

Study on the Impact of PBL Teaching on Undergraduate Research Ability

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Abstract

Nowadays, when scientific research and innovation ability are emphasized more and more, how to strengthen the cultivation of undergraduates' scientific research ability is a problem of great practical significance, and the PBL has been widely researched and applied in other disciplines from the beginning of its application in the field of higher medical education. As a new type of teaching method different from the traditional teaching method, PBL shifts the center of teaching from teachers to students, which has positive significance in cultivating undergraduates' innovative thinking, innovative ability, scientific research ability and independent learning ability. However, PBL also has the shortcomings of longer application time, diversified and disordered teaching content, and unbalanced students' ability, which are all problems we need to solve urgently. And this paper will specifically elaborate the relevant contents of PBL from these aspects.

Keywords

PBL; Undergraduate Students; Research Skills; Innovation; Dilemma.

1. Introduction

Since the 21st century, along with the breeding of a new round of scientific and technological revolution and industrial change, innovation ability has become more and more a decisive factor in the competition for comprehensive national power in the world [1]. The cultivation of scientific research and innovation ability has become one of the important requirements of education for the construction of a strong nation.

As an important symbol of a country's level of development and development potential, the main role of higher education is to serve scientific and technological progress and to promote high-speed social development. According to the spirit of the 19th CPC National Congress, the Ministry of Education, the Ministry of Finance, and the National Development and Reform Commission issued the Guiding Opinions on Accelerating the Construction of "Double First-class" Higher Education Institutions, pointing out that the level of scientific research should be improved, and emphasizing the supportive role of first-class scientific research in the construction of first-class universities. Scientific research ability is an important aspect of college students' ability development in the school stage, which is necessary for building students' innovative thinking and innovative talent cultivation mode. Many domestic scholars have carried out a lot of research and exploration on the concept of innovation ability and the construction of cultivation mode, but the evaluation of innovation ability is through the construction of the core qualities of innovation ability and evaluation indexes, and the students' self-knowledge is used to identify and evaluate their innovation ability, and the evaluation group is mainly oriented to the undergraduates and postgraduates, and there are few

researches emphasizing on the influence of teaching methods on the cultivation of students' innovation ability in all stages [2].

"Problem-based learning (PBL) was first introduced into higher medical education by McMaster University in Canada, and has received more and more attention because of its ability to cultivate students' ability to solve practical problems. Nowadays, PBL teaching method has been widely used in the United States, China, Canada, Spain, Turkey and other countries [3], and it has gone from the initial medical education field to the education field of other disciplines, and it is a kind of teaching mode that has received wide attention in recent years in the international arena, and it is now mostly used in the lectures of higher education theory courses. Overseas countries attach great importance to the development of scientific research ability of college students, and generally take research study and scientific research training as an important measure to cultivate innovative talents. Some universities in the United Kingdom and the United States have successively included the guidance of undergraduates in scientific research in their curriculum, for example, the Massachusetts Institute of Technology (MIT) "Undergraduate Research Opportunities Program" has set up undergraduates' scientific research credits. In recent years, many domestic schools have also carried out a wide range of exploration, such as seminar-type teaching mode, case-based teaching mode, college students' scientific research and innovation platform mode and so on. The cultivation of college students' scientific research ability has received more and more attention, and the PBL teaching method is beneficial to students' acquisition and integration of knowledge and skills, can cultivate students' innovative thinking, can create a positive innovation environment, provide abundant resources and support, and focus on cultivating students' personalities. However, in the classroom teaching practice, the PBL teaching method is found to be used for a long time, the teaching content is diversified and disordered, and the students' ability is not balanced and other aspects of the dilemma. Therefore, it is urgent to change the traditional teaching methods and utilize the integration of new teaching methods in order to enable students to better exert their subjective initiative, thus further enhancing the scientific research ability and comprehensive literacy to solve the economic development and specific problems in China.

Based on the above background, this study aims to investigate the impact of PBL teaching mode on undergraduates' research ability, and to excavate the problems arising from the application of PBL teaching in the classroom, which is not only an important guide to improve the quality of undergraduates' cultivation, but also of great significance to promote the construction of high-level universities and key disciplines.

