Study on Practical-teaching System of Environmental Sciences Based on the PBL Method

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Abstract. After investigation and survey, the Practical-teaching System of Environmental Sciences in electric power universities had been reformed based on the problem-based learning (PBL) method. The improved PBL teaching model as "Problems posing + Information researching + Schemes designing and implementing + Evaluating (PPDE)" was set up and expounded in this paper. The PRDES model was carried out in practical-teaching system of Environmental Sciences in our university, and good results had been achieved.

Introduction

Practical-teaching system is importance component of the creative personnel training system in universities. In our university, all the teachers of Environmental Sciences major explored continuously on the development of practical-teaching platform and curriculum system for ten years. At present, 23 separate practical-teaching courses (46.5 credits) and 12 courses with experiments had been established. Those courses played irreplaceable roles on the training of experiment skills, the abilities to solve problems, right thinking and rigorous research styles of students. Because Environmental Science is across the chemistry, physics, biology, geography, economy and management majors, and was set up for a short time, there are also some problems in the Practical-teaching System. These problems restrict the cultivation of creative personnel in the majors, and need to be solved.

As a widely concerned teaching method, the problem-based learning (PBL) method’s essence is problem (goal) orientation[1]. This method emphasizes the form of problem solving with discussion among students, aiming to train the creative thinkings and teamwork spirits of students, so it can make up for the shortcomings of traditional practical-teaching. We introduced the PBL method into the Practical-teaching System of Environmental Sciences, and set up the new practice teaching method and system with goal oriented, then made further practices on basic courses, major courses, comprehensive experiment courses and innovation competition projects, and so on. The PBL practical-teaching system consisting of experiment proposition, experiment environment, experiment instruction manuals and experiment examinations was established, and new ideas and approaches about the creative personnel training system of Environmental Sciences have been set up.

Application of PBL Method in the Practical-teaching System

Among the practical-teaching system of Environmental Sciences, teaching platform, curriculum setting, teaching content, teaching method and appraisal mode were investigated and analyzed, and problems in them were found out. Then the PBL method was applied in the practical-teaching system.

Design the Practical-teaching Platform and Curriculum System for Environmental Sciences

Practice-teaching system and work fields for graduates of environmental science major were investigated firstly, and then, at the background of electric power university, aiming at creative
personnel training, authors constructed the practical-teaching system of "experience, consciousness, basic experiment ability, professional experiment skill, innovation ability". The system consisted of four platforms as experience/consciousness practices, basic experiment ability training, comprehensive experiment skill training and innovation experiment ability training. The implementation plan was as fellows: (1) To integrate existing experimental resources, and set up a basic experimental capacity training platform; (2) To transformed and upgraded laboratory, and set up a comprehensive design experiment platform; (3) To relying on the support of projects, and set up a experience/consciousness practice platform and a innovation experiment ability training platform[2].

At present the environmental science comprehensive laboratory, Environmental science information platform, and teachers and students' communication platform in network have been completed. Training bases have been establish in sewage treatment plants and soil and water monitoring stations. The courses of "environmental and development research", "environmental information retrieval" and other PBL mode practical courses were set up. Using the above platforms many students participated in a number of contests on energy-saving emission reduction, innovation and entrepreneurship, and so on.

Study on the Experiment Teaching Model Based PBL Method

Status Investigation and Problem Analysis on Traditional Experiment Teaching Methods.
For a long time, most of the experiment teaching methods of environmental science was the traditional indoctrination mode focusing on the demonstration, verifying theories and experimental technology training, such as in a specified time students go to laboratories to do the prescribed experiments, and the experiment contents and main steps designed by teachers. The traditional method is widely used for its definite purpose and its convenient operation, but also has disadvantages as paying attention to imparting knowledge not to cultivating ability, and insufficient interaction between teachers and students.

Building of the Improved PBL Experiment Teaching Model. Organic chemistry B, Ecology, Environmental biology, Biochemistry and other courses were selected to carry out PBL experimental teaching practices[3]. The improved PBL experiment teaching model could be described as "Problems posing + Provision of information + Design and implement + Evaluating (PPDE)".

Problems Posing. First, Teachers put forward experimental propositions with curriculum characteristics. The experimental propositions should be comprehensive and designability with good cohesion to actual production applications, and can make students to practice more and develop the ability about flexibly using knowledge to analyze and solve problems in the limited experimental hours. For example, the proposition “the determination of the total coli-group index of the Fuhe River” required students to know about water quality indexes, water quality monitoring and the cultivation of microorganisms and many other aspects of the content.

Provision of Information. Second, the experimental instruction manuals of propositions were provided by teachers. The manuals were completely different from the traditional experimental handouts, in contents consisting of leading questions, descriptions of experimental conditions and equipments used, the background materials and laboratory considerations required for the proposition, and so on. Leading questions should be enable students to find and develop a reasonable experimental steps from theoretical knowledge and information, at the same time of answering questions.

