

# Research on the Science Education Model Based on Project-Based Online Learning

Siyu Yang

Faculty of Artificial Intelligence in Education, Central China Normal University, Wuhan, Hubei Province, China

**Keywords:** Online, Project-based learning, Science education

**Abstract:** The epidemic in 2020 has given birth to the rapid popularization of various forms of online education, and has also posed new challenges to traditional face-to-face science education and teaching. As one of the new teaching methods, project-based learning (PBL) is widely used in science class. However, if PBL is to be integrated with the development of online education, further adjustments are still needed. Accordingly, this research paper proposes an organization model based on Project-based Online Learning (PBOL) as a solution to help teachers and students better conduct science education in an online environment.

## 1. Introduction

From classroom teaching to online teaching, it is a transition from traditional teaching to information-based teaching in colleges and universities. Online education is bound to become the trend of future development [1], and more and more students are having online science courses. However, combining the epidemic and real challenges to online teaching, online teaching puts forward higher requirements for students' learning self-control ability and self-management learning ability. At the same time, due to the limitations of traditional teaching and the viewpoint of student, not a lot of teachers have used platform-based online independent learning, project-based learning and other information-based teaching methods. In the Internet, big data and intelligent learning environment, learners need to carry out independent cooperative inquiry learning with questions, projects and topics [2]. The teaching mode of PBL will greatly help to improve the existing online teaching methods. However, embedding the core elements of PBL into the online teaching environment, especially in the field of science education, is a new challenge for science teachers and course developers.

In recent years, the research topics of project-based learning at home and abroad have mainly focused on the models, procedures, groupings, strategies, advantages and disadvantages of project-based learning. The topic of applying project-based learning in the online learning process to achieve project goals has not yet been fully studied. There are basically no such science education learning platforms based on project-based online learning in China. The research tries to use the effective online teaching environment, and set the project-based learning as the orientation, to build a new organizational model to encourage students to actively engage in science learning.

## 2. The Construction of Project - Based Learning (Pbol) Organization Model Theory System

PBL (Project-Based learning) is one of the methods to create meaningful learning experience, which helps to promote the construction of students' knowledge and improve the quality of learning [3]. In view of the superiority of the PBL teaching model, many schools hope to use PBL to improve the overall quality of the school's curriculum system. However, the PBL teaching advocated by most schools is actually to provide students with surveys and reports on various topics, which is not a real PBL teaching. As one of the leading educational research institutions in China, Aha School of Social Innovation hopes to change this education status, so that schools' curriculum systems can focus on the overall development of students, which enables online learning students to learn the essential skills

through PBL, just like those students who learn in classrooms. Therefore, Aha School of Social Innovation and Kennesaw State University have cooperated to develop a set of instructive project-based curriculum development models, namely Project-based Online Learning (PBOL), to help more teachers apply the PBL teaching strategy to actual online courses.

The design and development process of PBOL, a new organizational model, is evolutionary, following the collaborative development process. Considering that this is a design and development research project, this research records every creative step in the model development process, and makes many iterations of the model referring to the “Science Based on Online Projects” advocated by the Center for Engineering and Science Education Reform and Development (CEISE) [4].

