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A Literature Review on the Practice and Challenges of Project-based Learning (PBL) in Teaching Primary (STEM) in China

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Abstract. With the rapid development of modern society, China is more and more eager for innovative talents; therefore, the national policy supports the adoption of Project-based Learning (PBL) pedagogy in Science, technology, engineering and Mathematics (STEM) disciplines. Although PBL can develop students' ability to solve real-life problems, such as solving the problem of sewage treatment in life, thinking independently, and exploring actively, the implementation of PBL in STEM teaching in Chinese elementary schools is still a great challenge because the current level of teachers in China is inadequate and lacks systematic training. This paper will analyze the positive views and shortcomings of previous researchers in relevant topics of inquiry through the literature review method and then propose some new ideas for improvement. For example, schools need to be better resourced with teachers as well and the government can provide schools with more funds to buy equipment to ensure that teaching and learning are equipped.

Keywords: Problem-based Learning; STEM; China.

1. Introduction

Against the backdrop of the rapid development of Chinese society, the country's desire for talent is growing, so the state attaches greater importance to the development of education and has introduced new education policies. The new education law advocates that students should be taught according to their aptitude and that their potential should be actively explored and their ability to discover, analyze and solve problems should be cultivated [1]. The U.S. education system also emphasizes the development of students' innovative and problem-solving skills. Many U.S. schools implement Project-based Learning (PBL) because it meets the current educational goals. Instead of using traditional textbooks, American schools are using textbooks developed according to the PBL approach [2]. The use of such textbooks in the PBL instructional model is more relevant. Due to the policy drive and the influence of globalization on education, China has started to borrow the PBL teaching method from abroad. China is now increasingly emphasizing the use of PBL pedagogy in science at the elementary level. With the development of social sciences, there is an urgent need to cultivate innovative talents and education policies emphasize the development of students' problem-solving abilities in real-life situations and the spirit of innovation [3]. Education departments and teachers are concerned with the development of students' core qualities, and primary science programs can develop students' problem-solving abilities and promote their overall development [4]. In elementary science, students need to observe and think carefully and consult various materials to solve problems, and in the process, each emerging problem will drive them to learn more. Liu pointed out that PBL is a problem-based learning method in which students learn how to solve problems rather than a single answer to a problem [4]. The implementation of PBL is a process in which students learn how to solve problems rather than a single answer. The implementation of PBL allows students to learn more interdisciplinary knowledge because they will inevitably come into contact with non-disciplinary knowledge in the process of researching a problem and reviewing information, thus broadening their knowledge [4]. There are many similarities between the PBL approach and the focus of primary science education [3]. It is because PBL teaching is in line with the teaching direction of elementary science education that the PBL teaching method is adopted and applied by teachers in elementary science education. However, in the las three years due to Covid-19, the implementation

of PBL pedagogy has also been hindered. The completion of most projects takes a lot of time down the process from identifying the topic to reviewing the information and then analyzing the research. Due to the fact that students were not able to go to school during the COVID-19 period, it was difficult for them to complete the projects within the time limit. The PBL methodology usually involves completing the projects in small groups, but due to the large number of students in each class in Chinese elementary school, it is difficult to divide the students into multiple groups to complete the projects. This paper will use a literature review to summarize more comprehensively what other scholars have done about the advantages and challenges of the PBL approach and give some suggestions for improvement.

2. PBL in China

The PBL teaching method has a unique idea of development and utilization in China. PBL is a student-centered teaching method in which the teacher acts as a learning guide to complete projects through group work and this teaching method can enhance students' problem-solving ability [4]. During the implementation of the PBL teaching method, students need to consult a large amount of information in order to find a solution to the problem and to complete the project, and in the process, they are likely to learn a lot of knowledge about other subjects. The process of completing the project can promote their overall development. However, the implementation of PBL pedagogy in China is relatively limited. Liu pointed out that PBL pedagogy in China is problem-oriented. This is more similar to problem-based learning both of which are centered on a specific problem [4]. In China, the PBL teaching method is commonly used in which students work in small groups to complete a project around a topic within a subject area, and the emphasis is on the final results [5]. Although the Chinese PBL approach also focuses on the development of students' innovation, independent thinking, and practical problem-solving skills, it is more concerned with the rapid completion of projects and seeing students complete projects in a short period of time.

