The Construction of Mathematics Inquiry Teaching Model in High School under the Technological Environment

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Abstract: *With the rapid development of science and technology and the advocation for ability, the mathematics inquiry teaching under the technological environment has been paid more attention. This paper follows the qualitative methods and steps of constructing teaching models and constructs "Technology-Inquiry" Teaching Model. Its basic elements contain theoretical basis, teaching objectives, implementation conditions and operating sequences. This study extends the theory of technology and inquiry teaching, and plays an active role in constructing reasonable integration and inquiry systems.*

1. Introduction

With the rapid development of science and technology in the 21st century, technology teaching and inquiry teaching follow the trend and receive favor from the educators all over the world. The combination of the two becomes a new issue. But through the questionnaire survey and the literature reading, we found that the present teaching situation of this aspect in our country is not ideal. The theoretical research is not as profound as foreign research. It basically behaves in low theoretical level and poor instruction. Teaching model is the bridge between the theory and practice. The research on the mathematics inquiry teaching model in high school under the technological environment can contribute to the deepening theory and practical guidance.

2. Theoretical Basis

2.1 Constructivism Learning Theory

The basic idea of Constructivism Learning Theory believes that knowledge is not taught by the teachers. In a certain situation (social and cultural background) , with the help of teachers, learning partners and necessary learning materials, learners acquire knowledge by way of construction. Constructivism Learning Theory emphasizes the importance of taking students as the center. It asks students to become active participants from passive recipients. And teachers should be the helpers and promoters instead of imputers of knowledge (see [1]). The process of guiding students to explore in inquiry teaching conforms to the process of constructing knowledge by students that Constructivism Learning Theory emphasizes. Technology is not only the media for transmitting information, but also an dynamic and open learning environment that promotes cooperative learning (see [2]). Therefore, inquiry teaching and technology teaching have absorbed the essence of the Constructivism Learning Theory.

2.2 Teaching Structure Theory

Teaching structure refers to a stable structure guided by certain education thoughts, teaching theory and learning theory. It reflects the interaction among the four elements of the teaching

system(teachers, students, teaching content and teaching media). Modern educational theory calls for changing the traditional teaching structure that takes the teacher or students as the center. It advocates to construct a new teaching structure which plays the teacher's leading role and reflects the students' subject status. That is Leading-subject teaching structure, as shown in Figure 2.1. Leading-subject teaching structure absorbs the advantages of "taking the teacher as the center" and "taking the student as the center". In the whole process, it actively uses information technology, and lets the students think, explore and discover, so as to form a stable structure of a new teaching activity process (see [2]). It can be said that the establishment of this new teaching structure requires the support of information technology and inquiry teaching methods, but also provides a theoretical basis for the two.

