

# Research on the classroom teaching reform method of bridge engineering based on the cultivation of innovation and entrepreneurship ability

Gangnian Xu\*, Ruishuo Zhang

School of Civil Engineering, Shandong Jiaotong University, Jinan, 250357, China

\*Corresponding author: 204144@sdjt.edu.cn

**Abstract:** Innovation has an important impact on a country and a nation. It is the premise of national development and national revitalization. The course of Bridge Engineering is also the most basic major course in the civil engineering specialty. During the course, there are many teaching contents with strong spatial sense and abstract characteristics. However, in the teaching process of the bridge engineering course, the traditional teaching methods have obvious shortcomings. The reform and practice methods of the existing teaching methods and teaching models in improving students' hands-on ability, innovation ability and team cooperation ability still need to be improved in the four aspects of course teaching content, teaching activities, teaching methods, and course evaluation. This paper analyzes the problems in the teaching of this course and puts forward corresponding suggestions.

**Keywords:** Bridge Engineering, Classroom teaching reform, Innovation and entrepreneurship ability, PBL teaching mode, TBL teaching mode

## 1. Introduction

The course of "Bridge Engineering" is an important course for civil engineering majors, the key to traffic engineering, and the guarantee for the opening of the whole line. This course covers a wide range of links and contents, including planning, exploration, design, construction, manufacturing, monitoring and maintenance. Its main course content involves reinforced concrete, prestressed concrete of beams and bridges, etc. This course is mainly to train students to understand some steps in the construction process of "bridge engineering", understand some famous bridge structures, and master some methods and skills to analyze and design bridges, so as to lay a foundation for the follow-up courses that can ensure the smooth progress of learning.

## 2. The Teaching Status and Problems of Bridge Engineering

### 2.1. Single teaching mode

Taking Beijing University of Science and Technology as an example, the teaching method based on blackboard writing and multimedia courseware is easy to make students lose interest in the boring learning process in this stage of teaching. Moreover, the design and calculation methods of different types of bridges are completely different, involving complex mathematical and mechanical principles and formula derivation process. The "bridge engineering" course has only 48 class hours, and the teaching time is limited. The "cramming" teaching method cannot give students enough time to think. For some students with poor foundation and do not know the true meaning of the formula, The teaching method of "cramming" has great difficulty in understanding. Therefore, it leads to mechanically copying formulas in the calculation process, and does not know how to change parameters or situations. It is only for the purpose of preparing for the exam. In the classroom teaching of "bridge engineering", while paying attention to traditional teaching methods, we should combine modern teaching methods, use multimedia, MOOC, etc. to set up network teaching links. Through the review of students and the strengthening of knowledge points in the network classroom, students can extend to extra-curricular activities in their spare time, so that students have more time to sort out the contents of bridge design, calculation process and formula use, etc, through online teaching in the form of online classroom, students can strengthen their autonomy and enthusiasm in learning and cultivate their ability to solve

problems by themselves. During learning, students' ability to solve problems independently has been strengthened.

## ***2.2. There is a serious gap between theoretical teaching and practice***

Bridge Engineering is a practical course for application-oriented undergraduates, focusing on cultivating students' construction ability and ability to solve practical problems. The classroom teaching is limited by the course arrangement and class hours, and focuses more on the internal force calculation of the concrete simply-supported beam bridge deck, the internal force calculation of the main beam, and the internal force calculation of the diaphragm beam. Generally, it is the repetition of textbook examples and after-class exercises, and lacks the practice link. Therefore, there are a lot of internal force calculation of the concrete simply-supported beam bridge deck in the classroom teaching, and the internal force calculation of the main beam, although the school has set up a 16-class hour course design of "Bridge Engineering", However, for arch bridges, suspension bridges, cable-stayed bridges, and the construction process of bridges, which are less in contact with long-span bridges in practical engineering, due to the less class hours, only the relevant calculation of concrete simply-supported beam bridges can be carried out, which most students have not seen. In the teaching process, the understanding of the bridge structure and the construction process, which only has pictures and simple text descriptions, is too abstract. For the understanding of the plane view, the vertical and horizontal section view and the overall effect view of the bridge, students cannot imagine the three-dimensional structure of the bridge, and there is recognition deviation. The use of some large machinery and equipment has little contact with advanced construction methods, and the understanding of the construction process is only superficial, resulting in serious disconnection of theoretical knowledge and actual engineering. In classroom teaching, teachers can help students understand the relationship between 3D space entities and bridge components by making some bridge models, so as to achieve the understanding of 3D space entities of bridges. In the classroom, video is used to show the design and construction process of the bridge to students, so that students can more intuitively understand the current bridge construction technology and the use of construction machinery in combination with the textbook knowledge and actual engineering. At the same time, students can further understand the structure, structure, stress and other aspects of bridge by organizing a bridge model design competition. The course "Bridge Engineering" aims to cultivate students' learning interest, hands-on ability and innovative ability <sup>[1]</sup>.

