

# Research on interdisciplinary teaching practice based on engineering projects

Jian Chen

Southwest Jiaotong University, Chengdu 610031, China

**Abstract:** In order to promote the conformal development of higher education and further improve the quality of talent training, this paper proposes an interdisciplinary practical teaching model based on engineering projects, which mainly takes engineering projects as the core and explores interdisciplinary teaching model in the subject groups involved in the project. The implementation of the project has a reference role in cultivating students' interdisciplinary skills and interdisciplinary thinking, enhancing students' overall development and creativity, and can provide ideas and accumulate experience for the construction of related disciplines and teaching reform.

**Key words:** interdisciplinary teaching; Engineering project; Practical teaching

## Foreword

Interdisciplinarity refers to the knowledge creation and dissemination activities involving two or more disciplines that transcend the boundary of a single discipline. With the promulgation of the Overall Plan for Promoting the Construction of World-class Universities and First-class Disciplines, the construction of “double first-class” has become the main theme of the current reform and development of higher education. Exploring how to consolidate the basic project of the construction of “double first-class” undergraduate teaching through the key promotion of interdisciplinary education has become an urgent topic of The Times1-3. The reform of interdisciplinary teaching in foreign countries started earlier and developed rapidly. American universities generally set up new disciplines and comprehensive courses that cross humanities and natural sciences, humanities and social sciences, humanities and technical sciences, such as the interdisciplinary composite course4-6 of the University of Pennsylvania, the “interdisciplinary course string” of the University of California, Los Angeles, and the undergraduate interdisciplinary collaborative teaching7-8 of the University of Michigan. The promotion of interdisciplinary education has become an important feature and strategic goal of many foreign research-oriented universities. The traditional single-subject “professional” training mode is more and more difficult to adapt to the increasingly comprehensive scientific development needs and increasingly complex social development needs, domestic universities actively respond to the requirements of this era, and earnestly commit to realize the transformation from disciplinary/professional education to interdisciplinary education. For example; For example, the sports technology and intelligent life course in the general education course of Southwest Jiaotong University, the multi-level interdisciplinary open experiment teaching practice carried out by Tongji University, and the interdisciplinary education experiment of Dongbei University of Finance and9-11 Economics. Comparatively speaking, interdisciplinary education in domestic universities is still in the stage of exploration and gradual promotion on the whole. The only way to further improve the quality of talent training is to evaluate the situation, take the initiative to change, learn from the experience of world-class universities in interdisciplinary education, and realize the fundamental reform of building first-class undergraduate teaching. Therefore, This paper proposes a practical teaching model of interdisciplinary teaching based on engineering projects, which focuses on cultivating students' interdisciplinary skills and thinking through the practice of specific engineering projects, so as to better meet the training needs of high-quality composite talents.

## 1. The key problems to be solved in the research of interdisciplinary teaching practice based on engineering projects

Considering that the traditional knowledge transfer classroom teaching structure is difficult to achieve interdisciplinary teaching, integrating problems in engineering projects into teaching and exploring truly interdisciplinary teaching methods can maximize the ability of students to solve problems in an interdisciplinary way. Its core purpose is to solve the drawbacks caused by the traditional teaching that only focuses on training students to solve relatively certain and narrow problems with a single professional knowledge through the learning of problem-solving ability based on engineering projects, so as to cultivate students' ability to find solutions to problems with an interdisciplinary perspective in the face of comprehensive and complex practical engineering problems. In the practice of the project, the specific key problems to be solved are:

- (1) How to choose the appropriate project, in order to cover the professional knowledge of multiple disciplines and effectively series, while meeting the needs of practical engineering application;
- (2) How to effectively organize students to carry out interdisciplinary learning in the project, complete the reserve of professional knowledge of different disciplines, and have the ability to solve routine engineering problems; at the same time, how to further train students' ability to apply the interdisciplinary integrated thinking mode and multidisciplinary research methods to solve complex engineering scientific problems.
- (3) How to evaluate students' learning effectiveness based on project results.

