Scientific Inquiry of the Project Cooperation PBS Teaching Mode under MATLAB Fitting

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Abstract. Based on project science teaching mode, to expand students' thinking and develop the research ability of the students, it need to team cooperation as dominant and scientific inquiry as the core, which are widely research and application in the United States science education and middle school classrooms. In view of the present situation of China education modernization, to briefly expound PBS teaching model, and then to carry out science status quo of PBS teaching mode, finally to carry out PBS teaching model empirical analysis in the MATLAB fitting, which can obtain the PBS that can deepen the students for the understanding of science, to effectively promote the effectiveness of teaching.

Introduction

The project is effective use of resources with a set of unique and interrelated tasks, to achieve particular goal efforts. Science based on project is also known as project science teaching, it is the concept of discipline principle as the center, and is real problem of life world as the background, using cooperation and a variety of resources to build learning environment, to carry on a kind of mode of inquiry learning. In the tide of international science education reform, inquiry is one of the highest frequency words [1,2]. It is the base of the essence of learning society construction and scientific research in science education, to introduce project learning practices that can be traced back to 1908, when the United States Massachusetts Bei'an Smith Agriculture Rufus Stimson school teachers in the teaching process pioneered the use of home project concept, then this purpose is to let students practice that is applied to the family farm operations in the school acquired knowledge. In this course, students should choose subjects, to determine the research methods, and then to carry out the experiment, thus it can draw the conclusion and communicate. That is to say, students do science in the true [3,4]. After this study, science is no longer a noun in the eyes of students, which merely contains the object of facts and formulas. Science has become a verb, a process, the assembly of a series of activities as well as a way of thinking. National science education reform advocates students' active participation in learning, its important and specific goal is wrote into the national curriculum standards. With the development of science educational theory and practice, PBS teaching mode is gradually the development of progressive education movement and constructivism science education reform movement. Dewey and progressive education scholars lay the foundation of psychology and curriculum for the development of PBS teaching mode [5,6].

PBS teaching pattern

Scientific educational reform emphasizes learning science through inquiry, visual inquiry students' learning essential activities. Science based on project is practice of a kind of inquiry teaching model in the United States high school that is referred to as the PBS mode. In the current international science education reform tide, inquiry is one of the highest frequency several key words. National science education reform all advocates students' active participation in learning, these important and specific goals is wrote in the national curriculum standards [7].

The emergence of PBS teaching model marks two great progress of the learning theory. First learning has become a kind of social activity, the PBS teaching mode is by students' cultural background, community activities and previous learning experience as the development of carrier, to answer those challenging problem and obtain mental progress through cooperative inquiry. At the

same time, the PBS teaching mode knowledge is acquired during the process of construction, the learning process is the students their life with the world to carry out interactive and finally construct their knowledge process. In the PBS teaching mode, it has 5 features as shown in Figure 1 [8].

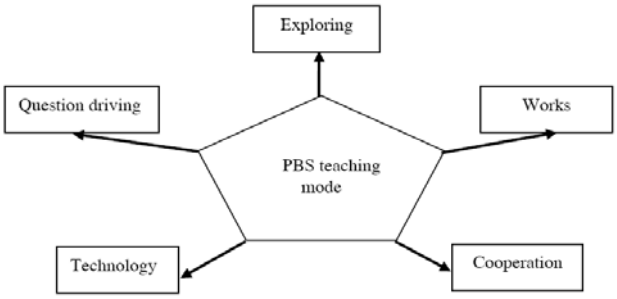

Figure 1. PBS teaching mode

As shown in Figure 1, the PBS teaching model has the above 5 features. Problem driven refers to emphasize the meaning of the problem, students find and select problem in real life; inquiry is defined middle school students to make assumptions in PBS learning activities, and to discuss the different hypotheses, design of plan or experimental scheme, information collection, analysis of data, forming a conclusion; works guide the students to complete a series of learning outcomes in explore; cooperation refers to each discussion among the students, teachers and members in the learning community; technology refers to the use of computer technology to obtain data and information [9,10].

To explore the science status quo of PBS teaching mode

PBS teaching mode is a research hotspot of science education, different science educators and researchers all have attempted to give their understanding of the PBS teaching mode. In early twentieth century, Dewey put forward to project learning as a teaching method in order to the basis of exploring. In the children and course, Dewey pointed out that children was the starting point of education, center and the final purpose, the most natural way of children learning is " learning by doing ". In this process, teachers must correct guidance children to provide appropriate learning experience and to develop critical thinking and research ability. "Learning by doing" approach was further developed by later constructivist Piaget and Vygotsky, to eventually develop into mature PBS teaching mode [11,12].

