

Application of Model Concept Teaching Practice in Middle Schools in Lhasa: Taking the Fibonacci Series as an Example

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Abstract: The concept of a mathematical model is the main expression of the core quality of mathematics in junior middle school, which runs through all the contents of mathematics teaching in middle school. In the “2022 Compulsory Education Curriculum Standards,” mathematics teaching requires an overall grasp of mathematical ideas. Teachers should pay attention to the model concept of the ideological method of explanation and application in the teaching process, which can improve the teaching ability of teachers and is more conducive to students’ development. The new curriculum reform further improves students’ application awareness in the cultivation of core competencies.

Keywords: Model concept; Middle school students; Mathematics education; Learning ability

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1. Introduction

1.1. Research background and significance

Since the 21st century, the improvement and enhancement of students’ thinking ability has become the focus. Through the survey and social report in recent years, the traditional theoretical teaching can no longer meet the needs of today’s information age. Therefore, educators should improve and pay attention to cultivating students’ or their own thinking abilities. For example, mathematics is an abstract subject, which is very helpful for training students’ abstract thinking abilities. It can enable students to think in many aspects and from many angles when they encounter complex problems, breaking the limitations of traditional thinking methods ^[1]. Learning good mathematics can not only help to grasp digital knowledge on one level but also master practical applications. Only by adhering to this, can one gradually make the mathematical language learned full of infinite vitality, in order to truly realize the value of mathematics itself in practice.

Introducing the concept of mathematical models and related ability teaching in the middle school compulsory education stage is important and necessary. Junior middle school students can cultivate the core literacy of mathematical abstraction and real-life problems, observe the world with mathematical eyes, think

about problems with mathematical thinking, and use mathematical language to express the world. The healthy development of using mathematical methods to build models and solve problems plays a key role.

1.2. Research status

A mathematical model builds a bridge between mathematics and the real world. As a support for solving problems in middle school, model concept ability is an important form of mathematical application, which greatly promotes the development of mathematics^[2]. In recent years, the model concept has been continuously paid attention to in the extracurricular and classrooms of colleges and universities and has been greatly promoted and developed. However, the deficiency lies in the lack of systematic teaching theory of model concept, which makes the course teaching difficult. Especially in the middle school stage, the concept of mathematical models appears theoretical, and the mastery of conventional theories is usually boring.

The 2011 edition of Compulsory Education Mathematics Curriculum Standards classifies model thought as one of the 10 keywords. Mathematical modeling is also another novel thinking form of mathematical language learning mode. It also provides students with some thinking space for independent study and research, which is a very favorable step. Model thought is also a basic way for students to experience^[3], understand the world, and connect with the outside world. In the “2022 Compulsory Education Curriculum Standards,” the model concept is mainly to have a clear understanding of the use of mathematical models to solve practical problems, a preliminary perception of the basic process of the model concept, and an understanding of the importance of mathematical application.

Therefore, it is highly necessary to carry out courses on mathematical models in the middle school stage. For example, in counting activities, “how many different line segments can be formed by four points on a straight line” is used as a model for a class of counting problems, so that “four people take turns to shake hands, a total of how many hands can be held” is classified as a typical model. The penetration of the model concept in middle school curriculum is conducive to the further development of core literacy, and can greatly improve students’ enthusiasm and excitement in learning^[4].

2. Model concept and the Fibonacci series in middle school textbooks

2.1. Model concept and the Fibonacci series in middle school textbooks

Most of the model concepts in middle school are presented to students in the form of cases. Students only need to understand the meaning and conclusion of the teaching, and initially perceive the basic process of the model concept, without needing to master its realization process. Since theoretical knowledge cannot be satisfied in the middle school stage, students only need to acquire this kind of model concept, the training of this kind of thinking concept is necessary, it can be transferred inside and outside the curriculum, conducive to interdisciplinary learning. Thus, solving problems is more diversified and comprehending the universality of mathematics application.

Fibonacci series is shown in the *East China Normal University Edition* and the *Human Education Edition* teaching textbooks, which are junior high school and senior high school textbooks respectively^[5]. In addition, the textbooks for primary schools are also displayed. There is little content about the Fibonacci series in the textbooks for primary schools, while the content for junior high schools is mostly related, which occasionally appears in the middle school exam questions. It is especially prominent in high school, where Fibonacci numbers are almost always included in the annual high school entrance exam questions in each province^[6].