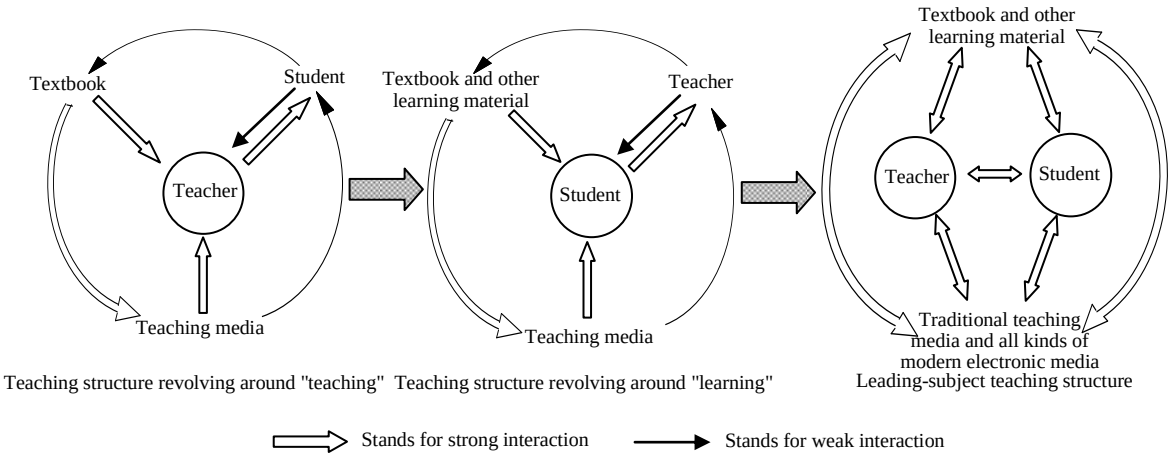

Figure 2.1 The Change of Teaching Structure

3. Analysis of Factors Affecting Construction

Any one of the models is subject to certain conditions. The model for all cases doesn't exist. When we construct the "Technology-Inquiry" Teaching Model, the following four factors are mainly considered:

3.1 Content of Courses

The teaching model is always relative to a certain kind of teaching content. As to different subjects, or different content of the same subject, we should choose different teaching models. The teaching model of this paper is suitable for the high school mathematics teaching (see [2]). Mathematics is highly abstract, widely used, and with aesthetic value. Each knowledge point is not just a mathematical fact, but also passes a kind of mathematics thought and method. Through inquiry, the thinking of the students gets training, and this is an important feature of mathematics teaching. In the construction of teaching model we should take full account of this feature. The constructed model is definitely different from the inquiry teaching model of Chinese, English and history.

3.2 Students

Different teaching models have different requirements for students' knowledge and intelligence level. We Should choose the teaching model which is suitable for the students' age characteristics and the students' physical and mental development (see [2]). On the basis of the nine-year compulsory education in China, high school students have a certain degree of abstract

generalization, space imagination, reasoning, analysis and problem-solving abilities. Thinking is changing from the concrete experience to logical abstraction, but not tight enough. They need to rely on the concrete experience of the material to help understand the logical relationship. These are very different from those of the low age group. The constructed model should accord with the cognitive characteristics of high school students.

3.3 Inquiry Teaching

At first, the core of mathematics inquiry teaching in high school under the information technology environment is inquiry teaching, so it can't be separated from the general model of inquiry teaching. Different researchers have different inquiry teaching models, but it usually involves the creation of situation, enlightening thinking, cooperation and exploration, evaluation and communication, and summary. We Can learn from and optimize the general inquiry teaching model while constructing. Secondly, generally speaking, inquiry teaching model has some basic characteristics, such as situation, problem, subjectivity, diversity, etc, which should not be ignored. In addition, we think that the study of mathematics is a gradual and cyclic process. It should be allowed to optimize the inquiry process gradually. This conforms to the law of human's cognition of things.

3.4 Information Technology Teaching

In the process of integrating information technology and mathematics curriculum, we should play the role of information technology. We should not regard it as a decoration, just as electronic blackboard or speaker, nor lost in the ocean of technology. The correct method is to carry out deep integration and give full play to the role of technology, such as creating situation, arousing interest, obtaining resources, simulating experiment, exploring and analyzing, improving efficiency, demonstrating and communicating, evaluating and feedback, etc.

4. The Construction of Teaching Model

From the above theoretical and practical analysis, combining a large amount of literature data and high quality teaching videos, we construct mathematics inquiry teaching model in high school under the technological environment, which is short for “Technology-Inquiry” Teaching Model. It mainly includes the teaching objectives, teaching environment, operating procedures and instructions.

4.1 Teaching Objectives

During the process of exploring, the students will experience the production and development of knowledge, master mathematics learning methods, improve the interest in mathematics, develop basic mathematics ability, form the habit of active exploration, questioning and innovation, and train the ability to solve the problem of mathematics by using information technology.

