Research on Project-Based Learning Strategy Guided by Core Literacy—Take the “Light Tracing System” Learning Project as an Example∗

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The development of project-based learning is conducive to stimulating students’ humanistic background, cultivating scientific spirit, guiding students to learn how to study and have a healthy life, forming students’ sense of responsibility, and promoting practical innovation. This paper is to carry out project-based learning of “light tracing system” guided by core literacy: The design principle of realizing the way is to adhere to the core quality as the direction of education, the basic knowledge as the necessary condition and the change of learning style; the implementation process includes three stages: preparation, implementation, and communication; the evaluation subjects are diversified, and the combination of process evaluation and performance evaluation is emphasized.

Keywords: project learning, core literacy, “light tracing system” learning project, role change

Introduction

Whitehead (2018) said in the Purpose of Education: “Today’s education system emphasizes a kind of primary general education, allowing knowledge to be divided into different disciplines. This system actually reflects the teaching of fragments of knowledge to students. I appeal here that we should adjust the different learning contents intuitively understood by students into a cycle, so as to weave harmonious patterns in the hearts of students and truly achieve the goal of educating people” (p. 31). From this, we can know that the importance of interdisciplinary teaching and collaborative thinking for talent training. In recent years, the Chinese government announced the core quality of students’ development and the project-based learning based on this is in line with Whitehead’s educational philosophy.

The Connotation of Project-Based Learning under the Guidance of Core Literacy

On September 13, 2016, the general framework and basic connotation of Chinese students’ core literacy development were released at the “Conference on Research Results of Chinese Students’ Development of Core Literacy,” which opened the era of core literacy of Chinese education. The ultimate goal of core literacy is to
“cultivate people with all-round development,” and project-based learning is the specific practice to achieve this goal. Core literacy belongs to the category of educational objectives, so it must be “landing,” that is, only when it is applied to practical teaching, can its real value be reflected (D. Qin & J. Qin, 2018). Project-based learning is exactly the specific practice path of cultivating core literacy, which is to better promote the implementation of core literacy training to students. At the same time, project-based learning can also give timely feedback to the core literacy. Through the practice of project-based learning, the core literacy problems can be reflected, so as to continuously improve the core literacy system, and finally achieve the goal of cultivating “all-round development of people.” Therefore, the project-based learning under the guidance of core literacy is the combination of theory and practice, and constantly improves the theory in practice. In this process, the theory guides the practice and the theory is constantly enriched in practice, and finally reaches the goal of cultivating “all-round development person.”

Project-based learning is called “PBL” (project-based learning) or “PL” (project-based learning) in foreign countries. It was first set up and implemented in the United States, Britain, France, and other Western developed countries, and then further extended to many developing countries (Hu, 2017). With the publication of the core literacy system of Chinese students’ development, the domestic research upsurge of project-based learning has been triggered. Hu (2017) defined project-based learning from the perspective of conventional teaching: It is to explore the practice based on the curriculum standards, that is, students form groups to explore the problems of practice or authenticity. In this process, students understand and understand the core of subject knowledge, so as to achieve the goal of developing innovation consciousness. Xia (2019) pointed out that project-based learning is a way for students to explore in-depth the driving problems related to the discipline in a continuous period of time in the form of team cooperation. In this process, students need to integrate a variety of subject knowledge, ability, and consideration to creatively solve new problems, and finally, present corresponding results for display, so as to improve students’ multifaceted literacy. At present, there is no clear definition of project-based learning. Looking at the definition of project-based learning, it is not difficult to find that the main body of project-based learning is to take the group as the unit, and to understand the core knowledge more deeply in the process of problem driven exploration, so as to achieve the goal of developing students’ innovation consciousness.

It is worth noting that under the guidance of core literacy in order to grasp the connotation of project-based learning more deeply, three types of project-based learning have been produced in the exploration of theory and practice: The first is the real life world project in the process of learning knowledge, it can connect students with life reality and create real life world projects. It is often difficult to obtain knowledge from the classroom and school. It is more conducive for students to acquire knowledge through real life world projects. The second is the project of virtual situation. The most important thing is to create a virtual situation. Although the situation is virtual, it really endows students with roles and requires students to fulfill the obligations of these roles to solve problems in these scenes. The creation of situations helps students have a sense of substitution, which is more conducive to wake them up for learning to a certain extent the internal driving force. The third is academic project, which points to the key concepts in the discipline, and is often the key problem in the discipline. The problem-solving is to find the core problem, which is full of certain challenges. In this process, teachers need to constantly guide students to think more deeply, encourage students to have the courage to try, so as to get the best solution in the exploration of failure experience.
The Value of Project-Based Learning Under the Guidance of Core Literacy