PBS teaching mode is as a form of situational teaching, it emphasizes students the construction of knowledge from problem starting. This process will continue a period of time; Krajcik, Czerniak and Berger pointed out that PBS teaching model has five basic characteristics, specifically as shown in Table 1 [13].

TABLE I. The basic characteristics of PBS teaching model

Serial number	Features
1	Organization and guidance teaching from the problem starting
2	Students can get the problem answer through research
3	To development of cooperation among Students, teachers and social relevant personnel
4	Students should use technology to carry out the investigation and production products
5	The result of learning is accompanied by a series of project product problem solving

In the PBS teaching mode, the key is to the project selection. The so-called project is a unique and interrelated task as the premise; the effective use of resources can achieve a particular goal as efforts. According to the different of students learning outcomes, the project of PBS teaching mode is divided into the following categories, specific as shown in Figure 2.

As shown in Figure 2, problem solving project goal is to develop the students' ability of solving problems and critical thinking skills in the project classification of PBS teaching mode; process project is to help the students acquire the skills and science process skills, such as having the research value problem, identify and forming the research hypothesis, survey and design, collection and analysis of data, drawing reliable conclusions, the exchange and report result and other ability; engineering design project is to develop the students design and test skills, which can obtain the techniques, materials and structure of knowledge in the process of tools; the theme of contain project and its goal is to teach the students scientific concepts, scientific knowledge, the history of science, scientific nature and other contents.

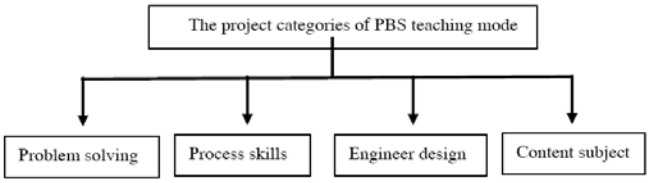

Figure 2. The project classification in the PBS teaching mode

In the process of practice, the selection and design of a kind of project teaching not only can achieve a learning objective. For example, it not only can develop the students' ability of solving problems and critical thinking skills in the question solution project, in which students also can cognitive science content, to understand the deeds of scientists and explore the scientific nature. Science teachers should understand the type of project in the PBS, in order to better achieve the goal of teaching.

PBS teaching model empirical analysis under the MATLAB fitting

In the PBS teaching mode, PBS teaching mode carries out a new location on the roles of teachers and students, the teachers no longer dominate the whole learning process, to provide help for students inquiry activities, to guide and control; classroom as a dynamic learning environment, in which the roles of teachers and students will have the corresponding change; classroom program design not only pay attention to method selection and scientific content evaluation, but also pay attention to learning area definition, the identification of learning environment and process, choice of resources, time and the potential learning challenges estimation and process evaluation on learning results.

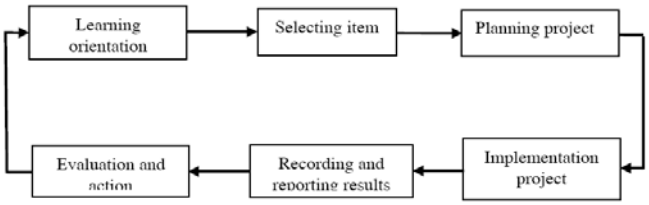

Figure 3. The PBS teaching mode project cycle

at the same time the PBS teaching mode can the actual life of students and community environmental and other situation that are integrated into textbooks, curriculum guidance materials and content standards, namely teachers can use the project cycle inquiry learning.

As shown in Figure 3, teachers can use project circle organization learning under the PBS teaching mode, its effectiveness is related with learning orientation, select item, planning project, implementation project, recording and reporting results, evaluation and action and other factors. We can use the index fitting to find affecting their main factors, which is a known function of a number of discrete function values {f1, f2,⋯, fn}, through the adjustment of some undetermined coefficient f (λ 1,λ 2, ... ,λ n) in the function, to make the function and known points set of difference (minimum square sense). Using the fitting are respectively established the mathematical model of PBS teaching mode, to find out the influence of their main factors. In the science class, using the PBS teaching mode has to do important things to a general orientation. In the process of adopting PBS teaching model, teachers and students should first clear the use of such teaching model expectations, requirements and its responsibilities. The student is not just itself interested in the PBS teaching mode, teachers should make students understand in the inquiry process, having certain expectations on a project, clear the cooperation importance of the scientific learning process, sharing all kinds of information and resources, clarify their respective responsibilities and roles, their learning outcomes will be how to evaluate and so on. On PBS teaching model, to carry out learn position before only first project study. Provided y is PBS teaching mode results that are respectively very satisfied, satisfied, general, non-satisfied, very non-satisfied proportion, and x_i is very satisfied, satisfied, general, non-satisfied, very non-satisfied proportion of each index respectively. In MATLAB, fitting the negative exponential model $y = c_i e^{-a_i}$ can obtain parameter values c_i and $a_i (i = 1,2,\cdots,m)$, to carry on multiplied treatment

