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Research on the Teaching Design of Primary School Science Experiment Based on Project Learning

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Abstract: This study discusses the application and effect of project-based learning in primary science education. Through the case study method, the influence of project learning on improving pupils' scientific knowledge, experimental skills and innovative thinking is analyzed. The project activity takes "Ecosystem and Environmental Protection" as the theme, emphasizing the active participation of students and the application of interdisciplinary knowledge. The research results show that project-based learning effectively enhances students' subject understanding and problem-solving ability, and promotes the cultivation of team spirit. Ultimately, it is suggested that future research should explore the cross-application of project-based learning among different disciplines and evaluate its impact on students' long-term development in order to promote the wide application of this teaching model.

Keywords: Project-based Learning; Primary School Science Education; Experimental Skills; Interdisciplinary Learning; Innovative Thinking

1. Foreword

Project learning, as a student-centered educational approach, focuses on promoting in-depth learning by exploring and solving complex problems. This learning style requires students to actively participate in real or simulated situations and complete projects of practical significance through collective cooperation. In the framework of project-based learning, students not only need to acquire the necessary knowledge and skills, but also need to learn how to apply this knowledge to create solutions. Moreover, this approach emphasizes the reflection and evaluation process, allowing students to learn more from each project and constantly optimize their learning strategies and outcomes.

In the field of primary school science education, the introduction of project-based learning is particularly important. Science is essentially a process of exploring the unknown, requiring observation, hypothesis, experiment, and verification. Through project-based learning, primary school students can practice scientific methods when exploring the mysteries of nature, so as to deepen their understanding of scientific concepts. For example, by designing a simple plant growth experiment, students can not only learn the basic knowledge of plant biology, but also personally observe the data, record the results, and learn how to adjust the experimental conditions according to the observation.

In addition, project-based learning significantly improves students' practical ability and innovative thinking by providing practical opportunities. In this teaching mode, students need to solve problems quickly. How to transform from theory to practice not only stimulates their interest in learning, but also develops the ability to solve complex problems. More importantly, project-based learning emphasizes the integration of multiple disciplines, enabling students to comprehensively apply mathematics, reading and science and technology knowledge in practice. This interdisciplinary learning method is crucial for cultivating the all-round development talents needed by the future society.

Therefore, the exploration and implementation of project-based science experiment teaching is of profound significance for improving the quality of science education in primary schools and developing students' comprehensive quality.

2. Literature Review

The wide application of project learning in the field of education is closely related to its theoretical basis, especially the constructivist

learning theory and inquiry learning theory[1]. Constructivist learning theory holds that knowledge is not passively accepted, but actively constructed through the interaction between the individual and the environment. Students gain new knowledge by solving problems by interacting with the real world and combining their own experience. Exploratory learning further emphasizes the active learning in the process of questioning, exploration and reflection, and is especially applicable to science education, because it encourages students to explore questions and find answers through scientific methods.

Internationally, project-based learning has been extensively studied and implemented, especially in primary science education. Research shows that project-based learning can effectively improve students' ability to understand and apply scientific knowledge. For example, an American study noted that through project-based learning in environmental science, students not only understand the complex concepts of ecology, but also can apply these concepts to everyday environmental protection. However, some studies point out that although project-based learning performs well in improving students' hands-on ability and creativity, it sometimes cannot compare with traditional teaching methods in the depth and breadth of knowledge.

The research and practice of project-based learning started late in China, but it has increased significantly in recent years. In the field of science teaching in primary schools, project-based learning has gradually been paid more attention to by more educators and researchers. Chinese education researchers have found that project-based learning helps to stimulate students' interest in learning and self-directed learning ability, especially in scientific experiment teaching. However, domestic applications also face some challenges, such as teachers' unfamiliarity with project-based learning methods, and limitations on school curriculum time and resources.

Moreover, although item-based learning has been shown to benefit students' learning in many ways, existing research has some shortcomings. First, most of the research focuses on the superficial level of learning results, lacking the assessment of students' deep thinking ability and innovative thinking development. Second, the long-term impact of project-based learning is not clear enough, especially its specific impact on students' future academic and professional careers. Finally, the current studies have mostly focused on theoretical and small-scale case studies and lack large-scale and long-term empirical studies to support the widespread application of this teaching model.