At present, we are in an era of rapid development. The arrival of economic globalization has also affected the flow of resources, technology and capital to a certain extent, which has led to the rapid flow of talents. It is true that the world is changing, and education must also make changes. Talents trained in the future must be able to actively adapt to the rapidly changing digital environment. The proposal of “core literacy” is based on this environment. Asia-Pacific Economic Cooperation (APEC), European Union (EU), and United Nations Educational, Scientific, and Cultural Organization (UNESCO) take the lead in proposing their own core literacy framework system from their own needs. On September 13, 2016, the general framework and basic connotation of the core literacy of Chinese students’ development were released at the “Conference on research results of core literacy of Chinese students’ development.” As shown in Figure 1, it can be seen that “people with comprehensive development” is the core, and then it is divided into three levels: independent development, social participation, and cultural foundation. Based on the cultural basis of core literacy, independent development, and social participation, this paper further explores the value of project-based learning under the guidance of core literacy.

![Core literacy framework of Chinese students' development](image)

**Figure 1.** Core literacy framework of Chinese students’ development

Cultural Basis Orientation: It is Beneficial to Stimulate Students’ Humanistic Details and Cultivate Scientific Spirit

In his book *Primitive Culture*, Taylor defined culture as the customs, etiquette, norms, and various values that form the tradition. At the same time, culture also has personal attributes and social attributes: In terms of personal attributes, it has an impact on the individual’s life world, emotional world and spiritual world; and in terms of social attributes, it reflects the values generally recognized by people in a certain social form of life (Cui, Zhu, & Zhang, 2017). In the core literacy, the cultural foundation is divided into three angles: humanistic accumulation, humanistic feelings, and aesthetic taste. In a comprehensive view, the requirement for students is
to have comprehensive humanistic quality. Through project-based learning, students can accumulate basic knowledge and achievements in the field of humanities at all times and in all over the world, and then form a people-oriented consciousness. At the same time, it can expand and sublimate beauty in life, so that students have comprehensive humanistic quality. At the same time, the scientific spirit of the core literacy is divided into three angles: rational thinking, critical questioning, and daring to explore. In project-based learning, teachers often issue a “fuzzy task,” which does not clearly point out how to carry it out. Students need to find and solve problems in project-based learning. In this process, we should learn to use the power of team to cultivate scientific spirit in cooperation.

Independent Development Orientation: It is Conducive to Guide Students to Learn How to Learn and Have a Healthy Life

Dewey believes that development comes from the experience process of interaction between individual and living practice environment. At the same time, the specific indicators of core literacy are formulated for the development needs of two aspects, namely, personal development and social development (Liu et al., 2016). In the process of project-based learning, students change from passive acceptance of knowledge to active exploration of knowledge. This change requires students to be good at learning self-learning and have the awareness of active learning. Especially, in the current information development, students are required to carry out project-based learning by means of information technology, which is conducive to the development of individual students, and this is related to the core literacy. The three perspectives of learning to learn coincide with each other: being willing to learn and good at learning and diligent in reflection and information awareness. To some extent, the needs of personal development and social development are intertwined. From the side, human development is based on social development. In project-based learning, students are good at reflection and summary, especially from the process evaluation and conclusive evaluation in the process of project-based learning, so that students get the exercise of thinking, they will start to think about the profound life and social problems, combine the internal world and external world of self, and then promote the combination of self and society.

Social Participation Orientation: It is Beneficial for Students to Form Sense of Responsibility and Promote Practical Innovation

Social participation in learning emphasizes dealing with the relationship between the id and the other and the relationship between self and society, so as to form correct values and moral thoughts on this basis (Cui et al., 2017). In the process of project-based learning, we need to exert our strength through the team, unite, and cooperate with each other, have the sense of team and the spirit of mutual assistance. In the process of guiding students to carry out project-based learning, teachers endow students with the role of team, which helps to cultivate students’ initiative, innovation, and cooperation to a certain extent. On this basis, it further cultivates students’ sense of responsibility and encourages them to take responsibility bravely in the process. From the three types of project-based learning, it can be seen that the real life world project pays more attention to the combination of students’ knowledge and real life, so as to cultivate students’ practical ability. The virtual situation project pays more attention to creating virtual situation to give students the role to solve problems, so as to stimulate students’ creative thinking; academic projects pay more attention to learning. Students independently solve the core problems in the discipline, so as to encourage students to try. These three types of project-based learning cultivate students’ practical and innovative ability to varying degrees, and constantly stimulate students’ innovative vitality in the process.
Implementation of Project-Based Learning of “Light Tracking System” Under the Guidance of Core Literacy