## 2. The practical content of interdisciplinary teaching practice research based on engineering projects

### (1) Selection of engineering projects

Selecting the appropriate project is a key to interdisciplinary teaching, which requires that the project itself can cover the professional knowledge points of multiple disciplines and connect these knowledge points effectively. Among them, the professional knowledge points involved in the project can be acquired by students through professional courses, and in the process of project practice and completion, the professional knowledge points of these different disciplines can be comprehensively applied. Therefore, the project takes the students' participation in the national BIM graduation design Competition as an opportunity to take the entries as practical projects, and sets up a team of teachers and students from architectural engineering, cost, construction management, electrical engineering, HVAC engineering, fire engineering and other majors to encourage students to carry out and complete the corresponding interdisciplinary learning. For example: The BIM application of Fuzhou International Finance Center and the BIM application of the comprehensive building of Hebei Normal University are all derived from actual engineering projects. In order to complete the BIM technology application of the project, it is necessary to carry out interdisciplinary and professional cooperation work such as building 3D modeling, structural calculation, engineering measurement and pricing, construction management, electrical engineering, HVAC engineering and fire protection engineering. Therefore, the project can meet the requirement of training students to conduct interdisciplinary learning.

### (2) Establish a teaching mode focusing on the cultivation of interdisciplinary skills and thinking

After the selection of the project, according to the professional knowledge required by the project, students are reasonably divided into projects, and students are required to learn the required professional knowledge. After students complete the required individual professional knowledge and skills training, students are gradually guided to jump out of their own professional restrictions. By consulting literature, learning online course resources, consulting other professional teachers or classmates and other ways to learn interdisciplinary knowledge, and try to examine problems from an interdisciplinary perspective, to cultivate comprehensive problem-solving ability. For example, in the BIM application of Fuzhou International Finance Center and the BIM application of the comprehensive building of Hebei Normal University, the electrical pipeline design and water supply and drainage design involved in the project can be successfully completed only after the team members have completed the interdisciplinary learning of electrical engineering and HVAC engineering. In this process, the students' interdisciplinary learning ability and the ability to use interdisciplinary thinking to solve comprehensive and complex engineering problems are further cultivated.

### (3) Conduct multiple evaluation and analysis on the effect of project implementation

In the traditional classroom teaching mode, the assessment of students' learning results usually adopts the way of examination and examination, the examination form is basically based on the final paper test, the score is usually based on the percentage system; The examination mode is mainly based on the students' completion of the report. The emphasis of both is to test students' understanding and mastery of professional knowledge, as well as their ability to use software. For practical teaching projects, if only the final exam paper test, report examination is easy to form students' test-taking psychology, it is difficult to evaluate students' comprehensive ability. Therefore, the whole process dynamic and diversified evaluation system is adopted for the project. In other words, teachers will conduct comprehensive and diversified evaluation on students according to their personal professional ability, interdisciplinary thinking ability, teamwork ability, innovation ability, ability to withstand pressure, ability to solve new problems, team dedication and final learning results of the project during the whole project implementation process. In order to train students to give full play to their strengths, overcome professional limitations, comprehensively improve their comprehensive ability, and adapt to the current needs of the society for the cultivation of composite talents.

## 3. Application of interdisciplinary teaching practice research based on engineering projects

The project results have been applied to guide the discipline competition of students and the cultivation and training of college students' scientific research and innovation ability, and have achieved good teaching effects and better expected materialization results in the practice of both. Meanwhile, the project results are planned to be gradually promoted and applied in the practice of college students' innovation and entrepreneurship, discipline reform and research practice.

(1) The application of the project results in guiding students' discipline competitions The project results have been applied to national and provincial level BIM competitions. Take the National College BIM Graduation Design Innovation Competition as an example. This competition is a national level competition jointly sponsored by the Chinese Society of Higher Education, the Construction Market and Bidding Research Branch of the Chinese Society of Civil Engineering and Guanglianda Technology Co., LTD., as one of the largest and most professional college architectural professional competitions in China. In 2020, it will be listed in the national discipline competition list of ordinary colleges and universities by the Chinese Association of Higher Education, and become the only selected event in the BIM direction of the national college students' architectural professional competition. The competition consists of nine modules. They are civil construction BIM modeling and application, mechanical and electrical BIM modeling and application, BIM whole process cost management and application, BIM bidding management and application, BIM decoration design creativity and application innovation, BIM construction project management application, prefabricated building BIM design and construction, intelligent construction and management innovation, BIM forward design application innovation. Relying on this teaching reform project, the members of the research group have completed two specific BIM projects, namely, BIM application of Fuzhou International Finance Center and BIM application of comprehensive building