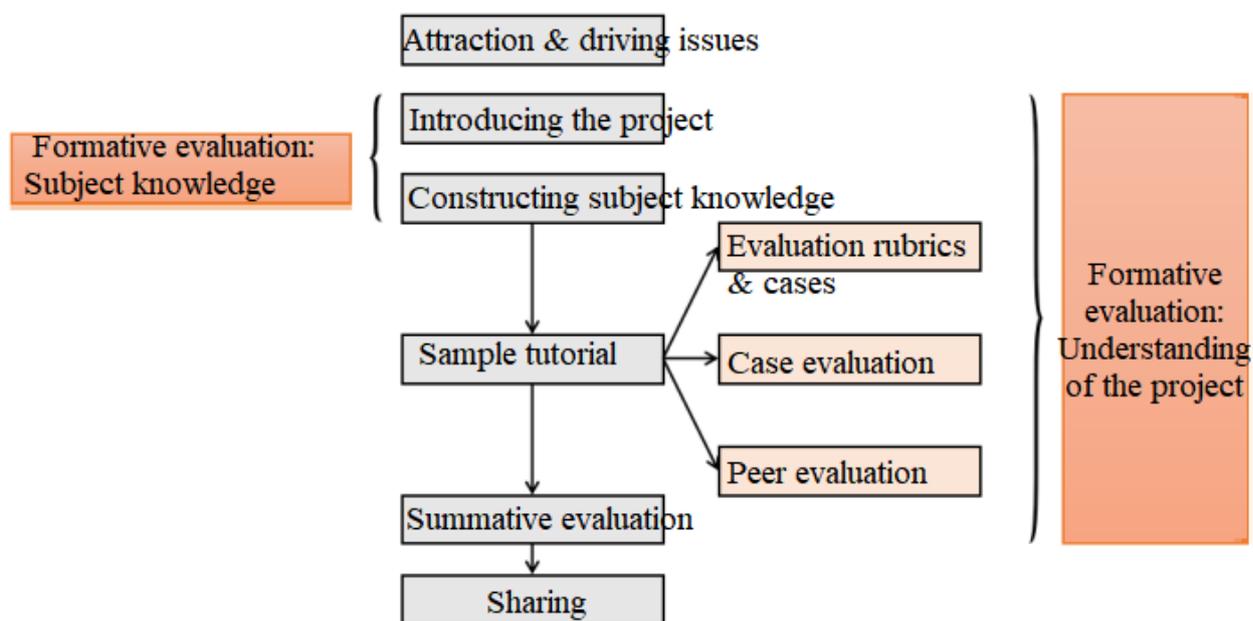


Fig.1 Schematic Diagram of Pbol Development Model

As shown in Figure 1, PBOL, the new teaching design model, is mainly composed of seven important parts: 1. Use driving issues as a “hook”: setting up a stage at the beginning of the course to attract the attention of students, so that the learners feel that the learning items of the course are closely related to themselves, and the problems they solve are the problems around them. 2. Introducing the project: Using online multimedia methods such as videos, explain to learners the important and difficult points of the course project and how to start the overall path of the project. 3. Formative evaluation: Formative evaluation will run through all aspects of the completion of the project in order to better evaluate students' understanding of what they have learned. At the same time, formative assessment can also help teachers grasp the overall understanding of the project and the mastery of subject knowledge. It will also help them to intervene appropriately in the learning process of students, and provide an effective reference for revising online course plans. 4. Constructing subject knowledge: In the process of completing the project, it is necessary to pay attention to the construction of the knowledge system. The project consciously includes a variety of audiovisual, literature materials, pictures, etc., which can help learners get in touch with new knowledge points, and the understanding and memory of these content will also help learners develop and improve their ability to “mobilize and use knowledge”, so as to efficiently complete the learning project. 5. Sample tutorial: The demonstration and study of the sample tutorial can help learners understand the entire expected and specific progress of the project. Specifically including: ①A vivid description of the project ②Project evaluation rubrics ③Project samples from students ④Through a video or screen recording, to show students how the teacher uses the evaluation rubrics to grade students’ samples ⑤ Students’ mutual evaluation or self-evaluation Comment. 6. Summative evaluation: Students submit the final project results, and further modify and improve their project results according to the relevant

guidance of their teachers. 7. Sharing: Students will show their work results online, comment on their opinions, and share their learning experience.

### **3. Application of the Online Teaching Model of Science Education under the Guidance of Pbol**

The research in the paper takes the online science course with the theme of “Bird Habitat” as an example to further explain how to integrate PBL into online and offline hybrid teaching or complete online courses. The driving issue of this typical PBOL course is: “Suppose you are an ornithologist, and you accidentally find a bird that has never been found before. How can you infer its habitat based on its morphological characteristics?” Students need to use exploratory activities and teamwork, and collect corresponding evidence to determine and support their views.

In the first lead-in class, the teacher introduced the course objectives and the scope of learning content to the students, and at the same time designs the “Entry Event” to introduce the project theme to stimulate the students' motivation for learning. In the introduction event of the “Bird Habitat” project, the instructor showed students photos of different birds by playing videos, and offered discussion about the similarities and differences between these birds, such as some birds' beaks are short and flat, some are very pointed and long; some have bright feathers, while others are single and dim.

After the lead-in class was completed, the teacher provided students with a “project start page”. The project start page summarized the necessary information for this PBOL course, including student project examples and specific evaluation results, evaluation scales, project-related reference materials, and materials required for teamwork to help students understand and learn. When students read the learning “project start page”, they were required to learn a student project example, and score and evaluate the content of the sample project based on the project evaluation scale. Then their evaluation was used to compare with the teacher's evaluation results to deepen students' understanding of the project objectives, evaluation content and evaluation methods of the entire project. Before formally starting project exploration, students also needed to complete and submit a corresponding project time management plan to strengthen students' time management awareness and improve the efficiency of project completion. At the same time, the teacher was also needed to design the learning of knowledge content related to scientific inquiry in the whole process. The teacher built a “scaffolding” for students to explore the project through the design of the project team mailbox, video conference system, collaborative whiteboard, etc., and further helped students to disassemble large and complex problems into operable staged small problems to gradually complete the final project. During the process, students could acquire scientific knowledge and accomplishments, gain scientific attitudes and establish social relationships.

In the online project “Bird Habitat”, students needed to focus on core driving issues, collect and analyze online or offline second-hand relevant information in groups, and use this information as a strong argument to support the answers to project-driven issues. The inquiry about “bird habitat” was open to a certain extent, and all the scientific knowledge in this science class also implied that “specific morphological features help organisms survive and multiply in the environment”. Teachers could observe whether students implemented this idea in the project from the correspondence between the image of this new species of bird and the predicted habitat. The final result of the project was that students needed to write an “academic report” as an ornithology expert, analyze the relationship between the morphological characteristics of this bird and the environment in more detail in the article, and report their important discoveries to others. Teachers could also check whether they have mastered the scientific knowledge from the reports written by students. The project theme of this course was practically related to students' daily life. Students could search for relevant information online through independent exploration, design new birds they “discovered”, and build their own “birds paradise”.