4.2 Teaching Environment

The first category: low-end configuration. The hardware includes a large screen projector, multimedia computer (teacher use), microphone, sound box, scientific calculator; The software

includes Microsoft Office, Z+Z geometric sketchpad intelligent education platform, Flash, Authorware, etc. This is the standard configuration of most primary and middle school multimedia classrooms, and it has been widely used in daily teaching. This teaching environment is suitable for teachers to explain, and for the teaching method of interaction between teachers and students.
The second category: middle-end configuration. It includes all low-end configuration. In addition, the hardware also includes physical showcase, computer (each group has one computer), video / audio switcher and video recorder. The software also includes Mathematica, Matlab, Maple, campus network, etc. This teaching environment is suitable for the students to communicate and cooperate in the group.
The third category: high-end configuration. It includes all middle-end configuration. In addition, the hardware also includes a handheld graphics calculator, and a computer (per student); The software also includes Mp_Lab (DM_Lab), PG_Lab (planar geometry Lab) (see [3]), (Dynamic Mathematics Laboratory), Internet, learning database, etc. This is a relatively ideal information teaching environment, but can not be used for everyday teaching. At present most schools can only have one or several such "mathematics laboratory". This teaching environment is suitable for the learning style of students' self exploring.

4.3 Operating Procedures and Instructions

According to the type of teaching knowledge, the operating procedures can be divided into three categories.

4.3.1 “Technology-Inquiry” Teaching Model A——Research on Theorem

Theorem is the core of mathematics. Theorem expresses the important mathematical facts, focuses on the mathematical ideas and methods, and reflects the results of previous research and innovation. It is a good material for improving students' mathematics quality (see [4]). It's a good idea that the teachers use inquiry teaching method and draw support from information technology when necessary. Operating procedures are shown in figure 4.1:

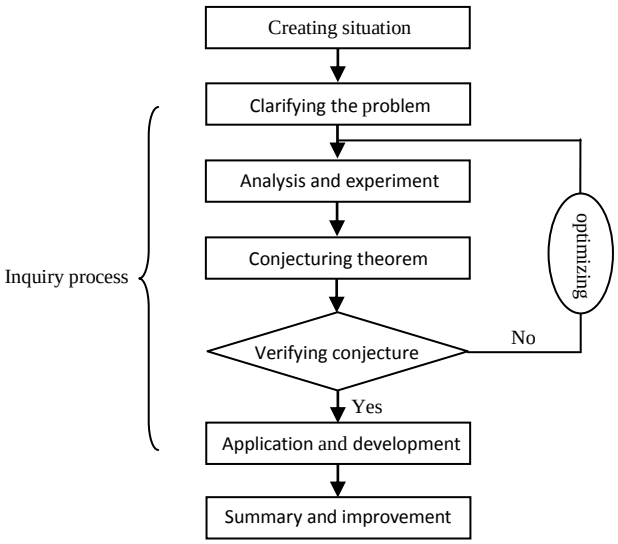

Figure 4.1 “Technology-Inquiry” Teaching Model A

Specific instructions are as follows:

Creating Situation

The creation of situation is the first step to stimulate students' learning interest and motivation, and it is also an important link to reflect the teachers' ability of mathematics accomplishment and innovation. In this part the teachers can cause the students' cognitive contradiction and problem consciousness through reviewing the old knowledge, introducing the history of mathematics, introducing life examples, carrying out mathematical games and simulating an activity. Students should follow the teachers into the teaching situation and be prepared to explore it. Information technology is the main tool of situational presentation, such as video, animation, pictures, games, courseware, graphics, text data, etc.

Clarifying the Problem

The problem is the heart of mathematics, and any effective inquiry activity begins with a meaningful question. Problems should be easy to explore. In this process, information technology is a tool for the problem presentation.

Analysis and Experiment

This is the basic link of teaching model. In this part, the experiment and analysis of the specific problems are discussed through the joint of teachers and students, the students' team cooperation and the individual exploration. Teachers should provide students with materials and tools, carry out the guidance of the method and grasp the direction of students' inquiry. Under the guidance of the teacher, the students use the materials and tools to analyze and deal with the information. Information technology is a tool to explore and exchange the theorem, such as obtaining resources, processing analysis, simulation experiments, demonstration and exchange, etc.

