**Exploration and Practice of Problem-Based Learning in Course Teaching**

Yu-min HE*, Qiang WANG and Jin-song HUANG

School of Economics and Management, Beihang University, Beijing, 100191, China

*Corresponding author

**Keywords:** Problem-based Learning, Research-oriented teaching, Course teaching reformation

**Abstract.** Research capability cultivation is very important for undergraduate teaching in universities. Course teaching is an important portion of undergraduate teaching. This paper analyzes the applications of research-oriented teaching in the universities in China. It provides a method based on problem-based learning for applying research-oriented teaching in course teaching to cultivate undergraduate students’ capability of problem solving. This paper also gives the practice of the proposed method in the course ‘Information Resource Management.’ The teaching reformation project has obtained good results. It is hoped that the course teaching mode of the practice-based course homework and the experiences of the course teaching practice can provide reference for course teaching reformation in other universities.

**Introduction**

Undergraduate students in universities serve various industries and work at various jobs after their graduation. Because of social development and advance in science and technology, students graduated from universities are required more and more research capability. Cultivating students to become qualified persons through university education tends more and more to cultivating undergraduate students. However, there are many problems in traditional classroom teaching in university education [1]. Traditional classroom teaching is not good for cultivating students’ research capability. Research-oriented teaching is paid more and more attention to cultivating undergraduate students’ research capability and innovative consciousness [2].

This paper analyzes the applications of research-oriented teaching in the universities in China and provides a method based on problem-based learning to apply research-oriented teaching. It also gives the practice of the proposed method in the course ‘Information Resource Management’ and analyzes the results of the course teaching reformation.

**Research-Oriented Teaching in University in China**

Many universities in China applied research-oriented teaching. For example, Dalian University of Technology applied research-oriented teaching using the mode of large-class lecture with small-class discussion in foundation courses such as ‘Higher Mathematics’ [1]. Harbin Engineering University adopted the experiences of teaching reformation in research-oriented teaching from China and abroad and developed the course system emphasizing theory and application [3].

Another typical example of applying research-oriented teaching is that Tsinghua University applied research-oriented teaching to the courses ‘Mechanics of Material’, ‘Rational Mechanics’, ‘Industrial Mechanics’, and so forth. Based on the course teaching, research-oriented teaching was put into practice thoroughly in Tsinghua University, Nanjing University of Aeronautics and Astronautics, and Nanjing Tech University. Relevant teaching reformation was performed and plentiful results were obtained [4,5].

School of Computer in Central China Normal University and School of General Education in Hankou University cooperated together to apply research-oriented teaching to the course ‘Information General.’ They introduced project driven and flipped classroom teaching modes to ‘Information
General. Topics of their project driven teaching mode included living in school, my hometown, my resume, and so forth. The tools applied included Word, Excel, and PowerPoint [6].

Problem-Based Learning

There are many methods that can be used for research-oriented teaching. Problem-based learning is one of research-oriented teaching methods. This method places study into complicated and meaningful problems to let students learn the knowledge behind the problems through problem solving so as to train students the skill of problem solving and the capability of self study [2]. Problem-based learning lets students participate problem-solving activities according to the problems raised by teachers. In teaching process, students search and read related materials, organize discussions, write reports, and so forth. They become the main body of study [2].

Another method that is very close to the method of problem-based learning is the method of problem-solving studying. This method designs contents to be studied as problems. Students raise problems and obtain related comprehension of concepts through problem solving [2]. Raising and solving high quality problems can help students to comprehend deeply the knowledge behind and therefore it is easier for students to apply new knowledge to problem solving in comparison to traditional teaching [7]. This method is different from traditional question and answer in classroom. This method requires teachers to inspire students to raise high quality problems to let students activate original experience and generate new comprehension and supposition [2].

A method applying problem-based learning is proposed in this paper. The problems are posed to students by the course teacher through assigning practice-based course homework. Practice-based course homework is different from traditional homework. Practice-based course homework is based on practical problems and let students study relevant knowledge behind by letting students solve practical problems. Practice-based course homework in a course teaching is used to replace some traditional homework that is often used to help students to consolidate the concepts, theorems, and methods learned from a course. Practice-based course homework is used to help students increase the capability of problem analysis and problem solving. Practice-based course homework is different from course design that needs to use additional course hours. Steps involved in the practice-based course homework are described as follows.

1. Forming Study Group
   At begin of a course, students form study groups. Each group is composed of students with good grades and students with bad grades. Students in each group study together and learn from each other.