### **4. Teaching Reflection on the Pbol Organizational Model**

It can be seen that the advantages of this project-based online learning (PBOL) teaching model compared with the usual offline PBL in the field of science education are mainly reflected in: 1. Teachers can guide, support and grasp online, free from time and space constraints, and easy to scale. 2. The project takes driving issues as clues, guides students to complete the final project results, and helps students think about and solve real problems in life, which has great practical and exploratory significance. 3. The “Entry Event” of the project uses vivid videos and real data to make students aware of the authenticity and importance of the problems studied in the project, which can well stimulate students' interest in learning. 4. Project-based online learning will focus on cultivating students' time planning, which can help students grasp the entire learning process to a certain extent, help students adjust control over it, and encourage students to complete projects on time and with quality. 5. From the Connectivism view of learning, learning is no longer a person's activity. Learning is a networked process connecting specialized nodes and information sources [5]. The network learning environment formed in the PBOL process is to establish the connection of resources, the purpose of which is to maintain the synchronization of knowledge between students, and to continuously gain experience and skills, and to create and connect new knowledge.

But this kind of project-based online learning still has aspects that need reflection: 1. It is difficult to realize the participation of external expert consultants to cooperate with students and guide them. 2. In the case of offline interaction, teachers cannot observe the specific performance of students in the project, and cannot give students corresponding feedback in time to modify and iterate courses. 3. Traditional teaching tends to use a competitive strategy to the relationship between students, while PBL is on the contrary, it emphasizes the division of labor and cooperation between students, and the spirit of teamwork [6]. The lack of face-to-face communication and cooperation between students makes it difficult to ensure the efficiency of cooperation between teams. 4. In all aspects of the entire online learning process, it is difficult for teachers to observe students. Therefore, it is difficult for the curriculum to be carried out with students as the center, and it is difficult for teachers to teach students in accordance with their aptitude. 5. In the PBOL model, the very important value points in the offline PBL are ignored, that is, the teacher and students will discuss and reflect together after the project is completed.

## 5. Conclusion

The online education in a traditional style of copy everything mechanically is only a temporary phenomenon during the epidemic, and is not a real need for science education. In the process of science education, the main significance of teaching in the form of PBOL is to shift the center of teaching knowledge to the independent inquiry learning of students, focusing on cultivating the basic scientific literacy of students to explore, discover and solve problems by themselves and effectively promote students' learning motivation. At the same time, the role of the teacher changes from the imparter of knowledge to the promoter of learning in this process. According to the general process of project learning and its learning characteristics, the network environment should provide resource support, tool support, community support, collaborative support, strategic support, management support, and outcome support for project-based learning [7]. At the same time, when applying the science education model based on project-based online learning (PBOL), these aspects need to be paid attention to: 1. The scientific nature of the project activities. All activities should be based on the most basic curriculum standards and syllabus. On the one hand, it can avoid some teachers' doubts about the scientific nature of the project activity goals, and on the other hand, it can also provide a guarantee for the smooth development of science education activities. 2. Diversity of project activities. Teachers and curriculum developers should design a series of inclusive and rich project activities. Teachers can choose different project activities to meet the learning needs of students, and encourage students to further think, explore, and judge actions. 3. Collaboration of project activities. In the online project learning process, in addition to designing collaborative activities between groups in the class, teachers can also strengthen inter-school collaborative learning activities so that students and teachers in various regions can discuss the phenomena and conclusions that exist in the activity. Discuss, communicate and collaborate on differences to further improve the quality of the course.

## References

- [1] Junyan Fan. Research on the development and design of online education curriculum in China and America [D]. Huazhong Agricultural University, 2016.
- [2] Baolai Cai, Qiang Lin, Guang Liang, et.al. Research on the transformation of college students' learning methods in the online teaching environment: Problems, trends and development paths [J]. Heilongjiang Researches on Higher Education, 12, pp.140-144, 2020.
- [3] Kingston, S. Project based learning & student achievement: What does the research tell us? [J]. PBL Evidence Matters, 01, pp.01-11, 2018.
- [4] Gang Yang, Xiaodong Xu. The concept, model and enlightenment of science education based on online projects: taking the learning environment of CIESE in the United States as an example [J]. China Educational Technology, 09, pp.15-21, 2010.
- [5] Meiling Wang. Study on Library and Information Science Online Education in the United States and Taiwan [J]. Library Tribune, 39 (01), pp.153-170, 2019.
- [6] Ning Lu. On the characteristics of PBL teaching mode [J]. Shenzhou, 03, pp.76-76, 2011.
- [7] Linlin Yang, Rui Feng. The design of project-based learning support system in network environment [J]. Journal of Yangzhou University (Higher Education Study Edition), 01, pp.91-93, 2007.