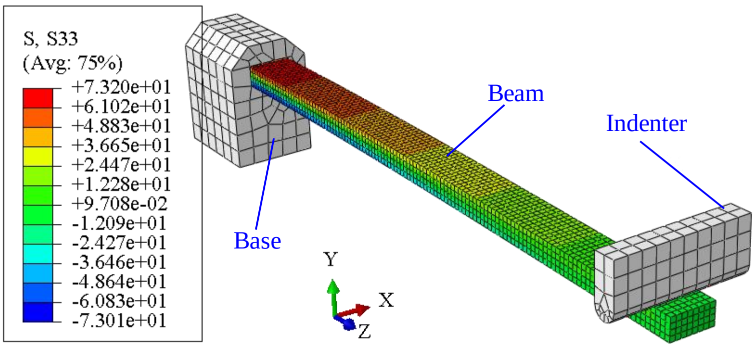

Figure 3. Finite element model with 100 N load. Source: Original figure

3.2. Teaching materials

The model was simulated on a computer and relevant nephograms were obtained. Some simulation materials will be applied to teaching. In order to study the stress law at different positions, 20 special nodes were selected on the upper surface of the beam, as shown in **Figure 4**. The S33 stress data of these nodes are called in the ODB (Open Date Base) of the finite element model and a statistical analysis was carried out, as shown in **Figure 5**.

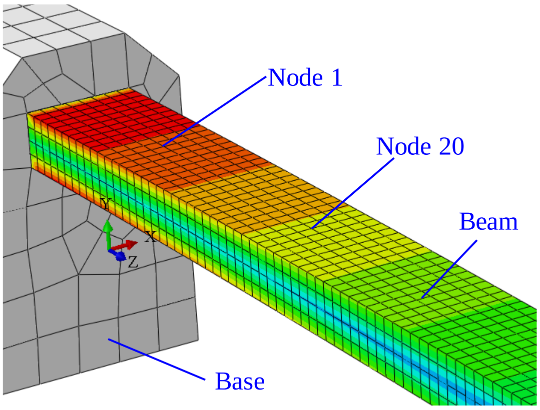

Figure 4. Selection of special nodes on the model. Source: Original figure

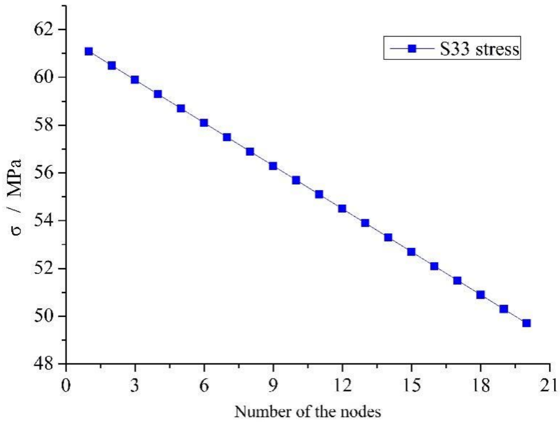

Figure 5. S33 Stress analysis of the special nodes. Source: Original figure

It can be seen from **Figure 5** that the further the node is from the base, the smaller the stress value. The law of change is approximately linear. This is consistent with the experimental data. However, it is clear that more data can be obtained by using the finite element method. In addition, it is easier for students to understand the method of representing the numerical difference of stress by different colors. These visual materials will be used in teaching experiments.

4. Teaching experiment

The teaching resources were planned in detail. The subjects were a class of 40, including 6 girls. The detailed teaching practice is as follows:

(1) The deformation and stress of beam under external force were reviewed.
(2) The teaching objectives were outlined. This course is about the solution of the stress law in different places on the beam.
(3) An example of an automobile crash simulation was presented on the projection screen.
(4) During the demonstration, the teacher explained to the students the meaning of the different colors in the diagram. Afterwards, the teacher asked the students: "Would you like to look at the simulated results of the beam being deformed by external forces?"
(5) Von-Mises stress nephogram was demonstrated in class. Then, the teacher asked: "Are the stress values of different regions equal? Why is it different?"
(6) Students were required to read the textbook and understand the content of the animation by using the formula in the textbook.
(7) The teacher encouraged students to speak on the platform and use what they have learned to prove their conclusions. The teacher encouraged the students to express their views bravely.
(8) A few students commented on the presentation. The teacher then complimented the speaker and then encouraged the other students to comment on the content of the speaker.
(9) The students' discussion was analyzed and concluded by the teachers.
(10) The teacher then carried out a detailed analysis of the function of stress and load
(11) Based on the stress nephograph, the teacher explained to the students the traditional mathematical solution. Students were then encouraged to refer to the textbook to fully understand the equations used to solve the problem.

(12) The teacher presented the results calculated using the traditional method. The teachers then asked the students to observe and determine if the results of the traditional calculation and the simulation were identical.
(13) The teacher posed the question: “How come the two calculations are slightly different?” This will be the students’ after-class assignment.
(14) The class ended

5. Teaching evaluation

A questionnaire was distributed to all 40 students in the class. All questionnaires collected were valid. There were five questions in the questionnaire (Q1–Q5).

Q1: Do you think this class is more interesting than the traditional class?

Q2: Do you still remember the general shape of the Mises stress nephogram?

Q3: Did the visualization material obtained by simulation help you better understand the mathematical calculation process?

Q4: Have your knowledge regarding this topic been consolidated through this lesson?

Q5: Have the material obtained by simulation helped you with your test scores?