2. Deciding Problem to Solve
   After the course teacher poses problems and provides relevant references, students need to read the reference papers, discuss within each study group, and decide a particular type of the problems to solve.

3. Working on Problem Solving
   Students study relevant course contents and the reference papers. Student groups work on their problem solving. Many activities are involved in the problem solving process such as designing evaluation index, designing questionnaire, putting questionnaire in website such as Wen Juan Xing to collect data, determining weight, testing consistency, analyzing data, and processing data. During the problem solving process, students study together, learn from each other, and solve problems encountered. For the activities, student groups also discuss with the course teacher, make corresponding changes according to the suggestions of the course teacher, and also study by themselves to fulfill the activities.

4. Writing Report
   Student groups describe the results of their data analysing and processing, and then write the conclusions on their reports for their practice-based course homeworks.
Practice and Result Analysis

In order to train students’ capability of practical, analytical, and problem-solving through course teaching, course teaching reformation was made for the course ‘Information Resource Management’ and problem-based learning was applied. The reformation was supported by School of Economics and Management, Beihang University. The teaching reformation project ‘Student Synthetic Capability Cultivating by Practice-based Teaching’ was granted as a general teaching reformation project by Beihang University in 2014.

The practice-based course homework was applied to the course teaching for the course ‘Information Resource Management’ for students in classes 110821, 120821, and 130821 in 2014, 2015, and 2016, respectively. Students participated the activities and accomplished their practice-based course homeworks. The teaching reformation project finished and obtained good results in 2016. According to the evaluation of experts, the project obtained the score of 86.5.

Surveys were made to collect students’ feedback of the course teaching reformation. The results are illustrated in Table 1. It can be seen from Table 1 that there are 20 students in the class of 2014. The number of effective answers is 18 with effective percentage 90%. Among them, there are 16 students select that practice-based course homework is helpful to their study and percentage of help found is 88.9%. There are 37 students in the class of 2015. The number of effective answers is 29 with effective percentage 78.4%. Among them, there are 28 students select that practice-based course homework is helpful to their study and percentage of help found is 96.5%. There are 26 students in the class of 2016. The number of effective answers is 22 with effective percentage 84.6%. Among them, there are 20 students select that practice-based course homework is helpful to their study and percentage of help found is 90.9%.

Table 1. Results of Feedback.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Students</th>
<th>No. of Return</th>
<th>No. of Effectiveness</th>
<th>Percent. of Effectiveness</th>
<th>No. of Help Found</th>
<th>Percent. of Help Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>20</td>
<td>18</td>
<td>18</td>
<td>90.0%</td>
<td>16</td>
<td>88.9%</td>
</tr>
<tr>
<td>2015</td>
<td>37</td>
<td>33</td>
<td>29</td>
<td>78.4%</td>
<td>28</td>
<td>96.5%</td>
</tr>
<tr>
<td>2016</td>
<td>26</td>
<td>22</td>
<td>22</td>
<td>84.6%</td>
<td>20</td>
<td>90.9%</td>
</tr>
</tbody>
</table>

From Table 1, it can be seen that there are 28 students out of 29 students who think that practice-based course homework is helpful to their study in the questionnaire of 2015. Percentage of help found is 96.5%. It is higher than percentages of help found in the other years. One possible reason might be that percentage of effective answers of the questionnaire of 2015 is low as 78.4%. Relatively, more students did not take part in the questionnaire in 2015. In summary, most of the students in the classes thought that the practice-based course homework was helpful to their study. Percentages of help found were 88.9%, 96.5%, and 90.9% in 2014, 2015, and 2016, respectively.

Summary

Undergraduate students not only need to master fundamental knowledge of science and technology and basic techniques of social activities but also need to possess more and more the capabilities of research and innovation. Therefore, research-oriented teaching is very important and becomes development trend for undergraduate education and teaching in universities.

This paper provides a method of applying problem-based learning to cultivate undergraduate students’ capabilities of problem solving and self study. The teaching reformation project has obtained good results. It is hoped that the course teaching mode of the practice-based course homework and the experiences of the course teaching practice can provide reference for course teaching reformation in other universities.
Acknowledgement

This paper is partial result of the teaching reformation project ‘Student Synthetic Capability Cultivating by Practice-based Teaching’ that was financially supported by School of Economics and Management, Beihang University and granted as a general teaching reformation project by Beihang University in 2014.

References