2.2. Characteristics of cognitive development and teaching of middle school students

In the cognitive theory of human development, the cognitive level of infants and teenagers is from intuition to abstract transition, and the thinking ability is gradually formed, able to actively judge things, and can be greatly improved through learning or education. When students' cognitive evolution enters the stage of fuzzy operation, they can learn new vivid theories and their relationships beyond the stereotypical thinking of concrete practical experience, so as to understand the new connections between elaborating language or other features and previously learned abstract concepts in one-to-one contact.

In order to make the acquisition of knowledge more meaningful, the teaching process must be able to establish the necessary correlation between the new vivid concepts and their relationships and the students' original cognitive ideas. Therefore, from the perspective of long-term progress, middle school students are well prepared to accept new concepts and ideas. In this new teaching of explanation and analysis, examples are not intended for students to use intuitive judgment or understanding, but to understand and comprehend its meaning in a different way of thinking^[7].

3. Data analysis

In order to promote the effectiveness and feasibility of the teaching design theory of model concept in middle schools, we conducted a survey on the learning and application of the model concept in No. 1 Middle School of Lhasa and formulated a questionnaire according to local conditions to study the teaching and learning problems of model concept in No. 1 Middle School of Lhasa.

Firstly, the questionnaire was prepared, which involved: (1) The understanding of the Fibonacci series, including whether the teacher could explain the reading materials in the textbook, whether the students could read and understand the Fibonacci series consciously, whether the teacher connected mathematics with real life, etc.; (2) The degree of understanding of model concepts, including whether students are interested in learning about or participating in the model concepts elective course. In four classes of No. 1 Middle School of Lhasa, 200 questionnaires were distributed and 182 valid questionnaires were collected, with an effective recovery rate of 91%. The reliability of the questionnaires was 0.813, and the validity KMO value was 0.712. In addition, a number of mathematics teachers in a middle school were interviewed individually to get an in-depth understanding of the current education situation.

The research found that in junior high school, students tend to be active in thinking, almost all of them are curious about new things, and their learning ability is strong and fast. However, junior high school students are in adolescence, the purpose of learning and life is weak, the academic attitude needs to be further improved, and students' correct concept of learning also needs to be further strengthened. Teachers play an exemplary role, taking model concept teaching as an example. Through the teaching of model concept knowledge and students' learning of model knowledge, students' initiative and enthusiasm can be improved, and their anti-interference and innovation abilities will also be enhanced.

For students, reading materials can enable students to recognize the essential problems of mathematics and master the essence of mathematics^[8]. It can arouse their interest in class and improve their efficiency in class listening. As for teachers, the purpose of teachers' knowledge systematization is to make students accept mathematics knowledge more effectively and easily. Effectively explaining the materials in the textbook can make students better understand the process of producing mathematical knowledge, which is conducive to correctly cultivating students' mathematical thinking^[9]. The survey of students' current knowledge of the Fibonacci series is shown in **Table 1**.

Table 1. Statistical analysis table of survey on students' current knowledge of the Fibonacci series

Questions	Yes	No	Proportion
Do you like reading material in your math textbook?	107	75	58.8%
Do you expect the teacher to explain and analyze the reading material?	144	38	79.1%
Do you understand the math problems involved in the reading material?	93	89	51.1%
Are you aware of the Fibonacci series ("rabbit series")?	38	144	20.9%
Have you ever actively learned about the Fibonacci series?	28	154	15.4%
Do you know the rules of the Fibonacci series?	29	153	15.9%
When you have a problem in your life that you need to solve, do you think about it mathematically?	122	60	67%
Do math teachers take care to connect math to real life when they teach?	143	39	78.6%
Do math teachers use different methods to solve math application problems in class?	153	29	84.1%

According to the statistics of the questionnaire data, most students like the math reading material and hope that the teacher can explain the material. As most of the reading materials are abstract, most students cannot understand them. In junior high school, students are less familiar with the Fibonacci series and do not take the initiative to understand the material. It can also be seen from the data that most students will consider problems from the perspective of mathematics when they encounter problems in life. In the middle school stage, teachers will also connect mathematics with real life and use different methods to solve the problems of mathematics applications^[10,11].