## **3. The course of Bridge Engineering is integrated into PBL and TBL teaching modes**

The classroom form of integrating PBL and TBL is to divide the class into several teams to learn and solve problems through self-study, thinking, discussion, publication and other ways. Collective learning is based on the concept of "student-centered", which returns the dominant power of learning to students, and the role of teachers is transformed into the facilitator and facilitator of learning. This learning strategy and model not only cultivates students' "team learning" and "autonomous learning" abilities, but also proves that students' learning achievements will be greatly improved. Based on the PBL teaching theory, Chen Baosheng studied and analyzed the main manifestations of the lack of divergent thinking ability in China's higher education from the aspects of university education philosophy, learning objectives, learning content, learning methods and learning evaluation methods. Taking "government frugality" as the carrier, the reform experiment on the development of college students' decentralized thinking ability was carried out. In the university classroom, we can carry out reform, cultivate students' divergent thinking ability, create PBL as the leader, take students as the center, adhere to the two "divergent", and focus on creating effective classroom and dynamic classroom. Pay attention to cultivating students' critical thinking ability and different thinking ability, and cultivate students' intelligence and decentralized thinking ability through extensive courses and information databases <sup>[2]</sup>. Zheng Ying et al. explored the problem-based teaching method (PBL) by carrying out the pre-rehabilitation practice skill strengthening of PBL combined with TBL teaching method for selected college students, the comparative test with traditional teaching method, and the application effect of the teaching method with group discussion as the core (TBL) combined with pre-rehabilitation practice skill strengthening. Finally, it is concluded that applying PBL combined with TBL teaching method to skill strengthening before rehabilitation practice is conducive to the improvement of students' learning effect, comprehensive skill level and comprehensive quality of practice <sup>[3]</sup>. According to the new situation of bridge engineering course teaching, Zhan Yulin and others introduced the PBL teaching method based on OBE concept and applied in teaching from three aspects of "problem as the main line,

teacher as the leading, and student as the main body", combined with teaching experience and student feedback, to reform the teaching content of bridge engineering, the goal decomposition of teaching methods, and the implementation and application of teaching methods. Create an innovative classroom [4].

### ***3.1. The course of Bridge Engineering integrates PBL and TBL teaching advantages***

The specialization of bridge engineering is divided into theoretical training and course development, which is the main professional course of civil engineering (road and bridge direction). The school integrates the original teaching and curriculum design of bridge engineering theory into the bridge engineering curriculum, combines theory with practice, strengthens the development of students' engineering ability, and emphasizes students' practical ability. At the same time, in the process of implementing the teaching reform, the curriculum design method after the end of the theoretical study last week was changed, and the theoretical study time and practical training time were integrated to design the curriculum. The theoretical study and curriculum design were synchronized and crossed. Emphasize the student-centered learning process, strengthen the development of students' engineering ability, and pay special attention to the development of students' engineering ability in the learning process.

The teaching reform of the "Bridge Engineering" course is guided by the course development project and the problem. It aims to change the teaching concept, reform the teaching method, change the evaluation method, cultivate the students' self-learning ability, develop the engineering practice, innovation ability, and improve the overall quality of students. It uses PBL and TBL models for project-oriented learning, and closely combines theoretical learning with engineering practice. The main body guides teaching, thus improving the quality of course teaching, stimulating students' interest and initiative, and developing innovative ability. PBL and TBL learning modes provide an effective way to train high-quality bridge professionals to meet the needs of society.

### ***3.2. Application of PBL and TBL teaching modes in bridge engineering courses***

Adopt the on-the-job learning and on-the-job learning mode, and the curriculum design is based on engineering projects and theoretical knowledge to cultivate students' ability of analysis, decision-making and innovation. From the traditional theoretical learning model and curriculum design as a supplement to the new curriculum design model and theoretical learning model, the selection of practical engineering projects as the curriculum content runs through the whole learning process. The realization of curriculum development under the PBL model is divided into five main stages: curriculum development, activity research, curriculum development and implementation, curriculum development and protection, and teaching evaluation. The students carry out complete learning activities under the guidance of the teacher, and the teacher carries out in-depth discussions and exchanges at each stage. In theoretical learning, we should adhere to the teaching principle of "teacher as the leading factor and student as the main body", fully mobilize students' initiative in the classroom, stimulate students' learning motivation, and cultivate students' self-learning ability and innovation ability. With the curriculum development project as the driving force and the problem-oriented, typical engineering cases are complementary.

The training content is not limited to the preparation of teaching material chapters, and the training content is project-based. This course requires students to master that the main type of bridge is simple beam bridge. The course content is also the superstructure of the simplification bridge. During the teaching process, provide students with a set of bridge drawings, including upper and lower structure drawings. They often use different cross sections and always take the bridge drawings as the main line to explain the theoretical knowledge points such as the planning and design of the bridge, the upper and lower structures of the simply supported bridge and the top structure of the bottom structure of the bridge: students should improve their ability to read and read the drawings after class. Improve the combination of drawing ability and curriculum design, and teach engineering application skills [5].