2. Introduction to PBL

2.1. Implications of PBL

PBL is the abbreviation of English Problem--Based--Learning, PBL teaching method is a kind of student--centered teaching method, through letting students carry out a period of research, investigation, to solve complex problems or challenges, and then learn new knowledge and acquire new skills from them. PBL is a problem--centered teaching method, and its core is to design the problem carefully. Problems are both the starting point and the basis of PBL [4], so in the process of translation we will also call it problem-based learning or "project-based teaching method". This teaching method is divided into seven steps in the teaching process, from clarifying an unfamiliar term, defining the problem, brainstorming, restructuring the problem, defining the learning objectives, and finally collecting personal information and sharing the information in the group, which is in the form of group discussion, emphasizing on active learning of students, aiming at cultivating students' creative thinking, innovative ability, independent learning ability and critical thinking ability.

2.2. The Evolution of PBL

2.2.1. The Origin of PBL and its Development Abroad

PBL teaching method originated in the 1950s in the United States of America's West Yu University School of Medicine, 1969 home to the United States of America's neurology professor Barrows first introduced PBL into the field of medical education, Mc Master University Medical School in Canada formally at the level of the entire school comprehensively launched the PBL teaching method. After the U.S. medical schools in the basic curriculum (anatomy, pharmacology, physiology, etc.) has been widely used, and since then the PBL teaching method is more and more by other areas of attention and adoption, such as business education, construction education, legal education and social work education, etc [5], and then it is in the primary and secondary school education to attract attention and promote the use of.

By the 1990s, some medical schools in the United Kingdom also realized the importance of the PBL teaching method, so the major medical schools in the United Kingdom, such as the University of Liverpool Medical School and the University of Manchester Medical School, began to apply the PBL teaching method in their teaching. With the maturity of PBL teaching method, this teaching method began to spread to the East, Japan as a developed country first introduced the teaching method used in the teaching of Tokyo Women's Medical University. The change of students' learning mode from knowledge accumulation to problem solving ability became one of the hotspots of the change of medical education in Japan at that time [6].

2.2.2. The Development of PBL in China

Although PBL was introduced in China later than in Western countries and Japan, like Western countries and Japan, we were the first to teach PBL in the medical field. 1986, Shanghai Second Medical University and Xi'an Medical University first introduced PBL, and this teaching method began to emerge in mainland China. After that, Taiwan and Hong Kong also introduced PBL teaching method one after another, and since the 1990s, the use of PBL teaching method in major universities in mainland China has gradually increased and achieved considerable results in the basic and clinical courses of medicine and experimental courses. However, compared with foreign countries, due to the relatively late introduction of PBL teaching method in China, our in-depth research on this teaching method has not yet been perfected, and compared with foreign countries, our research mostly stays in the medical field.

2.3. Advantages and Disadvantages of PBL

2.3.1. Advantages of the PBL

PBL teaching method takes the problem as the starting point and requires students to carry out independent learning, which makes the roles of teachers and students change radically compared with the traditional education method. It responds to the needs of the times, mobilizes students' enthusiasm and creativity in learning, and is conducive to the cultivation of innovative talents. In addition, PBL teaching method is carried out in the form of group cooperation, which not only requires independent learning in class, but also requires group discussion in class, which not only exercises students' independent learning ability, but also strengthens the team cooperation ability among students, and improves students' learning quality from a comprehensive aspect.

2.3.2. Disadvantages of the PBL

Since PBL teaching has high requirements for students' independent learning ability, when students' basic knowledge is not solid enough, students focus their attention on problem solving and tend to ignore the mastery of knowledge, and lack of coherence and systematization of knowledge [7]. In addition, the implementation of PBL in Chinese education also faces some difficulties. Students are mostly passive recipients of knowledge, and it is difficult for them to accept the PBL teaching of independent learning. In addition, PBL was introduced late in China,

as a new teaching mode, many people do not understand it well, we do not have a complete PBL teaching system like the western countries, how to carry out systematic PBL teaching, how to integrate PBL teaching method into today's textbook arrangement system, these are the difficulties to be solved.