Design and Implement. Third, the experimental environment was built and students carried out the experiments. The teacher organized students to experiment in proposition groups of four to five. The proposition groups discussed the questions in the experimental instruction manual and collected the relevant information, answered questions and put forward the experimental schemes, and then wrote the experimental plan with experimental objectives, steps, equipment, materials and other content and submitted to the teacher. In this process, the teacher provided communication platform for students, each group were available to statement or reference a variety of opinions on the platform, and teachers could guide the direction of discuss and make necessary question answering. From the process, the
team members could share the achievements of learning, work together in teams, obtain and evaluate information. It was also the most important way to contribute autonomous learning.

According to the proposition and the team's plan, teachers arranged the necessary instruments, reagent, laboratory and testing time to set up experimental environment for students. Students experimented with the content and procedures of their own design with on-site guidance of the teacher. From this process, students' participation can be better mobilized, and students achieve a sense of accomplishment, so that it stimulate their interest and improve their learning effect.

Evaluating. After completing the experiment, proposition groups submitted the experiment report and made a brief statement and reply. Students could further consolidate and master their knowledge in the process. The teachers will be graded according to plans, procedures, reports and statements of proposition groups.

Evaluation and Analysis of the PPDE Experiment Teaching Model. The effect of PPDE model was surveyed in students by questionnaires. The questionnaire was conducted in an anonymous manner. The results were shown in table 1.

<table>
<thead>
<tr>
<th>Evaluation items</th>
<th>Good effect</th>
<th>Modest effects</th>
<th>Bad effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>To consolidate and deepen the theoretical knowledge</td>
<td>86%</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td>To strengthen the grasp of basic knowledge</td>
<td>96%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>To improve motivation and initiative of study</td>
<td>98%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>To improve the ability to analyze and solve problems</td>
<td>98%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>To improve the effect of learning and self-study ability</td>
<td>92%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>To improve the ability of language expression</td>
<td>88%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>To cultivate of innovative thinking ability</td>
<td>86%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>To develop cooperation and team spirit</td>
<td>98%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Are you willing to accept the PPDE method?</td>
<td>Yes:100%</td>
<td>No:0</td>
<td></td>
</tr>
</tbody>
</table>

As shown in table 1, all of students questioned were willing to accept the PPDE experiment teaching model. More than 85 percent of students considered the PPDE model with good effect on consolidating and deepening the theoretical knowledge, improving the ability of language expression, cultivating of innovative thinking ability. More than 95 percent of students considered the model with good effect on strengthening the grasp of basic knowledge, improving motivation and initiative of study, improving the ability to analyze and solve problems, improving the effect of learning and self-study ability, and developing cooperation and team spirit.

Study on the Course Teaching Model Based PBL Method

The authors constructed the systematized courses of teaching content, teaching method, teaching material, examination method such as “Comprehensive experiment of environmental ecology”, "environmental and development research", “Environmental Analytical Chemistry” and "environmental information retrieval”[4-5].

"environmental and development research": Students needed to study the course after learning the basic knowledge and theory of environmental science. The PBL propositions were posed as “investigate and report of the environmental problems in certain areas” in this course. The students chosen the propositions independently and the teachings were scattered. Throughout the process, the teacher only given the necessary guidance to answer the student's professional questions, or inform
the students of the expertise involved in where to start. The practice course covered chemistry, environmental biology, environmental science, ecology, environmental economics, environmental monitoring, environmental toxicology, environmental geology, environmental information retrieval, etc. To finish this report, students needed to learn the methods about research on environmental issues, information collection, data induction processing, analysis and synthesis, report writing and other working methods. From repeatedly revised and completed the report, professional knowledge and practical ability to work of a student was exercised and tested.

“Environmental Analytical Chemistry”: The course mainly deals with the whole analysis process of environmental samples from sampling, pretreatment, enrichment, detection and so on. Principle and methods of experiments run through the course, so the PBL teaching mode was used mainly in the course teaching. The PBL propositions in this course were posed such as “Quantitative detection of polycyclic aromatic hydrocarbons in flue gas desulfurization gypsum”.

“Comprehensive experiment of environmental ecology”: The PBL propositions were posed as “Field comprehensive investigation of vegetation in certain region”. The propositions required students to carry out (1) investigating an ecosystem and surrounding information, and evaluating the current state of the ecosystem; (2) analyzing the ecological problems of the ecosystem and investigate the causes; (3) establishing relationships between environmental factors and the structure and function of this ecosystem. Based on the knowledge gained, students collected, analyzed and written their reports, and the teacher only given the necessary guidance.

Conclusion

The PBL practical-teaching system has been implemented in the practice-teaching of the third grade of environmental science students, and has made good result there are some problems in it, such as Systematic of experimental and courses teaching platforms are not so high, the evaluation system and the standards are relatively thin, theoretical and practical research achievements have limited impact. These problems need to be thought, researched and explored further.

References