#### **4. The Reform Method of Classroom Teaching of Bridge Engineering Centered on Innovation and Entrepreneurship**

##### ***4.1. Rely on school education resources to update the concept of entrepreneurship and innovation education***

In practice, we should give full play to the role of the College of Innovation and Entrepreneurship Education for College Students. In accordance with the relevant requirements of the Guiding Opinions on Further Supporting the Innovation and Entrepreneurship of College Students, we should comprehensively launch the school's innovation and entrepreneurship education courses, explore the laws of innovation and entrepreneurship education, and guide college students to participate more actively in practical exploration, so as to promote the improvement of education effect [6]. Make innovation and entrepreneurship ability form among college students. For example, through continuous and in-depth exploration, the university cultivates the innovative and entrepreneurial spirit of college students and strengthens the innovative and entrepreneurial ability of college students. It needs to continue to promote educational reform, and gradually guide students to carry out innovation and entrepreneurship through classroom teaching, independent learning, comprehensive practice, assistance and guidance, cultural guidance and other channels [7]. In addition, the School of Innovation and Entrepreneurship Education and its organization should also actively organize college students to participate in social practice, and jointly with relevant education departments, social human resources departments, etc., establish a closed-loop system for the cultivation of innovation and entrepreneurship ability of students in the Bridge Project, step by step strengthen the communication between schools and between schools and enterprises, form a school-enterprise collaborative talent cultivation model, and gradually take regional college student talent cultivation as a case, Explore a complete set of innovative and entrepreneurial education resources, and create innovative and entrepreneurial education demonstration courses with regional characteristics, so as to form a comprehensive training for college students, so that college students can participate in innovation and entrepreneurship more actively, and effectively improve the effect of innovation and entrepreneurship education in schools.

##### ***4.2. Practically strengthen the construction of school teachers and comprehensively grasp the teaching prerequisites***

After changing teachers' teaching concepts in time, it is also necessary to improve teachers' teaching level to make them better adapt to the goal of cultivating innovative ability, which is necessary for the cultivation of innovative ability of students in the "bridge engineering" course. The most critical is the effective construction of the teaching staff. At this stage, education pays more attention to the education of students' innovative ability. To effectively help students improve their innovative skills, it is necessary for the teachers of Bridge Engineering to fully grasp the objectives of innovative education and effectively optimize their teaching effects. Schools should build a teaching system reasonably from the aspect of improving teachers' teaching ability. For innovative education, high-quality teachers are the prerequisite for effectively improving the level of innovative education in schools, and the effective construction of innovative system is required. Schools should be committed to the innovative teaching of teachers and build the training system in time [8]. We should not only meet the goal of innovative training education, but also pay attention to the characteristics of the times and the cognitive level of students. Determine relatively complete training tasks according to the learning characteristics of students. At the same time, the school can also be committed to hiring teachers with rich practical experience. By optimizing the structure of teachers, it can effectively build an entrepreneurial model and lay a good foundation for improving the innovative ability of college students.

##### ***4.3. The innovation and entrepreneurship practice training platform has been fully established to increase practice opportunities***

In order to better help students effectively obtain the promotion of innovation and entrepreneurship ability, in addition to improving the curriculum education links, we should also formulate practical entrepreneurship programs, design practical content, guide students to effectively play their entrepreneurial potential on the premise of improving the basic theory, optimize their entrepreneurial thinking with the help of practical activities, better improve their practical level, and effectively expand employment channels, And the construction of the practice platform can also help college students improve their innovation skills. In the process of building the practice platform, the school can first optimize the practice activities in the school, so that students can find their own problems in time,

accumulate experience, and further improve their practical skills in practice after learning the basic entrepreneurship courses [9]. At the same time, the school carries out the design of entrepreneurship competition for a certain theme, which can help students deepen their understanding of entrepreneurship and enhance their entrepreneurial awareness. Inspired by the competition, students can actively improve the activity content in combination with their interests and hobbies.

For example, schools can carry out entrepreneurship contests based on students' knowledge level and entrepreneurial ability and in combination with their interests. Guide students to use modern technology to create in multiple fields, and use the Internet platform to create. In this process, teachers can also effectively participate in the construction of entrepreneurial models with students. This practical measure of the school can effectively improve students' practical level and guide students to improve their learning plan [10].

## 5. Conclusions

To sum up, to promote the growth of college students' professional ability, a scientific and perfect education model is the top priority, while innovation and entrepreneurship education is an important educational task that not only determines the level and ability of students' "bridge engineering" majors, but also plays a vital role in their professional growth. Therefore, the "bridge project" curriculum - innovation and entrepreneurship education design for school students is targeted to promote students to form a good innovation and entrepreneurship ability that is more suitable for the current social development trend and has stronger core competitiveness in the employment market. Based on this, in the research of the thesis, a deep exploration and analysis was carried out around the cultivation of the innovative and entrepreneurial ability of the students of Bridge Engineering, in order to promote the cultivation of the innovative and entrepreneurial ability of the students of Bridge Engineering, and strengthen the level and quality of talent cultivation in colleges and universities.

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