

Research on the Application of Experiential Teaching Method for General Education of Engineering Undergraduates

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ABSTRACT

Experiential teaching carries out and implements specific teaching activities on the basis of students' physical and mental growth, cognitive characteristics, etc. In the cultivation process of engineers, learning, experience and practice are three necessary processes. Engineering experience, as the connecting point of engineering learning and practice, is the central part of general education of engineering undergraduates. To research the effectiveness of experiential teaching method, we used this teaching method in our general engineering education course "The Logic of Failure". The study investigated 61 students in two classes. There are 26 questions designed to collect their comments on the course. Then we make the statistics of the returned questionnaires. The results showed that experiential teaching method can greatly arouse students' learning interest and help improve their learning and practical ability.

Keywords: *Experiential teaching mode, Environment creation, Situational experience, General education.*

1. INTRODUCTION

Experiential teaching method is a new teaching method, which has been widely concerned by scholars since it was proposed. This teaching method is mainly based on the classroom teaching objectives and teaching content to create a teaching environment^[1]. In the past period of time, many scholars have carried out a lot of research on teaching method. Wurdinger suggested that experiential learning method constructs multidisciplinary learning experience that replicates real world learning^[2]. Samantha Wehbi used experiential teaching methods in social work education and suggested that there were at least 3 ways in which these methods can affect practice: by extending learning beyond the confines of the course, by modeling skills and attitudes useful in practice, and by allowing students to experience events that might later be confronted in practice^[3]. Chang, Lee, Ng and Moon conducted a study using experiential learning and noted that students found simulations helpful in developing teambuilding, decision making, planning and managerial skills^[4]. M Gadola and D Chindamo suggested that student competitions can play an important role in education: they promote interest and engagement of the students, as well as of the teachers^[5]. Siddique et al. suggested that experiential learning is a key to

developing career sustaining innovation met competencies, which will be required by engineers of the future to solve interdisciplinary and complex problems^[6]. Li Dan applied experiential learning in Japanese teaching, and she suggested that teachers should integrate modern information technology and make good use of the training centre and training base to enhance the atmosphere of experiential teaching^[7]. Raja, Farhan Uddin compared the effect of experiential learning method and traditional learning method on improving students' communication skills, and the results showed that experiential learning method could improve students' communication skills more than traditional teaching method^[8].

As public elementary course, general education course is a vital part of university teaching, and plays a role of connecting general education and professional education. Focusing on arousing students' scientific interest and inspiring their initiative and creativity, general education is not to help students learn about complex theoretical knowledge but aims at enhancing their understanding about industry background, optimizing their knowledge structure, cultivating their comprehensive abilities and helping them lay a solid foundation of career planning. However, for the complex knowledge system and wide subject area, general

education needs rich teaching resources and high level of teaching methods. And actual teaching effect of existing general education is not ideal. To solve this problem, we use experiential teaching method and improve teaching scenes and methods. Then we apply it in the course of "The Logic of Failure". This paper first described training objectives, and then described application strategies. Finally, the effectiveness of this teaching method was evaluated and verified by questionnaire survey.

2. TRAINING OBJECTIVES OF EXPERIENTIAL TEACHING MODE

2.1. Ability to Identity and Analyse Engineering Problems

Engineering practice ability includes keen insight, the ability to find valuable problems from the ubiquitous objective phenomena, the ability to see through the appearance to perceive the essence, the ability to solve practical problems and the ability to organize and coordinate when dealing with problems, etc. In the future, engineers will not only face some routine problems in industrial production, but also will face more complex practical engineering problems integrating different disciplines. Some problems are obvious and can be seen through a glance, while others lie beneath the surface and hard to notice. At this time, we need to analyse it in depth, identify the abstract problem. Therefore, the ability to identify and analyse engineering problems is an essential ability for engineering students.

2.2. Ability of Knowledge Application

The development of modern industry has put forward new requirements for the training of engineers, but the undergraduate education based on the training of engineers has not changed too much. There is a large gap between the capacity of engineering graduates and the demand of industry development in the 21st century. This gap is especially manifested as the lack of clear understanding and practical experience of engineering graduates in the real work place. We can not learn well by books only. The industry is keen on students with practical ability, especially those who have the ability to apply theoretical knowledge to practical industry problems.

3. APPLICATION STRATEGIES OF EXPERIENTIAL TEACHING METHOD IN "THE LOGIC OF FAILURE"

3.1. Take Case Analysis as the Thread That Runs through the Teaching Process

Case teaching method plays a significant role in Experiential Teaching Mode, which can enhance collage students' direct experience of relevant knowledge. As promoting students' knowledge level keeps the main teaching objective, many engineering theories that have been verified repeatedly and summarized on the basis of engineering practice are characterized by strong theory, abstract and complicated, which make it difficult for teachers to explain clearly to students. Therefore, if abstract theoretical knowledge could be described based on perceptual materials and typical examples, it can not only enhance students' ability to solve engineering problems and enable students to better understand what they have learned, but mobilize students' enthusiasm for learning, activate classroom atmosphere and stimulate students' thirst for knowledge as well.

3.2. Use Diversified Teaching Carriers and Scenes

Multidisciplinary fusion, boundary crossing and knowledge integration are distinctive features of the development of modern industry. As a general course, "The Logic of Failure", characterized with strong comprehensiveness, involves a variety of engineering systems and failure cases in different fields. For this reason, we adopt diversified teaching carriers and teaching scenes. On the one hand, the traditional textbook forms are broken through in teaching materials and different teaching carriers are chosen for different teaching contents. For example, when describing failure cases, it adopts the form of accident and disaster atlas, and when describing the history and development of failure science, it adopts the form of newspaper, so as to better highlight the teaching content with the advantage of different information carriers. On the other hand, the teaching place is not limited to the classroom. According to different course contents, the museum laboratory and the production workshop can be the teaching place. Obviously, the effect of fault cases in the museum is much better than that in the classroom.