Conjecturing Theorem

This is a summary of the results of the previous research, but also an important link to promote research. In this process, information technology acts as a tool for communication and presentation.

Verifying Conjecture

This is the key part of this teaching model. For the proposed conjecture in the last part, teachers organize students to verify. If the conjecture is correct, we need to explain or prove it. On the contrary, it is necessary to discuss the causes of failure, and return to the "Analysis and Experiment" link to continue to explore it. Teachers and students, students and students should make full exchange. Information technology acts as a tool to explore and exchange the result, such as expressing opinion, accessing resources, mathematics experiments, etc.

Application and Development

This part mainly includes three meanings:(1)Application of new knowledge. Inquiry results is used to solve the relevant problems, including the general practice and the practical application of the problem. (2)Curricular development. Teachers organize students to study and explore the content of the extra-curricular knowledge, such as the history of mathematics, application examples in daily life, knowledge beyond the requirements of the curriculum standards but is helpful to the understanding of the course. (3) Evaluation and feedback. That is to test the learning effect and to feed back in time. Information technology acts as a tool for demonstration and evaluation, such as presenting problems, obtaining data, testing, etc.

Summary and Improvement

This part is the sublimation of inquiry teaching. Teachers sum up and evaluate the whole research activity， such as summing up the knowledge points, commenting on the students' learning situation, or expanding the problem situation for the next class. Students exchange their experiences，analyze the causes of success and failure by self rating and mutual evaluation, and

accumulate experience for more effective inquiry activities. Information technology is a tool for communication.

4.3.2 “Technology-Inquiry” Teaching Model B——Research on Concept

The concept of mathematics is one of the basic elements of mathematics, and the correct understanding of the concept is the basis of learning mathematics. The so-called "correct understanding" not only refers to the definition of the concept, but also to the background, formation process, and mathematical ideas and methods contained in it. This requires students to experience the inquiry process of the concept. Using inquiry teaching in the teaching of mathematics concept is a good method. Operating procedures are shown in figure 4.2:

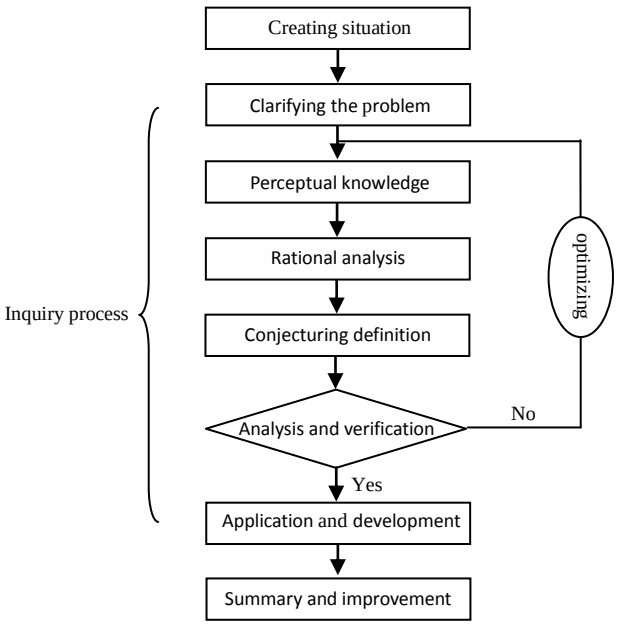

Figure 4.2 “Technology-Inquiry” Teaching Model B

"Creating Situation", "Clarifying the Problem", "Application and Development" and "Summary and Improvement" are the same as the model A. Only the rest of the link are described as follows:

Perceptual Knowledge

For the concept that is about to explore, the teacher provides students with relevant materials, or organize students to carry out mathematical experiments. Students follow the teacher's pace, and get a preliminary understanding of the concept. Information technology acts as a tool to demonstrate, such as video, animation, pictures, games, experiments, etc.