Design Principles of Project Learning

Project-based learning is a form of learning that relies on challenging projects and works as the guide, and builds practice and stimulates interest on this basis (Luo, Wu, & Wang, 2019). Therefore, the following principles should be followed in the implementation process: First, the core literacy is the education orientation. In January 2018, the Ministry of Education issued the curriculum plan for general high school and curriculum standards for all disciplines (2017 Edition), in which the core literacy of various disciplines was defined (Li, Zou, Su, & Pan, 2019). Project-based learning is consistent with the three major themes of Chinese students’ core literacy system: self-development, social participation, and cultural heritage. It is implemented through project-based learning practice in practice, and the ultimate goal is to cultivate people with all-round development. Second, basic knowledge is a necessary condition. Project-based learning is driven by problems. In the process of solving problems, it is based on the original basic knowledge and the knowledge and experience of students as the background. Knowledge is not fragmented, but interrelated. Only in this way can the cognitive level change from memory to problem solving and finally achieve development. The purpose of innovation consciousness, and then make the core literacy better landing. Third, the change of learning style is the way to realize it. The change of learning style puts forward higher requirements for students’ autonomous learning ability. In project-based learning, students change from passive acceptance of knowledge to active exploration of knowledge. Especially in the rapid development of information technology, students should learn to use digital learning resources to acquire knowledge, solve problems, and finally complete the learning task in the practice of autonomous learning and cooperative negotiation.

The theme of the project design of “light tracking system” comes from the promotion of green energy by the state. Carrying out this project-based learning in school-based construction is conducive to cultivating students’ environmental protection literacy. At the same time, it can also arouse students’ thinking and interest in learning, such as what technology can be used to improve the efficiency of solar power generation, and how to build a solar power generation system Yang energy small model and small production. The project of “light tracking system” also includes explicit and implicit objectives. The explicit goal is to use software and hardware to make devices related to “light tracking system.” The implicit goal is to improve students’ abilities in various aspects in the process of exploration and practice, so as to achieve educational goals, such as learning ability, innovation ability, and practical ability. The project also reflects the idea of “interdisciplinary,” involving the knowledge of multiple disciplines. The project integrates the knowledge of mechanical and electrical operation, computer, physics, and other disciplines. In addition, the project adopts the mode of group division of labor. According to the situation created by teachers, the group carries out division of labor and cooperation to complete the task, and cultivates the ability of responsibility and cooperation in practice.

The Implementation Process of Project Learning

The implementation of project-based learning mainly includes preparation stage, implementation stage, and communication stage.

Preparation stage. Design project. In the design of projects, teachers often need the guidance of teachers. Teachers can carry out targeted design of projects by analyzing students’ grades, curriculum guidance, and other aspects, design the content of a special topic, so as to achieve the maximum participation of students, so
as to draw out the internal driving force of students and achieve the goal of developing students’ innovation consciousness. In the “light tracking system” project, the teacher first created a situation for the students to form a “Technical Department of the solar company” to find a solution to the problem of “the solar panel on the roof is not even enough in the daytime” reflected by the customer.

**Division of labor by groups.** In order to better play the effect of learning, “light tracking system” project will be divided into groups of students, the number of people in the group can be set as a group of six according to the needs of the project. In the group role allocation, it is divided into the process department and the engineering department. Before the role department of the group is determined, the team members need to consult the relevant information, observe the physical structure, and watch the relevant online courses, and on the basis of understanding the technical principle of the light tracking system, determine their respective roles according to their own advantages and mutual discussion among members, and select the small group through comprehensive consideration team leader, in order to maximize the role of the role, to achieve the optimization of the team.

**Implementation phase.** **Decomposition problem.** In order to better solve the problems in the later stage, the first thing for each team is to decompose the problems to be solved. In the “light tracking system” project, what is the core problem to be solved in the project?—It is the production of the core control part of the “light tracking system”; what tools and software should be prepared to better solve the problem when making the core control part?—We can first design the relevant programming based on the theory to present the space diagram, and then build the hardware on this basis; and finally, based on the “tracking system” design core technology, how to better develop the corresponding products?—In the actual development of corresponding products, more consideration should be given to the actual situation, and then the technology should be constantly adjusted. In the process of project implementation, there will also be other problems, such as what is the time allocation for each part of the problem? What should I do if there are problems in the process? etc.