3. The Impact of PBL Teaching on Undergraduate Research Skills

3.1. Beneficial to the Cultivation of Undergraduate Students' Creative Ability

Compared with other teaching methods in the past, PBL teaching method has significant positive significance on the improvement of undergraduates' scientific research ability. PBL teaching method is a teaching mode based on the real world, under the guidance of teachers, "student-centered, problem-based", through the use of group discussion, so that students can independently collect information around the problem, discover the problem and solve the problem, solve problems, and cultivate students' independent learning ability and innovation ability teaching mode [8]. In the PBL teaching mode, students have been transformed from passive recipients of knowledge into independent learners, able to go deeper into the classroom, and have a deeper understanding of what they have learned in the process of problem solving. In the traditional teaching method, it is mainly centered on the teacher, the classroom and the textbook, the teacher determines the theme of each lesson, and then teaches around this theme, the students are more listening, acceptance of the state, the initiative is more in the hands of the teacher. PBL teaching pays more attention to stimulating students' initiative in learning, teachers can assign students corresponding preclass thinking assignments before class, and in the classroom process, assist the group in setting goals, selecting key points, formulating plans, and guiding students to constantly discover unknown problems or challenging tasks, prompting students to constantly give play to their imagination and creativity, and use their own knowledge to independently solve the The students are encouraged to utilize their imagination and creativity to solve the problems independently by applying what they have learned, so as to improve their innovative ability. This teaching mode will give students greater subjectivity and autonomy, so that students become the new classroom center, so that students personally experience the real problem situation, to establish the idea of problem solving, to establish the evidence consciousness, to construct their own evidence, views, conclusions system, the formation of evidence-based reasoning thinking model, and then cultivate the evidence-based reasoning of the students' literacy [9], which is conducive to the construction of knowledge and the development of innovation ability of the students. At the same time, the content form of PBL teaching method is more diversified, not only limited to listening to the teacher in the classroom, but also allows students to conduct social practice, field research, experimental research, hands-on operation to stimulate students' interest in learning, and in practice to develop students' imagination and creativity.

3.2. Contribute to the Development of Undergraduate Research Skills

The PBL teaching model proposes the edge of the scope of learning, the beginner can be at the edge of the learning situation, and learning is a kind of starting from the edge of the continuous advancement, and gradually enter the core of the process of in-depth participation [10]. Each learner is in the process of hands-on practice to refine his or her own research skills, so as to continuously solve the problems encountered. In this model, students rely more on their own ability and cooperation with group members to solve the research topic, and each of them is responsible for their own best part of the work, so that the team's greatest strengths can be fully realized. In PBL teaching, each student plays a different role, some students are responsible for research and data collection, some are responsible for experiments and observations, and some are responsible for analyzing data and writing reports, etc. The division of labor enables each student to give full play to his or her own strengths and talents, and

develops students' leadership, communication skills and cooperation spirit [11]. The students trained by PBL teaching method are more in line with the contemporary society's demand for scientific research talents, and can steadily and solidly improve students' scientific research ability.

3.3. Contribute to the Enhancement of Undergraduate Students' Self-directed Learning Skills

Li Baochun suggests that in the Chinese context, the basic process of PBL should include at least eight steps: defining learning goals; organizing learning groups; refining group and individual learning tasks; starting the exploration of new problems; solving problems; reporting on the learning results and the confusion in mind; reflecting, summarizing, and evaluating after the problem has been solved; and exchanging the learning experience or presenting the paper publicly [12]. This series of processes is entirely student-driven, requiring them to independently and autonomously on the subject of inquiry, the teacher is only a certain guidance for students, the entire learning process is still more autonomy in the hands of the students. Students in order to solve the problem in this process need to be more conscious and active learning, while cooperating with other members of the independent, play the collective strengths to make up for the shortcomings. When students succeed in designing a solution based on their own ability, they will get a great sense of satisfaction and achievement, which will give them more confidence and motivation to devote themselves to the next study and research, and increase their sense of self-efficacy. For students, academic self-efficacy is an important individual intrinsic factor that enhances their interest in learning, stimulates their desire to learn, and improves their learning effectiveness [13]. According to Gist, an individual's internal control tendencies, intrinsic motivation, and expectations increase with self-efficacy, thus positively guiding student behavior [14]. The "success experience" in the PBL teaching process can make students enhance their sense of self-affirmation [15], thus making them more conscious of independent learning and forming a virtuous cycle.

