

Practice of Interschool Collaborative Hybrid Teaching and Research in the Virtual Teaching and Research Section of Engineering Graphics

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Abstract. Virtual Teaching and Research Section (VRS) as a new basic teaching organization in the era of "intelligence+" is formulated to improve the teaching quality of higher education in China. Based on modern information technology and online education platforms, through playing the leading and demonstrating roles of National Excellent Course (NEC), national first-class teaching teams and renowned teachers, VRS utilizes advanced methods of smart education to carry out virtual and real combined online/offline hybrid interschool collaborative teaching and research activities, effectively promoting the co-construction and sharing of high-quality education and teaching resources, advanced concepts and mature experience, to strengthen communication and cooperation between similar courses and course groups in higher education institutions, promote the deep and high-quality development of higher education. This article takes the pilot construction of national VRS platform project as an opportunity to explore the practice and development direction of Engineering Graphics curriculum reform.

Keywords: Virtual Teaching and Research Section (VRS), Engineering Graphics, Collaborative hybrid teaching, Flipped classroom, Knowledge Graph.

1 Introduction

The Teaching and Research Section (TRS) is a basic teaching organization in China's higher education institutions established to implement small-scale teaching and research activities, focusing on teaching and research and other teaching related activities, mainly for the purpose to meet the requirements of teaching. In the early 20th to 21st centuries, TRS not only took on the task of teaching organization and implementation, but also achieved the inheritance of excellent old teachers' teaching skills and techniques, knowledge system, teaching habits and teacher ethics through its "pass on, help and guide" characteristic activities. TRS in colleges and universities have multiple functions such as new teacher training, scientific research, and subject construction, which once played significant roles in organizing teaching and research activities. TRS characterized teaching and research system in colleges and universities carries unique Chinese cultural attributes and reflects the teaching and research habits with Chinese characteristics^[1].

In order to implement the 14th Five-Year Plan (2021-2025) for education development deployment, achieve the fundamental task of improving talent cultivation quality in higher

education institutions, the Chinese Ministry of Education has launched the first pilot projects for the construction of national VRS in colleges and universities. Relying on the national VRS platform, an intelligent learning community of highly integrated courses and majors is created, to cultivate a group of teaching exchange and practice platforms with wide specialty coverage and teacher inclusiveness. Based on modern information technology and online education platforms, VRS explores the methods to build a new type of teaching and research organization in the internet environment, with the goal of improving teacher's teaching ability as well as talent cultivation quality. It fully leverages the advantages of NEC, high-quality teams and renowned teachers to create an innovative collaborative communication platform, so that stimulate teachers' teaching enthusiasm and form the cohesive force in teaching research.

As a new type of basic teaching organization in the era of "intelligence+", VRS fully integrate internet thinking and information technology of smart education, carry out varied virtual and real, online/offline hybrid teaching and research activities. It breaks through the space-time limitations of traditional TRS, carries out diverse and information-based teaching and research activities, promotes the co-construction and sharing of teaching resources, promotes the inheritance of first-class teaching concepts and customs, and promotes the deeper and higher quality development of higher education^[2,3].

- ① Fully utilize information technology, explore online and offline combined teaching and research models with diverse forms, create new ideas and methods for the construction and management of the innovative basic teaching organizations.
- ② Promote teachers strengthen research and exploration in specialty construction, curriculum construction, teaching content, teaching methods and evaluations. And promote the development of frontline teachers' comprehensive teaching abilities.
- ③ Collaboratively construct teaching resources to form a high-quality shared teaching resource database, such as talent training program, teaching syllabus, teaching cases, knowledge graph, teaching videos, electronic courseware, experimental projects, training projects, etc.
- ④ Give full play to the exemplary and leading role of national teaching teams, renowned teachers, and first-class courses, promote mature experience, effective talent cultivation models and course implementation plans.