Therefore, future research need to pay more attention to the effect of project-based learning in improving students' deep thinking ability, explore its long-term benefits, and verify its effects through broader empirical research. At the same time, researchers should consider how to effectively implement project-based learning in an educational environment with limited resources and time, ensuring that all students can benefit from it. This will help to optimize the project-based learning strategy for its more effectively promotion and implementation across the country.

3. Research Objectives

This study aims to explore the application of project-based learning in scientific science teaching, especially its influence on students' scientific understanding, experimental skills and innovative thinking. The research objectives include: 1) evaluate the effect of project-based learning on pupils 'scientific concepts; 2) analyze the development of students' experimental skills in the project-based learning environment; 3) explore how project-based learning promotes the improvement of students' innovative thinking and problem-solving ability.

Study subject and sample selection

Students from a public primary school located in the city were selected for the present study. The sample selection criteria are based on the following conditions: first, students must be Grade 3 through 5 students in science courses; second, students and their parents must agree to participate in this study and sign informed consent. A total of 60 students from two classes were selected as the study sample. To ensure the breadth and comparability of the data, the two classes were matched in terms of previous academic achievement and social background.

4. Research Technique

This study used a case study method, combining qualitative analysis and quantitative data analysis. Qualitative data were mainly

collected through observations, interviews and student reflective diaries, while quantitative data were obtained through pre-and post-hoc tests and periodic assessments.

5. Design of Project-Based Learning Activities

The project-based learning activities in the study were designed around the theme of "ecosystem and environmental protection". Activities begin with the introduction to fundamental concepts, such as the definition of the ecosystem, the food chain, and the importance of environmental protection. Students are divided into groups, each responsible for a sub-topic, such as studying local ecosystems, designing sustainable environmental solutions, etc. Each project requires students from planning to execution, including data collection, experimental operation and results presentation.

6. Project Implementation Process

In the implementation process, teachers mainly play the role of instructor and coordinator. Under the guidance of teachers, students determine the research problems, design the experimental scheme, and carry out practical operation. For example, in projects studying local ecosystems, students need to investigate the biological species in their locations, and then design experiments to observe the interactions between different organisms. Throughout the process, teachers help students solve their encountered problems through regular discussions and individual consultations, while ensuring that students can actively participate in and reflect on the project.

7. Data Collection and Analysis

Studies use pre-and post tests to assess students' progress in scientific knowledge and skills. Tests include standardized scientific knowledge testing and experimental skills assessment. In addition, students 'performance during the course of the project was recorded through video recording and observation, which were subsequently used for the qualitative analysis of students' behavior and interaction patterns. Students 'diaries and interviews are used to collect students' opinions and self-reflection on the project learning experience, which will help researchers to deeply understand the impact of project-based learning.

Through the above study design, this study is expected to comprehensively evaluate the implementation effect and educational value of project-based learning in primary science education, and provide scientific basis and guidance for future educational practice and policy making.

8. Conclusion and Suggestion

This study shows that project-based learning has a significant effect in primary school science teaching, and can effectively improve students' understanding of scientific knowledge, experimental skills and innovative thinking[2]. Through practical activities, students not only deepen their understanding of scientific concepts, but also cultivate the ability of problem solving and team spirit. The successful implementation of this teaching model demonstrates its wide applicability and far-reaching potential in primary education.

For future research directions, it is recommended to explore the cross-application of project-based learning among different disciplines, such as integrating science, technology, engineering and mathematics (STEM) education[3], and exploring its applications in literature and social sciences. Furthermore, research should further assess the impact of project-based learning on students' long-term academic and professional development to fully understand their educational value. This will provide educators with more in-depth guidance to help them design more effective teaching strategies.

Reference

[1]Helle, Laura, Päivi Tynjälä, and Erkki Olkinuora. Project-based learning in post-secondary education–theory, practice and rubber sling shots [J] . Higher education 51 (2006): 287-314.

[2]Hung, Woei. Theory to reality: A few issues in implementing problem-based learning [J] . Educational Technology Research and Development 59 (2011): 529-552.

[3]Macías-Guarasa, Javier, et al. A project-based learning approach to design electronic systems curricula [J] . IEEE Transactions on Education 49.3 (2006): 389-397