4. Conclusion

By exploring the application of Problem-Based Learning (PBL) in undergraduate education, this study demonstrates that PBL is effective in cultivating undergraduates' research ability and independent learning ability. Through empirical analyses and case studies, our group found that the PBL pedagogy effectively stimulates students' innovative thinking and problem-solving abilities, and also strengthens their teamwork and leadership skills. Across multiple subject areas, students using the PBL pedagogy demonstrated higher motivation, greater spirit of inquiry, and superior academic outcomes.

5. Suggestion

5.1. Further Popularization and Optimization of PBL Pedagogy

Institutions of higher education should widely adopt the PBL model of teaching, which encourages students to learn through real-world problem solving, which helps to enhance their critical thinking and innovation skills. For different disciplines, the PBL model should be appropriately adapted to ensure effective integration of teaching methods and subject content. For example, science and technology subjects may require more experimental and practical activities, while humanities and social sciences subjects may focus more on discussion and analysis.

5.2. Strengthening Teacher Training and Support

PBL teaching mode emphasizes student-centeredness, and the teacher's work is mainly to guide and supervise the students, which requires the teacher to complete the pre-design of the course before the class, count the data in the student evaluation scale after the class, and organize and analyze the data and finally provide feedback to the students on the evaluation results. [16] This kind of task is a big challenge for teachers, and if the teachers' own ability level is not good, it is very likely that the effect of PBL teaching will be greatly reduced. Therefore, educational institutions should provide teachers with specialized training in PBL pedagogy so that they can fully understand and master the core elements and implementation of PBL. Schools should also provide the necessary resources and technical support, such as laboratory materials, case study resources and technical equipment, so that teachers can implement PBL more effectively.

5.3. Establishment of Evaluation and Feedback Mechanisms

It is crucial to establish a systematic assessment mechanism, which not only assesses the learning outcomes of students, but also the effectiveness of the teaching process itself. Through continuous feedback and improvement, teachers can adjust their teaching strategies based on students' feedback and learning outcomes to further enhance teaching effectiveness. The construction of the assessment mechanism must also take students as the main body, so that students can express their true ideas in this assessment mechanism, the assessment mechanism of the problem can include students' ideas and suggestions to the teacher's classroom organization, as well as the detection of students' comprehensive quality has been improved in two major parts of the latter problem should be real and feasible, so that students in the problem solving process can clearly sense their own problem solving ability has been improved, the assessment of the problem should be based on the students' feedback and learning effectiveness, and the assessment of the problem should be based on the students' feedback and learning effectiveness. The latter questions should be realistic and feasible, so that students can clearly perceive whether their problem-solving ability has been improved in the process of solving problems, and the setup of assessment questions should be consciously different from the traditional teaching assessment, and should be more flexible in examining the students' innovative ability and logical thinking ability.

5.4. Intensive Interdisciplinary Learning Program

Interdisciplinary PBL programs are encouraged to enable students to apply and integrate knowledge and methods from different disciplines in solving real-world problems. Such interdisciplinary collaboration can develop students' ability to think comprehensively and work in teams. The problem design of PBL methodology needs to be systematic and progressive, meeting the three criteria of continuity, sequentiality, and integration for the effective organization of students' learning experiences. [17] Therefore, in the process of teaching students, teachers should consciously differentiate themselves from the traditional teaching practice of treating the knowledge of each subject in isolation, but should integrate the knowledge of each subject, so as to enable students to form a systematic knowledge system, which helps to develop students' thinking ability and improve their comprehensive literacy.

5.5. Enhancing Student Engagement

Schools can enhance students' engagement and practical experience by providing more practically relevant cases and problems. For example, school teachers can work together to develop more interesting, practical and innovative curricula and provide students with more practical opportunities so that they can better understand and apply what they have learned in the learning process, and improve their motivation and effectiveness.

Through the implementation of these recommendations, it is expected that the teaching effect of the PBL teaching method can be further improved, more adapted to the needs of modern education, and lay a solid foundation for the improvement of students' comprehensive ability and the success of their future career.

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