

Research on "Matrix Structure Design Competition" Teaching Mode

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Abstract. The "Matrix Structure Design Competition" model fits the development strategy of the State Council to propose a modern vocational education system. This teaching model is based on the purpose of the structural design competition to cultivate students' practical ability, innovative ability and cooperative spirit. Through this teaching mode, the concept of "learning as the center" can be realized, and the undergraduate teaching reform and curriculum reform of applied civil engineering can be effectively deepened and promoted. The purpose of this teaching mode is to adapt to the application-oriented civil engineering professional training program and the construction industry high-level talent knowledge structure and skills development consistency requirements.

1. Introduction

In February 2019, the State Council issued the "Notice on the Implementation of the National Vocational Education Reform" to propose the requirements for improving the high-level applied talent training system. This requirement has improved the modern vocational education system with equal emphasis on academic education and training, developed professional demand-oriented, focused on practical ability training, and initiated specific opinions on the pilot work of the 1+X certification system. The "matrix-structured design competition" model fits the national modern vocational education development strategy, and implements the scientific concept of "student center, industry benchmarking, and large-scale training", which can effectively deepen the application-oriented civil engineering undergraduate teaching reform.

2. Reasons for the reform of "structural design competition" model

2.1 The background of "structural design competition" teaching model

The National Undergraduate Structural Design Competition is jointly sponsored by the Ministry of Education, the Ministry of Housing and Urban-Rural Development, and the National Civil Engineering Society. It is one of the nine national university student competitions identified by the Ministry of Education. The competition has been jointly funded by the Ministry of Education and the Ministry of Finance, and is the highest level of competition in the civil engineering discipline competition. The purpose of the competition is to strengthen the cultivation of college students' practical ability, innovative ability and cooperative spirit, and create a good competition platform for outstanding talents to stand out. The purpose of the competition is to promote the reform of the talent training model and practical teaching of higher education.

The topic of national college student structural design competition is challenging, practical and social. The social participation of the event is high, requiring college students to use professional knowledge and social forces to solve social concerns. The competition is divided into provincial and national levels. According to the competition regulations, the top two provincial competitions and the host college are shortlisted for the national competition. All colleges and universities attach great

importance to the honor brought by the national college student structural design competition. The event has a great influence on professional assessment and construction industry. Each university has gradually formed a stable teamwork of professional instructors and a model of continuous student participation, which has improved the overall level and competitiveness of the competition.

2.2 “Structural design competition” under traditional model before reform

In the past, the competition mode was that the college assigned a civil engineering professional class teacher to participate in the competition. The instructor has different research depths and guiding students' strengths depending on their ability and attitude. Many schools did not conduct school-level competitions and students were not selected. The participation in the competition is not high, the level is uneven, and the winning rate is low. School incentives are not internalized to guide teachers and students intrinsic motivation. The thoughts of the management of the school are not unified, and the concept of unity and forge ahead, innovation and development cannot be embedded in the competition. Therefore, it is difficult for schools to implement the purpose and purpose of the national college student structural design competition.

3. Thoughts and measures for reforming “matrix structure design competition” mode

The school adopts a “matrix structure design competition” to facilitate the formation of a teacher team responsibility system and an innovative studio combination model. The expert guidance committee composed of the above-mentioned members with rich professional structure knowledge and experience is the core technology, responsible for in-depth research and analysis of the game, and provides guidance and suggestions. The technical services of the experimental center are responsible for preparing materials, providing experimental operations, and making model guidance; instructing teachers and student groups to optimize models, analyze calculations, and continuously improve. Figure 1 matrix model, fully deploying teacher resources, expert steering committee top-level design and professional high level, guiding teachers and students software analysis, simulating structural stress, making model verification structure scientific and rational, technical service providing structural experimental guidance and Technical support and collaborative work.

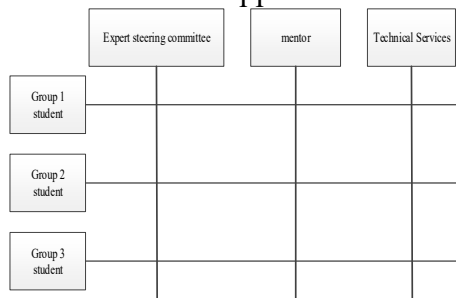


Fig. 1. Matrix Structure Design Competition mode

Figure 2 is a matrix mode workflow. The process highlights the entire process of “study-centered” and teacher teamwork. The aim and goal of “competing innovation through competition” and the open and free combination learning model have inspired students to be eager, curious and enterprising.