$$y^m = \prod_{i=1,2...m} c_i e^{-a_i x_i}$$

Opening n radical signs can be available for

$$y = e^{\sum_{1}^{m} \ln c_i - a_i x_i}$$

When the learning areas are identified well, students will write down problem. Let students through the standard to ask themselves questions, and the final needs to the implementation of PBS teaching mode project, to carry out investigation for the problems, its the statistical table is shown in Table 2.

TABLE II. Project implementation problem statistical table of PBS teaching mode

Project	Very satisfied	Satisfied	General	Non-satisfied	Very non-satisfied
Problem 1	2.47%	46.06 %	31.04 %	7.63%	2.80%
Problem 2	6.61%	47.93 %	32.23 %	6.61%	6.61%
Problem 3	2.48%	21.49 %	33.06 %	23.14%	19.83%
...	...	...	...	...	...
Problem n	12.40%	47.93 %	31.40 %	7.44%	0.83%

Each index model parameters of using MATLAB fitting is shown in Table 3.

TABLE III. Parameters after fitting

Index	x_1	x_2	x_3	...	x_n
Value c_i	7.285	8.281	12.55	...	15.6
Value a_i	-0.0392	-0.03986	-0.2111	...	-0.01176

To carry on multiplying treatment, it can get

$$y^n = 7.1585e^{x_1} * \cdots * 15.321e^{x_n}$$

It can carry out the project planning process that provides questions thinking and discussion for the second aspect, and then to propose the concrete research process. The result is a project plan through the project plan formulation, and students can determine the content and modes of learning, to obtain the evaluation of learning content and the basis for the way. A project plan is no fixed format, generally including the subject, research questions, research purpose, research methods and procedures, tools, materials, time planning list, roles and responsibilities, evaluation activities.

In general, teachers hope that a project team has 2~5 members, each study group put forward their research program according to the initial research questions. The complexity and delicacy of research program can charge according to the grade level, learning, research, curriculum objectives, teaching time and of different available resources. It can be available when 8 times radical signs

$$y = 8.18e^{0.00154\ x_1} + 7.19e^{0.00231\ x_2} + 7.46e^{0.00109\ x_3} + \cdots + 8.738e^{0.000984\ x_n}$$

Students need to use tools, materials, techniques collection and recording data, and also need to analyze data and reporting. In this part, the students should cooperate with each other mutual respect. The teachers mainly carry out guidance for the whole process, the relevant science experiment success or failure key steps are patience and careful observation in the process, adopting a variety of measure, the true record of the data, the use of appropriate tools, start monitoring and correcting for the data of multiple interpretations.

At the same time, the teachers also grasp different group progress, to need help and guidance group. a_i carries out normalization processing that is recorded by b_i as shown in Table 4.

TABLE IV. Data after normalization processing

Index	x_1	x_2	x_3	...	x_n
b_i	0.085871	0.087317	0.462432	...	0.025761

Students should state the panel concluded, to answer the problem teachers and other group. After the presentation, students can carry out their project review process. They think the group cooperation, individual participation in the learning process as well as future project place that need

to be improved. They also reflect on the project and their understanding of science concepts and skills are obtained which improve. The PBS teaching pattern indexes are quantified by written very, comparison, general, less, non} as{5,4,3,2,1}, PBS teaching mode index formula:

$$H_s = 8.78^{\sum_{1}^{8} b_i x_i}$$

Teachers should evaluate the students' project results, including the project plan, data list, model, improved tools, multimedia materials, final report and so on. In the assessment of project results, teachers should have a clear evaluation criterion, to expand the student's self-evaluation and allow students to make clear what kind of project results are a good project results.

Conclusion

Based on the project of scientific teaching model as the research object, to discuss the theory and practice of teaching mode, specific definition as well as implementation way, it plays a facilitating role in the improvement and implementation of science education teaching methods. In the PBS teaching mode, students carry out research through the project, to investigate real life world problems, cooperation and in charge of their own learning, students can not only obtain the knowledge understanding and skills, but also can be the development of scientific thinking ability. At the same time, the teachers are also benefited, which can communicate with students through the constantly study of new task, teachers will become lifelong learners.

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