3. Science, Technology, Engineering and Mathematics (STEM) in China

STEM mainly consists of four subjects: science, technology, engineering and mathematics. STEM tends to cultivate talents who have the ability to meet the needs of the country with the ability of innovation, practical problem solving and teamwork [5]. Through the four courses, students can gain interdisciplinary knowledge, and the four courses included in STEM have both similarities and differences. For example, a student completing a science-based project is likely to use technology, engineering, and math. However, Hu mentioned that the implementation of elementary school science programs in China is still relatively low, and the implementation of STEM requires sufficient teacher resources and high demands on teachers [5]. Teachers need to have interdisciplinary knowledge to ensure that they can provide accurate guidance to students when using PBL.

4. Advantages of Applying PBL Teaching Method

The implementation of PBL pedagogy has enabled the students to improve in different aspects. First of all, the PBL teaching method helps to improve students' ability to solve complex problems (6). The PBL teaching method focuses on students' flexible application of theories to solving practical problems. Students in this educational mode are good at analyzing and solving problems and their overall comprehensive quality can be cultivated. Guo also suggests that students in the traditional fill-in-the-blank mode of teaching are not able to solve the problems well [6]. complex problems. In the traditional Chinese education model, students only need to receive knowledge and neglect to cultivate their independent thinking, analyzing and problem-solving abilities. As a result, their ability to solve real-life problems is so weak that they do not know how to apply the theoretical knowledge they have learned to solve problems. In addition, students' ability to learn spontaneously is also practiced under the PBL mode. Liu pointed out that the PBL mode can motivate students to learn spontaneously [4]. Students need to go through different stages in completing a complete project, including identifying

the topic and method of investigation, data collection, discussion, and analyzing the results of the experiment, etc. They also need to work closely with their group members at each stage, which can also develop their ability to get along with others. The final results of the research are not only presented and scored by the group members but also scored by other groups [4]. In this scoring process, students' internal motivation will be strengthened, and when they find that the projects presented by other students are excellent, their internal motivation will push them to learn from their excellent classmates. Different students can learn from each other to find their own weaknesses and actively communicate as well as learn from the strengths of others. Finally, the PBL approach fosters students' interest in technology and engineering. Tang writes that the implementation of PBL in STEM has resulted in students' deeper interest in technology and engineering as well as a desire to pursue STEM as a whole [7]. The PBL approach allows for flexibility in the learning process as well as the ability for students to explore at their own pace and choose their own preferred field of study. In the process of research, they learn a lot of interdisciplinary knowledge so that they can learn more about the areas of interest and develop a deeper interest in them.

5. Challenges of Implementing PBL Pedagogy in China

Although the PBL approach has many benefits for students in STEM programs, there are also significant challenges in implementing this approach because PBL requires a high level of teacher qualifications. First, PBL requires interdisciplinary knowledge and teachers need to be proficient in a variety of disciplines in order to provide project guidance to students. Secondly, the PBL approach is flexible in that the teacher needs to design and direct the entire program. Teachers need to design a challenging topic of inquiry that can arouse the interest of students so as to motivate students to actively think about the inquiry [8]. Before determining the topic, the teacher needs to get a lot of relevant information and make effective screening to ensure that the inquiry question has value and is not too simple, but also to attract students so that there is an internal motivation in the research process to trend students to explore. Teachers also need to control the overall progress, such as when to complete what parts and in what form the final results will be presented. It takes a lot of time and effort to complete a project from start to finish, from planning to implementation [9]. The whole process requires teachers to have interdisciplinary expertise as well as design the whole program and keep a strict schedule.