4. “Matrix structure design competition” mode to realize undergraduate talent cultivation in applied civil engineering

4.1 Characteristics of outstanding works in national college student structural design competition

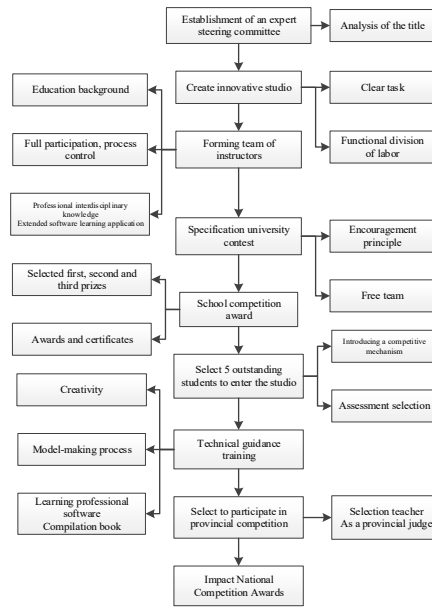


Fig. 2. “Matrix Structure Design Competition” mode workflow

Through the analysis of Figure 3, it can be concluded that the seven characteristics of the excellent structural design model are in line with the high-level talent training objectives of civil engineering application training. The competition promotes the students' structural design innovation concept and professional knowledge integration. Practice verification, apply what you have learned.

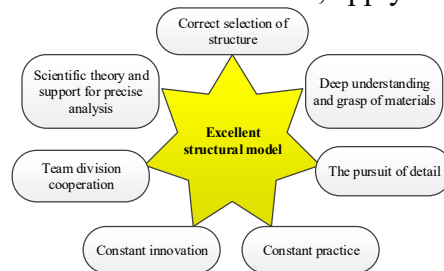


Fig. 3. Characteristics of excellent structural models

4.2 Analysis on setting of scoring standards for national college students' structural design competition

The 2019 national competition score is set to five parts: theoretical program scores, on-site model scores, on-site statements and defense scores, material and time utilization efficiency scores, and load performance scores.

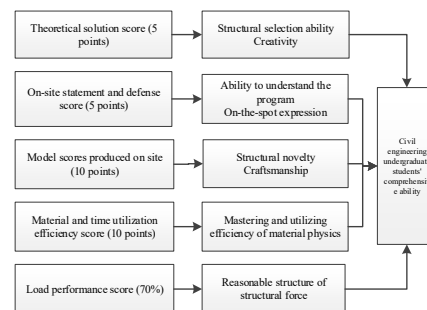


Fig. 4. National College Students' Structural Design Competition Scores Set Corresponding Skill Requirements

Through the analysis of Figure 4, it can be concluded that the five parts of the assessment content comprehensively examine the comprehensive ability of undergraduate students in civil engineering. An important indicator of the structural design competition is the loading performance. The loading verified the rationality and scientificity of the structural model, the fineness of the model, the familiarity and selection of the physical and mechanical properties of the bamboo, bamboo, 502 glue

and other materials, as well as the on-site psychological stress tolerance and disposal capacity. The load-to-weight ratio is the key factor in the loading performance, that is, the load of the lightest structural system bearing load (including wind load, earthquake action, static load or vehicle moving load), which best reflects the students' choice of construction materials and structure selection. The type of force is scientifically sound, structurally calculated, hands-on and other knowledge and ability to directly verify the learning effect.

4.3 Role of structural design competition in promoting deep reform of applied undergraduate teaching in civil engineering

The goal and purpose of the structural design competition put forward higher requirements for the application of civil engineering applied undergraduate talents, and promoted the teaching reform of civil engineering disciplines. The application of undergraduate talent training program for civil engineering is based on the national civil engineering professional teaching quality standards and professional certification standards. Students are trained to have good civil engineering professional ethics, engineering literacy, solid theoretical foundation and professional technical skills. According to the survey results of previous graduates and employers, the diversified core competencies of applied civil engineering undergraduates are five skills: mapping, engineering measurement, structural design, construction, and project management.

The structural design competition can improve five core skills, as shown in Figure 5.

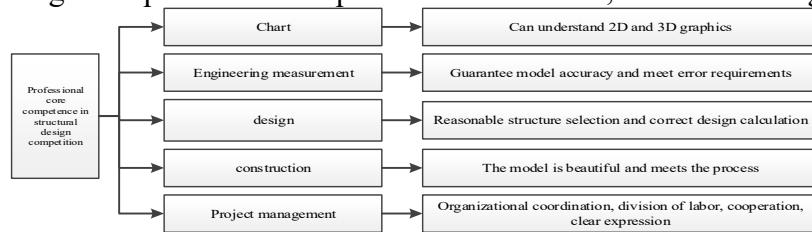


Fig. 5. Application of five core skills of applied civil engineering students in structural design competition

4.4 Professional analysis software to expand students' professional skills and improve training specifications of talents

The design competition should submit a structural calculation book with a score of 10%, requiring professional design calculation and verification of the adopted structural model. The professional analysis software with practical engineering application, beyond the field involved in the subject curriculum system, expands and extends the classroom knowledge structure through the professional training of the “second classroom” instructor.