Rational Analysis

This is the basic link of the teaching model. The students use the perceptual knowledge gained in the last link to analyze the elements of the concept in the way of group cooperation. The teacher does the method guidance and grasps the analysis direction of students. Information technology is a tool to explore and exchange the result, such as obtaining resources, processing analysis, simulation experiments, demonstration and exchange, etc.

Conjecturing Definition

After the rational analysis, the students generalize the definition. Information technology is a tool for communication and presentation.

Analysis and Verification

This is the key part of this teaching model. For the concept proposed in the last part, teachers organize students to verify. If comprehensive and accurate, it will succeed. On the contrary, it is necessary to return to the "Rational Analysis" link to re explore. Teachers and students, students and students should make full exchange and discuss together. Information technology should be a tool to explore and exchange it, such as the expression of views, resource acquisition, mathematics experiments, etc.

4.3.3 “Technology-Inquiry” Teaching Model C——Research on Method

Mathematics method is the basic procedure to solve the problem of mathematics, it is a summary of the solution to a class of problems, and it is also the embodiment of the mathematics thought. Similar to theorem and the concept, students' mastery of the method should not be limited to the "can use" stage. Students should make the method's background and formation process clear, so as to " flexibly use" the method. For some mathematics methods, teachers can still use the information technology to expand the inquiry teaching. Operating procedures are shown in figure 4.3:

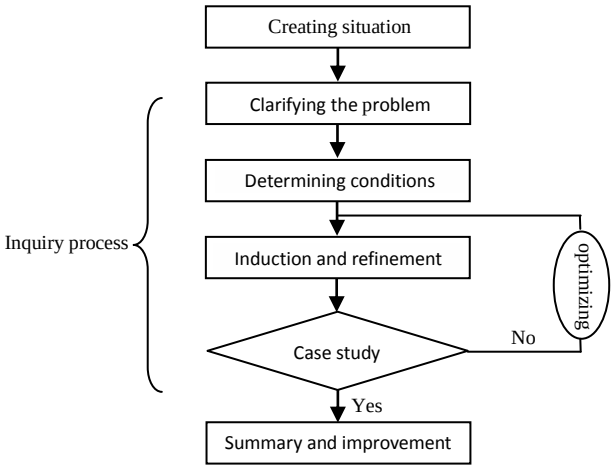

Figure 4.3 “Technology-Inquiry” Teaching Model C

"Creating Situation", "Clarifying the Problem" and "Summary and Improvement" are the same as the model A. Only the rest of the link are described as follows:

Determining Conditions

Any method has its specific applicable conditions. In this process, the teachers lead students to explore the working condition of the method by the way of teachers and students exploration, the group cooperation and student individual exploration. Information technology is a tool for demonstration, communication and exploration.

Induction and Refinement

This is the key link of teaching model. Students have gained some experience from the "Creating situation" link. The task of the teacher is to guide students to experience the rise of experience as a

reason, and then sum up the method. Finally, students elaborate the method. In this link information technology is a tool to explore, exchange and demonstration.

Case Study

A typical case is needed to test whether the refined method is perfect or not. If the problem is solved, the induction is successful; otherwise it's necessary to return to the "Induction and Refinement" link to further optimize. Information technology in this process should act as a tool to explore, communicate and demonstrate, such as presenting problems, mathematical experiments, etc.

5 Conclusion

In the “Technology-Inquiry” Teaching Model we can see that, by inquiry teaching technology becomes a tool for cognition, inspection and inquiry from electronic blackboard, and bids farewell to the vase status. Deep integration of information technology and mathematics curriculum is realized. With the help of information technology, many problems can be solved quickly and intuitively, and more effective inquiry activities can be carried out. Because the society is paying more and more attention to the students' comprehensive development, any single teaching method is not enough to meet people's needs. The reasonable combination of various teaching methods is the developing trend of modern school education. “Technology-Inquiry” Teaching Model is the perfect combination of technology teaching and inquiry teaching.

References

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