The cultivation of learning habits is also the top priority^[12]. Good learning habits can get twice the result with half the effort, and academic performance can be steadily and effectively improved. The questionnaire also involves students' understanding of model concepts, and the survey of students' understanding of model concepts is shown in **Table 2**.

Table 2. Survey and statistical analysis table of students' current understanding of model concepts

Questions	Yes	No	Proportion
Have you heard of the model idea?	82	100	45%
Do you understand the steps of the model concept?	51	131	38.9%
Are you interested in learning about model concepts?	123	59	67.6%
If the school offered an elective on model concepts, would you take it?	118	64	64.8%

According to the statistical description of the data in the table, the pie chart and bar chart are prepared as shown in **Figure 1**.

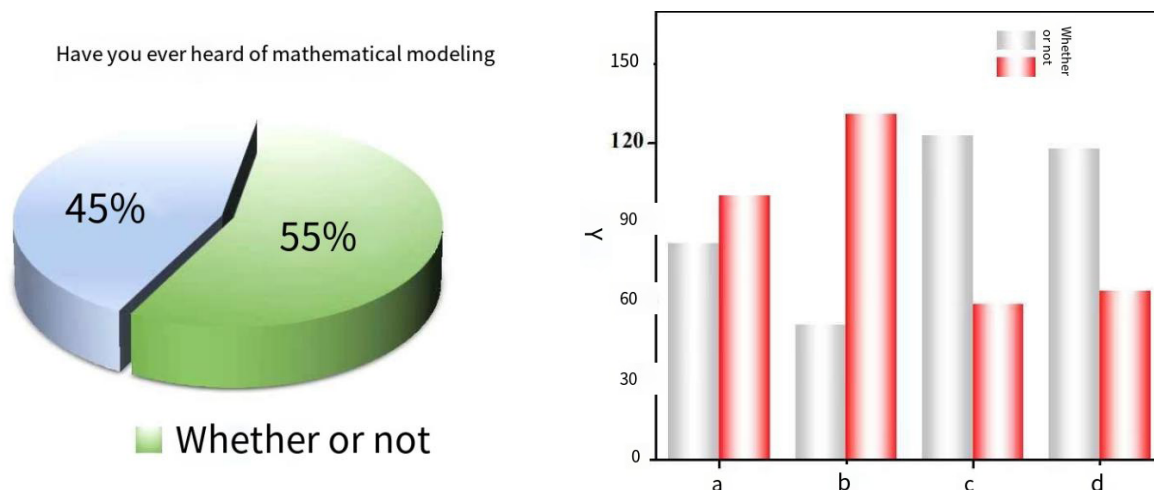


Figure 1. Survey statistical analysis chart of students' current understanding of model concepts

According to the pie chart, the number of students who have never heard of model concepts reaches 55%. Only a few students have heard of it and understand the modeling steps. According to the information in the table, students' enthusiasm for understanding the concept of modeling is particularly high. Through the teaching practice carried out on the students in the later period, it is found that before and after the instilling of teaching concepts and ideas, students' learning habits have been significantly improved, and their interest in learning mathematics has been greatly enhanced. Therefore, in the usual teaching process, teachers should pay more attention to the edges and corners of the textbook, which will usually arouse the interest of readers, and can often instill some concepts related to the model concept to the students and guide the formation of the core quality of the model concept^[13].

4. Prospect

The Fibonacci sequence runs through school, high school, college, and other stages^[14,15]. It is universal and suitable for students at any stage to learn. Laying the groundwork in advance in primary school, they will be able to accept it faster and learn more deeply in further learning. Its appearance is completely in line with the principle of spiral teaching. This research is mainly aimed at primary and secondary schools, and the investigation of some schools has been expanded to more schools. Through data analysis, it is clearly pointed out that it is necessary to expand and deepen the model concept in the next mathematics teaching, and one of the shortcomings is that the development of model concepts and ideas is not utilized in the process of mathematics teaching. It is hoped that the research of this paper can increase the attention of primary and secondary school teachers to the awareness and concept of mathematical models. Finally, it is worth mentioning that the data obtained in this paper is only applicable to some primary and secondary schools in Tibet, and the educational development status of each province and city is different. However, from another perspective, it is necessary to develop regional characteristic teaching according to local conditions, which can accurately solve the educational problems in local areas.

Disclosure statement

The authors declare no conflict of interest.

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