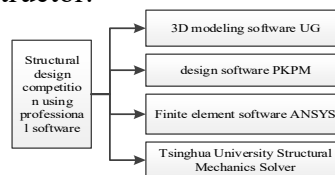


Fig. 6. Professional software applied to the structural design competition

4.5 Promote teamwork and improve production skills

The fineness of the model making and the bonding process are the key to the performance of the structural design competition. Excellent structural selection relies on sophisticated manufacturing processes. The level of craftsmanship is based on hard work and hard work. Structural innovation is achieved in solid theoretical foundation and continuous failure improvement. The Structural Design Innovation Studio provides training materials and venues for selecting outstanding student teams. The implementation of the "Second Classroom" self-study mutual aid model has cultivated students' rigorous work style and passed on the meticulous craftsmanship of civil engineering.



Fig. 7. Structural design innovation studio student production model site map

5. “Matrix structure design competition” mode plays leading role of young instructors

Through the analysis of Figure 8, it can be concluded that the instructor of the team responsibility system plays a leading role in the structural design competition; the professional advice of the expert committee teaches the young teachers to teach and preach, and trains them to transform the frontier knowledge of structural design innovation into theoretical and practical teaching content. Through the competition platform, learn from other college experience, analyze the gap between theoretical teaching and engineering application, so that the college will pay more attention to the development of the industry, thus promoting the improvement of teaching level and scientific research ability.

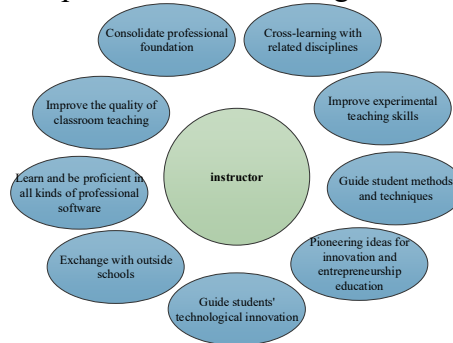


Fig. 8. The "Matrix Structure Design Competition" mode guides the teacher's nine roles

6. Structural design competition to strengthen exchange and cooperation between schools and schools

The structural design competition has a high level of competition. The Yunnan Provincial Department of Housing and Construction and the Yunnan Provincial Department of Education attach great importance to the event. The leading local enterprises are strongly supported and actively involved. University players such as “211”, “Double-class”, “Applicable” and “Professional Skills” competed on the same stage and became the highlight of the structural design competition. Expert lectures and on-site seminars in this field promote cooperation and exchanges between enterprises and universities.

The annual structural design competition can update the latest requirements of construction enterprises for the applied talents of the professional, scientifically and rationally formulate talent training programs, and deepen the teaching and curriculum reform. From 2011 on the structural design competition student achievement, corporate research and analysis, the application of civil engineering undergraduate training program revision and deepening teaching reform recommendations:

(1) Optimize the curriculum module, eliminate out-of-date courses and skills, build gold courses, and increase the curriculum system developed by the future construction industry such as “3D modeling” BIM technology and assembly technology.

(2) In response to the requirements of the Yunnan Provincial Department of Housing and Construction, starting from 2018, the second-level construction division and second-level cost-employed professional qualification examination policies for students in civil engineering

colleges and universities in Yunnan Province. The school will add relevant exam-based elective courses, which will be selected by the students according to their personal career planning, so that they can achieve 1+4 construction engineering professional qualification certificate. The school cooperates with industry associations such as Yunnan Graphics Society and Civil Engineering Society to carry out CAD and BIM skills qualification examinations and certifications to increase the quality of student employment.

(3) The school unified the idea of full-time teachers with the teaching philosophy of “applicable application of sufficient theory and skillful application of vocational skills” in applied civil engineering, appropriately reducing the number of theoretical teaching hours and controlling the number of courses offered, using a diversified assessment mode, and matching according to a certain proportion. Construct a second class of “competition as the main body” than the time for students to study independently.

7. Conclusion

The structural design competition is a comprehensive evaluation of the level and level of the local applied civil engineering undergraduate colleges in the construction industry, which maps the consistency between the application of civil engineering applied talents and the needs of enterprises. The “Matrix Structure Design Competition” model focuses on the “student-centered” concept and promotes the transformation and development of applied civil engineering undergraduate courses. Professional assessment, professional certification, and “double first-class” construction bring opportunities and challenges to the application of civil engineering undergraduate teaching reform. The top design of the college, the introduction of incentive policies, actively create a structural design competition team, special research, adhere to innovation, continuous improvement, diversification, multi-method deepening the reform of civil engineering disciplines, in line with the national talent modernization 2035 and the future development of the construction industry.

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References

- [1] B. L. Zhong and F. Fang, First-class undergraduate education is an important connotation of "double first-class" construction, *Chinese university teaching*, No.4, pp. 4-8, 2016.
- [2] Y. X. Wang and L. S. Zhou, On the Inner Logic of the Five Development Concepts, *Theoretical monthly*, No.8, pp. 21-27, 2016.
- [3] Z. Z. Zhou, Epistemological Foundation and Value Choice, *Peking University Education Review*, No.8, pp. 90-107, 2014.
- [4] D. Yin and D. K. Shen, On the Ideology of "Double-Class" Construction in Colleges and Universities, *Heilongjiang Higher Education Research*, No.8, pp. 122-124, 2016.