of Hebei Normal University. Among them, the BIM application project of Fuzhou International Finance Center won the special prize of A module and the first prize of B module of the Third National College BIM Graduation Design Innovation Competition, and the first prize of the university group of the second “Li Bing Award-Kaiming Cup” BIM competition in Sichuan Province; The BIM application project of the comprehensive building of Hebei Normal University won the first prize of A module and the second prize of B module in the Third National BIM Graduation Design Works Competition of Colleges and universities, and the excellence award of the first “Li Bing Award-Kaiming Cup” BIM Competition of colleges and universities in Sichuan Province. The results and knowledge obtained through the competition further stimulate the students’ enthusiasm for interdisciplinary learning, enhance the students’ confidence in daring to face the comprehensive and complex engineering problems, and provide ideas for the school to cultivate high-quality interdisciplinary talents.

(2) The application of the training of college students’ scientific research and innovation ability in the project practice, through the preparation of an open, multi-functional and interdisciplinary project innovation practice platform to provide students with a good learning and practice environment for competition, and integrate extracurricular teaching activities such as college students’ discipline competitions. Relying on the interdisciplinary practical projects, the students have been guided to complete two college students’ scientific research innovation ability training plan (SRTP), one personalized experiment project, two utility model patents, and completed and published two related academic papers.

## Conclusion

The project practice shows that the interdisciplinary teaching practice research based on engineering projects can better solve the drawbacks caused by only focusing on training students to use a single professional knowledge to solve relatively certain and narrow problems. By adopting interdisciplinary teaching mode, students can cultivate their ability to solve comprehensive and complex practical engineering project problems. At the same time, it improves students’ ability of active learning, teamwork, daring to face practical problems, active innovation and creativity in the project, which provides ideas for the training of high-quality composite applied talents in colleges and universities and the reform and construction of disciplines.

## References:

- [1] Yan Wang. New Interdisciplinary Education: The Only way for Chinese universities to build first-class undergraduate teaching -- Taking Environmental undergraduate teaching as an example [J]. China Higher Education Research,2016, 06:17-23.
- [2] Qunyi Huang,Haiying Fu,Yilin Wang. Research on Practice Teaching Mode of Multi-specialty Collaborative Innovation enabled by discipline competition [J]. Education and Teaching Forum, 2022,08 (33) : 41-44.
- [3] Cuili Chen,Jianhong Xie,Tong Wang. Research on the reform of Interdisciplinary and multi-major comprehensive Practice Teaching -- A case study of the College of Applied Arts and Science of Beijing Union University.[J]. Science, Education and Literature Exchange,2016, 03:3-4.
- [4] Xiaobao Zhang. Research on Interdisciplinary Talent training Model of American research universities [M]. Changsha: Hunan Normal University Press, 2018
- [5] Dehong Guo.Xiaoqing Liu. Progress and reference of undergraduate interdisciplinary Education in American universities [J]. Contemporary Educational Science, 2019, 01:83-86.
- [6] Xiaobao Zhang. [J]. Higher Education Administration, 2019,13 (05) : 92-103.
- [7] Liping Zheng,Ning An,Qiang Lu,Xuegang Hu. Practice and Conception of Interdisciplinary Teaching [J]. Computer Education, 2013, 1:3-5.
- [8] Haijing Huang,Shuyang Deng,Gang Chen. Architecture Teaching for Training Composite Applied Talents: Interdisciplinary Joint graduation design practice [J]. Western Human Settlements and Environment Journal,2015,30(06):38-42.
- [9] Xiaozhen Xie,Meifang Peng. An analysis on the Cultivation path of interdisciplinary degree talents in universities [J]. Science and Technology in Chinese Universities,2021,07:63-67.
- [10] Zhen Pang. The “Way” of Teaching Reform in Super-Interdisciplinary Education [J]. University Education Science,2019,04:53-58.
- [11] Xiaogang Wang,Chao Zhao,Xinhua Xu,Yajuan Fan. Hierarchical and Interdisciplinary Open experimental teaching practice [J]. Laboratory Research and Exploration,2013,32(09):160-163. (in Chinese)