VRS relies on the national education platform and utilizes modern information technology to break away from the small-scale teaching and research model of traditional TRS. It strengthens communication and cooperation among similar course teaching and research organizations and even among similar course groups in higher education institutions. Compared with the teaching, research and inheritance functions of traditional TRS, VRS simultaneously possesses "synergy", "sharing", and "organization", providing references for curriculum reform, providing support for the improvement of teaching quality in higher education^[4].

2 Interschool collaborative hybrid teaching and research based on VRS platform

Engineering Graphics is the first technical foundation course for engineering students in higher education institutions, laying solid foundation for their introductory understanding and deep learning of professional courses. However, not only the number of class hours for Engineering Graphic courses in different universities shows remarkable difference, but also new teaching technologies and methods adopted diametrically vary. The major teaching forms include classroom teaching, online/offline hybrid teaching (including flipped classrooms), software teaching, surveying and mapping practice, VR/AR assistance^[5]. As one of the first pilot construction projects of VRS announced by the Ministry of Education, Engineering Graphics VRS has built a platform for display and exchange of Engineering Graphics teaching resources, teaching methods and new teaching technologies. It has played a leading and guiding role of excellent teaching teams and renowned teachers, and effectively improved the educational and teaching effectiveness of Engineering Graphics courses.

2.1 Institutional construction and teacher training function of VRS

VRS needs a clear institutional construction. It is supervised by the project leader, who is responsible for formulating the overall plan and construction plan of VRS curriculum, implementing the construction tasks, clarifying the members and responsibilities of the cooperative units, jointly achieving the curriculum construction goals. According to the development needs of Engineering Graphics, the development ecology including training, attraction and co-construction of teaching staffs is explored, and the teaching research and teaching reform activities are also organized. In addition to actively participating in various collaborative teaching and research activities of VRS, the cooperative colleges and universities are responsible for organizing the teaching plan implementation and other daily management of the Engineering Graphics pilot class.

Through lectures, topic discussions and other forms, regular teacher trainings are carried out to enhance teachers' information literacy, teaching awareness and abilities. Give full play to the leading role of national teaching teams, renowned teachers, and first-class courses, promote new forms of teaching materials, mature and effective teaching organization forms and curriculum implementation plans, and promote the comprehensive development of frontline teachers.

Explore the educational ideas and theories of Engineering Graphics based on modern information technology, teaching practices and teaching evaluation systems. The main activities include:

Regularly organize teaching seminar activities, such as lectures on graphics knowledge, modern educational technology training, industry lectures, school-enterprise cooperation, enterprise visits, etc;

Conduct teacher training and exchange of Engineering Graphics courses, including technical training of VRS platform, implementation of graphics national standards, engineering case study of enterprise, competition experience exchange, etc;

Select teachers of cooperative groups to conduct course inspection and learning, and improve the theoretical level and project practical ability of professional teachers.

2.2 Co-construction and sharing of course resources

Gather the wisdoms of "integrated" teaching team through collaborative lesson preparation, discussion, training exchange, resource sharing and other ways. On the basis of full research and exchange by VRS members, the collaborative construction includes but is not limited to talent training programs, teaching syllabus, knowledge graph, teaching videos, teaching cases, experimental projects, practical training projects, data sets and other resources. Build and optimize high-quality course resources and teaching cases to form a high-quality and shared teaching resource library.

① Construct the knowledge graph of VRS. Systematically sort out the knowledge system and knowledge associations of Engineering Graphics courses, and use the tools of VRS platform to build the knowledge graph of Engineering Graphics.

② Share the teaching cases. In response to the reality that Engineering Graphics teachers lack engineering background and practical application experience, cases sharing of actual engineering projects and construction drawings is carried out, and experience exchange and discussion are also carried out. Taking the processing of simple parts as an example, there is a huge difference between manufacturing drawings and teaching drawings used by graphics teachers. Through cases sharing and study, the gap between Engineering Graphics teaching and engineering practice can be bridged.

③ Setup Engineering Graphics demonstration course and famous teacher's workshop. Give full play to the exemplary and leading role of national teaching teams, teaching masters and first-class courses, demonstrate to all VRS members through online, offline, or hybrid teaching demonstration courses, promoting the teaching abilities of VRS members.