6. Suggestions for Improving the Implementation of PBL Teaching Methods in China

In order to promote efficient PBL pedagogy in STEM schools and teachers need to make some improvements. First, schools need to show a supportive attitude to the implementation of PBL [10]. The implementation of PBL requires a lot of time so it is hard to avoid taking some time away from other courses. Schools' support for PBL can encourage teachers to spend more time on designing and implementing projects, otherwise, teachers may worry that PBL will take too much time away from other subjects, which may hinder the implementation of PBL. Moreover, teachers need to improve their teaching skills to facilitate the implementation of PBL. Teachers need to motivate students' interest in inquiry, develop students' motivation to learn, and help them understand and update their pedagogy [9]. Although PBL is a student-centered learning process with the teacher as a facilitator, the teacher also plays an important role in the progress of the program. At the beginning, the teacher's choice of project topic has a direct impact on the students' motivation. The teacher needs to make sure that the topic chosen has value for inquiry and meets the students' willingness to do research, because a good topic promotes the students' curiosity to learn more about the subject through the project. In the process of PBL instruction, the teacher needs to change himself from a knowledge transmitter and classroom leader to a facilitator, and recognize the students' subjective status and actively encourage students to find solutions to problems on their own, rather than simply telling them how to solve the problem when they encounter difficulties. Furthermore, the government can provide financial support to schools to help them purchase more equipment. STEM programs include many

experiments. Adequate equipment can ensure that more students have the opportunity to do experiments, which can promote the better development of PBL.

7. Conclusion

To conclude, in order to cope with the development of the times and the urgent demand for innovative talents China's National Education Bureau is now strongly supporting the use of PBL teaching methods in STEM subjects. This teaching method advocates student-centered teacher-designed projects to be completed by students' independent exploration. During the whole process, students can learn interdisciplinary knowledge in addition to the project, and also develop their independent thinking, teamwork and problem-solving skills. Through the PBL teaching method, students' interest in STEM can also be deepened. However, the implementation of PBL in China is still facing great challenges, especially the overall level of teachers, who are responsible for selecting a research topic of interest and value to the students, and need to have a wealth of interdisciplinary knowledge in order to provide guidance to the students when they encounter difficulties, and also need to be in control of the progress of the whole project. As a result of national policies and challenges to the pedagogy, schools and teachers need to make improvements. For example, schools need to show clear support for PBL and teachers need to make efforts to improve their teaching. This dissertation examines the implementation of PBL in elementary school STEM teaching and learning with a limited age range, and future research could delve deeper into the application and challenges of PBL in middle school and high school curricula.

References

[1] Song, W. A little reflection on the current situation of education in China. Exam Weekly, 2018, (82), 7-8.

[2] Shi, K. A comparative study on the application of PBL teaching model in teaching chemistry laboratory courses in Chinese and American universities. Chemistry Education (in Chinese and English), 2022, (12), 124-129.

[3] Wang, L. A case study on the implementation of "water theme" STEM program based on PBL concept (Master's thesis, Ningbo University), 2021, https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202301&filename=1022470905.nh

[4] Liu, K. The application of PBL project-based instruction in elementary science teaching. Enlightenment and Wisdom (Up), 2022, (09),76-78.https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C44YLTlOAiTRKibYlV5Vjs7iM4VjA7s_Xyk4M-4Xrf6_eV9cZOQD8IU4Ivor8lBHfpqlxAxH0B1HejeTy11u80q6&uniplatform=NZKPT

[5] Hu, X. Research on the Development of Elementary School STEM Curriculum Based on Project-based Learning (Master's thesis, Southwest University), 2021, https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202201&filename=1021768789.nh

[6] Guo, X. Research on PBL on Students' Ability to Solve STEM Complex Problems (Master's thesis, Shanghai Normal University), 2017, https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201801&filename=1017161043.nh

[7] Tang, S. Case Design and Empirical Research on STEM Activities for Elementary School Students Based on Project-based Learning (Master's thesis, Chongqing Normal University), 2021, https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202202&filename=1021762215.nh

[8] Li, L. Coexistence of "STEM", "PBL" and "traditional culture" educational model. Educational Science Forum, 2018, (32), 27-30.

[9] Levine, J B. & Mosier, G. Literature Review on Problem-based Learning, 2014, http://1stmakerspace.com.s3.amazonaws.com/Resources/PBL-Lit-Review_Jan14.2014.pdf

[10] Liu, M., Wivagg, J., Geurtz, R., Lee, S., and Chang, H.M. Examining how middle school science teachers implement a multimedia-enriched problem-based learning environment. Interdisciplinary Journal of Problem-based Learning, 2012, 6(2).