3.3. Innovative Assessment Method

The purpose of studying general education for students is not just to pass the exam, but for the purpose of understanding and mastering basics. The assessment of a general education course should not be limited to a single examination, but should be understood as an important teaching accordingly. Our team require students to work in teams to finish four project

presentations. After freely teaming up, students choose the topic according to the cases provided by the teachers or the direction they are interested in, then hold group discussion and ultimately write a report on the basis of the collection and collation of relevant literature. Finally students report their own work results and division of labour in the form of defense. Through this process, students' abilities in independent thinking, collaboration, document writing, language expression, logical thinking, questioning and refutation are cultivated.

4. THE TEACHING EFFECT SURVEY AND EVALUATION

In this section, questionnaire survey was used to investigate whether our teaching method could lead to better learning effect and to verify its effectiveness. We used several indicators to evaluate the teaching effect: the effect in arouse students' learning interest, the effect in helping improve their learning and practical ability, students' favourite teaching method, and whether the teaching method in this paper helps to improve students' willingness to engineering works.

All the students who joined this class filled the questionnaire. According to Figure 1, we can find that students who think that experiential teaching method can greatly improve their learning interest account for 67% in all students, and 13% of the students think that the effect of this method on improving learning interest is ordinary. So we can draw a conclusion that our teaching method is helpful in improving students' interest in learning to a certain extent.

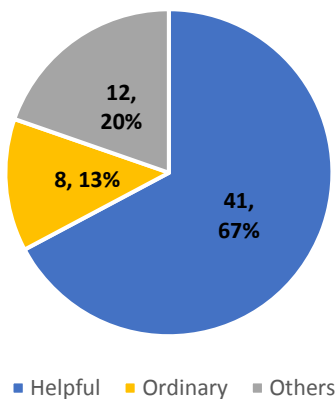


Figure 1 Effect in arouse students' learning interest

The results in Figure 2 show that 84% of students think that experiential teaching can be helpful for their learning and practical ability, while 8% of students think that it is general in helping them understand theoretical knowledge and improving their knowledge application ability. It proves that experiential teaching is helpful for students to understand the relevant theoretical knowledge,

and can help students make a better application of those knowledge.

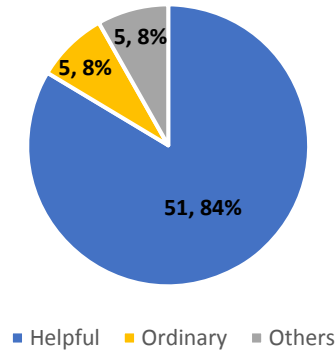


Figure 2 Effect in helping improve their learning and practical ability

In the voting part for students' most favorite way of teaching, we can learn from the Figure 3 that 28 students were interested in case study, 26 students were interested in video teaching. So, we can draw a conclusion that the teaching method with case analysis as the main line is helpful to improve students' learning enthusiasm.

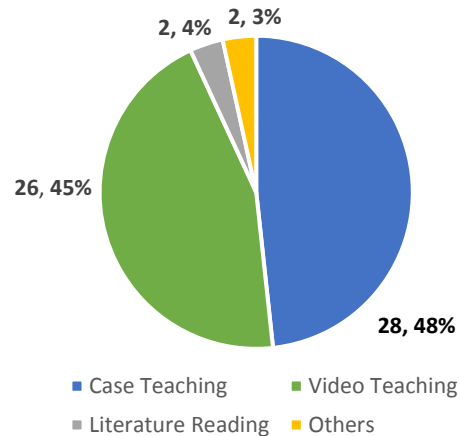


Figure 3 Survey result of students' favorite learning method

In the last flow-graph of employment intention, we can find that when a student takes an active role in learning and applies methods learned in class in practice, his willingness to pursue an engineering career is enhanced.

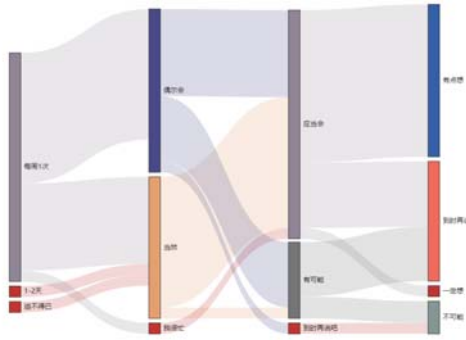


Figure 4 Flow-graph of employment intention

In short, experiential teaching can arouse students' interest in learning to some extent, help students to obtain a better understanding of theoretical knowledge and enhance students' interest in working in engineering field. It can be considered that the teaching method in this paper has achieved good results.

5. CONCLUSION

In short, the experiential teaching method makes the students closer to the real engineering scene. Through the implementation of experiential teaching, the teaching quality and level can be improved, students' interest in learning can be aroused and their professional thinking and practical ability can be cultivated.

There are also some deficiencies in this paper. First, we adopt the form of group defence, so the investigation of each member may be insufficient. Second, more modern technologies like VR can be applied in teaching to create a richer teaching scene. Third, questionnaire results can not objectively reflect the teaching effect, so more detailed inspection of the teaching effect can be adopted. It is hoped that these problems will be further studied in the future.

AUTHORS' CONTRIBUTIONS

Conceptualization, investigation, Shenghan Zhou; methodology, writing—original draft preparation, Chaofan Wei; data curation, Yiyong Xiao; supervision, Wenbing Chang; writing—review and editing, funding acquisition, Shenghan Zhou & Xing Pan; All authors have read and agreed to the published version of the manuscript.

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