**Cooperate with each other.** In project-based learning, the most important thing is to give full play to the strength of the team. Each member of the group should participate in it. They should have a clear understanding of their role in the group. The members of the group should cooperate with each other to make sparks. In solving the “light tracking system” project, it is divided into the program department and the engineering department. The most important thing is that the members of the group need to communicate and discuss constantly. After having a preliminary understanding of the core control part of the “tracking system” based on theoretical learning, students who are good at software programming can program, and those who are good at hardware construction can build on the basis of programming. In this process, the team leader should also play a good role in overall planning and assistance, especially when there are differences within the group and different opinions arise.

**Discussion strategy.** The group discusses several sets of strategies and methods to solve problems. Teachers can guide and guide students to seek the best solution through repeated exploration, and finally form the research results obtained through cooperation. In the “light tracking system” project, there may be differences within the group. Some students will think that it is better to design a solar tracking system to solve the problem, while the other part will think that there will be two preliminary ideas for the practical device based on the light tracking technology. When the group cannot find out which scheme is the best, teachers can give guidance and teachers can make comprehensive consideration, give your own ideas and opinions, and give some guidance to the group.
Communication stage. Exchange results. After each group completes the research, they need to show their own research results, and can choose a variety of communication methods to report. There are various ways to report achievements, such as holding achievement exhibitions and auctions (Gao & Tao, 2009). Through the reports, we can find the shortcomings in the process of solving problems, and can also bring some inspiration to other groups. The exchange of achievements can be carried out in the middle and later stages. The medium-term exchange is more about the exchange and discussion of the preliminary plan, and the latter is the display of the final results. In the “light tracking system” project, the medium-term communication adopts the form of “world coffee.” The team members flow to listen to the plans of other groups and put forward corresponding opinions and suggestions. Then, they come to their own group to exchange their harvest and experience, so as to modify and improve their own design scheme. Later, stage communication is to hold a “product conference,” each group will display its own achievements, invite experts in relevant fields to comment, strengthen the contextualization by simulating “investment,” and select various awards through comprehensive evaluation.

Self-evaluation and mutual-evaluation. Self-evaluation and mutual evaluation are carried out in parallel with the exchange. In the medium-term “world coffee” communication stage, the group carried out self-evaluation when reporting their own plans, and put forward their own advantages and disadvantages for the scheme within the group, while other groups listening to the report and putting forward their own opinions are inter group evaluation. In the later stage of “product launch” communication, the main task is to evaluate each other among groups, and then select various awards by simulating “investment.”

The Evaluation Method of Project Learning

In the “light tracking system” project, teachers are not the only evaluation subject, and the evaluation subject also involves students and experts. The students make self-evaluation and mutual evaluation in the project, the teachers conduct the guiding evaluation in the project, and the experts give professional comments on the final results. The evaluation criteria are also comprehensively considered. In the “product release” of the “light tracking system” project, the evaluation of students, teachers, and experts is integrated to set up various awards, such as “best design award,” “best popularity award,” and “best practical award,” which can not only stimulate students’ interest and creativity, but also guide students to creation is connected with imagination. The way of evaluation is no longer single, mainly including process evaluation and performance evaluation. The process evaluation is mainly aimed at the cooperation between groups, such as how to solve the problems encountered by the groups, how to carry out the division and cooperation among the groups, and how the members of the group integrate the knowledge in the design scheme, etc. Performance evaluation is mainly aimed at the performance of students in the process of communication, whether they are confident in expressing their own plans, how to deal with the questions of other groups, and whether they express clearly when communicating their own plans.

Conclusion

In the implementation process of project-based learning, we can see the change of teachers’ role: Teachers change from lecturers to guides, which require higher professional ability of teachers. In the “light tracking system” project, teachers first need to change the mode of classroom teaching and create situations for students. The creation of situations is to materialize the abstract knowledge in textbooks, and combine the difficult to
understand problems with the real situation. At the same time, teachers also need to integrate practical knowledge into the project. In the “light tracking system” project, teachers use real life problems to guide, this problem is also linked with our real life, reflecting the life and practicality. With the change of teacher’s role, students also change from passive receivers to active explorers, which, to a certain extent, put forward higher requirements for students’ autonomous learning ability. In the “light tracking system” project, students need to learn team cooperation, play their respective roles in the team, and work together to explore the best solution to solve the problem. At the same time, they should also learn to communicate, learn self-evaluation and mutual evaluation, and constantly improve their own programs in mutual communication to achieve the best effect.

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