Through interschool collaborative teaching and research, advanced teaching concepts and mature experiences are achieved to mutual learning and reference, promote the co-construction and sharing of high-quality teaching resources, drive innovation and reform of traditional teaching models, and improve the teaching quality.

2.3 Develop collaborative teaching and research based on first-class template

Based on the national first-class course resources shared online, the virtual hybrid teaching and research pilot classes are simultaneously established, and multiple institutions are linked to attend the collaborative online/offline hybrid course. Regularly summarize and share the collaborative teaching experience, study the teaching cases of flipped classroom, and establish the teaching evaluation system of Engineering Graphics.

The collaborative hybrid teaching pilot class has made a new change in the traditional teaching mode and thinking habits of Engineering Graphic courses through teaching practice and teaching reflection, which explore a new path to combine online high-quality course resources and rich offline teaching experiences, integrate resources, enlighten thinking, reshape courses, and regenerate first-class courses.

3 A case study of collaborative hybrid teaching reform

As the first pilot projects of VRS announced by China's National Ministry of Education, Engineering Graphics VRS has launched a collaborative online/offline hybrid teaching pilot class that takes the National Excellent Online Course on MOOC as a template, China's top universities such as Dalian University of Technology, Northeast University and other domestic universities have jointly participated in the teaching practice of the collaborative hybrid teaching and research pilot class, and launched the hybrid teaching reform of first-class Engineering Graphics courses.

Making full use of the characteristic of collaborative hybrid teaching which is significantly different from other teaching modes, that is more open and shared, emphasizing synergy within the group, the rich, detailed, and referable hybrid teaching practice samples practiced by NEC teaching team for many years can be fully utilized through a series of diverse collaborative teaching and research exchange activities, to promote hybrid teaching experience, as well as the inheritance of hybrid teaching skills and techniques, and promote the overall upgrading of Engineering Graphics courses.

(1) Based on the unified online national course "Modern Engineering Drawing" on MOOC, SPOC or MOOC classrooms are built by reasonably taking into account the differences among different universities, forming multiple participation modes of hierarchical and differentiated teaching, so that a new situation of collaborative teaching practice that combines "unified MOOC online teaching" and "hierarchical and differentiated teaching" is created.

(2) Build a virtual teaching and research cooperation union, regularly carry out collaborative teaching and research activities, such as "flipped classroom practice cases" and "curriculum application of Knowledge Graph", to promote the updating of hybrid teaching methods and skills through feedback and communication. Wherein VRS Knowledge Graph constructs the correlations between knowledge topics, uses visual means to display the overall knowledge structure and teaching design including hybrid teaching, and effectively achieve knowledge sorting and correlation mining.

(3) Open up multiple learning and evaluation channels, such as online learning, group collaboration, stage-testing and flipped classrooms. Simultaneously, actively responding is necessary to help students adapt the challenges of blended learning, symposiums, surveys and other forms are organized to master students' learning situations and promote deep learning^[6,7]. Actively evaluation of teaching model is regularly carried out through collaborative teaching and research.

4 Conclusions

VRS promote the reshaping of the teaching and research system, and create a new paradigm for first-class curriculum construction. It innovatively develops communication platform, carries out virtual and real combined collaborative online/offline hybrid teaching and research activities, and creates more open and shared communication and cooperation educational environment.

The construction of interschool cooperation based on VRS, establish interschool collaborative hybrid teaching pilot classes, develop the virtual teaching and research model for interscholastic co-construction and sharing, and explore the theoretical and practical system of virtual teaching and research. Promote the restructuring of Engineering Graphics curriculum system, transform traditional teaching models and thinking habits, strengthen systematicness and practicality, establish new courses, new quality, and new systems under the new teaching reform model of higher education in the information age.

Through teaching practice and reflection, excellent online course resources and rich offline teaching experiences are fully combined and utilized, the traditional teaching mode and thinking habits have been completely reformed and inspired, exploring a new path to integrate resources, reshape and regenerate first-class courses.

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