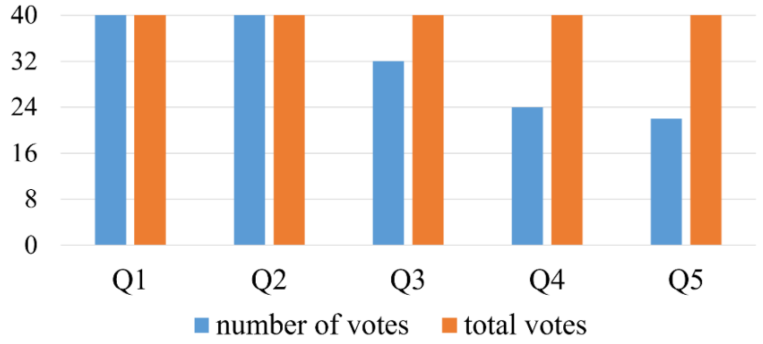

Figure 6. Questionnaire for students. Source: Original figure

The statistical data is shown in **Figure 6**. The “number of votes” bar refers to the number of “yes” votes. All the 40 students answered “yes” to Q1 and Q2. This shows that the skills competition works can enhance the students’ interest in learning and enable them to master the content they have learned more firmly. There are 32 “yes” votes for Q3, which showed that most students recognized visual teaching materials. However, the number of students that voted “yes” for Q4 is 24, accounting for 60.0%. Q5 received only 22 “yes” votes, accounting for 55.0%. Some students who voted “no” for Q4 and Q5 believed that Engineering Mechanics is very difficult to learn. There is no denying that these digital materials can help them more intuitively understand the laws of deformation of the support beam. However, these materials have little effect on test scores, effort during classes and after classes is still more important in order to get good grades.

6. Conclusions

Skills competitions act as a platform for students to showcase their abilities, as well as a rich source of materials for classroom teaching content. This paper creatively included skills competition as part of the teaching content of Engineering Mechanics and conducted a teaching experiment. The teaching quality was evaluated by questionnaire. The results show that skills competition-related content can draw students’ attention and significantly improve teaching quality.

Funding

(1) The Project of China Vocational Education Association (Project number: ZJS2022YB024)

(2) The Project of Innovation and Development Center of Ideological and Political Work (Beijing Polytechnic),

(3) Ministry of Education (Project number: 2022X305-SXZC)

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. X.W. revised the format of the article.

References

[1] Wang S, 2019, Significance, Characteristics and Implementation Measures of the Implementation Plan of National Vocational Education Reform. Journal of Shijiazhuang Vocational and Technical College, 31(3): 4–10. http://doi.org/10.3969/j.issn.1009-4873.2019.03.002

[2] Meng K, Hao ZH, 2022, The New Vocational Education Law: Significance, Characteristics and Breakthrough. Vocational and Technical Education, 43(15): 20–24. http://doi.org/10.3969/j.issn.1008-3219.2022.15.005

[3] Liu XN, 2022, Analysis of the "Good Law" Characteristics of the New Vocational Education Law from the Perspective of Policy Analysis. Vocational and Technical Education, 43(22): 6–10. http://doi.org/10.3969/j.issn.1008-3219.2022.22.002

[4] Wan J, Chen BB, Si HY, 2017, Mining and Measurement of Vocational Skills and Their Association Rules based on Big Data. Proceedings of the International Conference on Digital Technology in Education, 59–63. https://doi.org/10.1145/3134847.3134858

[5] Chankseliani M, James Relly S, Laczik A, 2016, Overcoming Vocational Prejudice: How can Skills Competitions Improve the Attractiveness of Vocational Education and Training in the UK? British Educational Research Journal, 42(4): 582–599. https://doi.org/abs/10.1002/berj.3218

[6] Zheng M Y, 2022, Research on the Cultivation of Applied Top Talents of Sports Economic Management Specialty Based on Vocational Skills Competition. Jiangsu Business Theory, 2022(08): 117–120. https://doi.org/10.13395/j.cnki.issn.1009-0061.2022.08.008

[7] Li SN, 2021, The Research on the "Hierarchical Ladder" Training of Vocational Ability of Students in Electronic Major of Secondary Vocational School based on the Professional Skills Competition. The Guide of Science & Education, 2021(13): 39–41. https://doi.org/10.16400/j.cnki.kjdk.2021.13.013

[8] Wang S, Wang X, Feng Z, et al., 2022, Thoughts on Construction of Practical Training Base in Vocational Colleges. Proceedings of 2021 International Conference on Education, Language and Art (ICELA 2021), 367–371. https://doi.org/10.2991/assehr.k.220131.067

[9] Zhu Y, Feng J, Gao S, et al., 2016, The Analysis and Consideration to Talents Training in Higher Vocational Colleges of Professional Skills Competition. Proceedings of 2016 International Conference on Education, E-Learning and Management Technology, 459–463. https://doi.org/10.2991/iceemt-16.2016.89

[10] Li GQ, Geng YH, Pang HM, 2016, A Discussion about the Impact of Vocational Skills Competition on the Teaching Reform in Vocational Colleges. 2nd International Conference on Arts, Design and Contemporary Education, 1090–1093. https://doi.org/10.2991/icadce-16.2016.268

[11] Ding QJ, 2018, Analysis on the Practice of Vocational Skills Competition Promoting the Reform and Development of Vocational Colleges. Charming China, 2018(45): 149–150. https://doi.org/10.3969/j.issn.1673-0992.2018.45.270

[12] Gong GM, Qiu WZ, 2013, Influence of Nursing Skills Competition on Nursing Education and Teaching. Chinese Journal of Practical Nursing, 29(21): 68–69. https://doi.org/10.3760/cma.j.issn.1672-7088.2013.21.028