Strengthen Mathematics Modeling Teaching and Cultivate the Innovation Ability of Middle School Students

Xiao Yuan[a], Liang Fang[a,*]

[a] College of Mathematics and Statistics, Taishan University, 271000, Tai'an, Shandong, China

[*] *Email:fangliang3@163.com*

Abstract—**China's Ministry of Education has proposed six core literacies in the Compulsory Education Mathematics Curriculum Standards (2011 Edition), including mathematical modeling, mathematical abstraction, mathematical operations, mathematical reasoning, data analysis and intuitive imagination, of which mathematical modeling is one of the important components of the core literacies. At the junior high school level, teachers train students to master the basic skills of mathematical modeling, guide them to use mathematics as a tool to solve real-life problems, and clarify the role of mathematical knowledge in real life during the modeling process to develop their creative abilities. Recently, junior high school teachers have been educating junior high school mathematics classroom in an innovative way, because the teachers' innovative ideas are not clear enough and the execution is not strong enough, resulting in innovative education being affected to some extent. The author believes that mathematics education at the compulsory education level should focus on exercising students' problem-solving thinking and their sense of independent innovation.**

This paper analyzes and discusses how to strengthen mathematical modeling teaching and cultivate secondary school students' innovative thinking and innovative ability based on the current situation of mathematical modeling teaching in China and the status of mathematical modeling in the core literacy of secondary school mathematics subjects and the importance of strengthening mathematical modeling teaching and cultivating secondary school students' innovative ability, and proposes contextual-taught, heuristic, cooperative learning, reverse thinking, and other effective strategies for developing secondary school students' innovative abilities.

Index Terms—**Creative ability; cooperative learning; reverse thinking; heuristic teaching; mathematical modeling**

I. INTRODUCTION

A. Background of the Study

With the deepening of curriculum reform, teaching mathematical modeling in secondary schools as an effective model for implementing core literacy in mathematics curriculum reform. Mathematics is a universal means for humans to describe the abstract structure and pattern of things rigorously, and can be applied to any real-world problems. Therefore, building, solving and applying mathematical models has become an important tool for dealing with various practical problems and achieving precision, quantification and mathematization.

Secondary school students already have a certain system of mathematical knowledge, however, most of them will only use this knowledge to solve the exercises in the textbook, and will not use what they have learned to live and apply it to solve practical problems and mathematize practical problems, not to mention innovation.

Based on this, this paper discusses how to cultivate secondary school students' innovation ability from the perspective of strengthening secondary school mathematical modeling teaching, aiming to explore secondary school mathematical modeling teaching, improvement and implementation of teaching strategies. Firstly, through the reading and analysis of literature and the experience during the internship, we get the teaching design principles and teaching strategies of secondary school mathematical modeling courses. Through this study, we can strengthen the theoretical basis and corresponding strategies of secondary school mathematical modeling teaching, and provide some help for teachers to improve the current situation of secondary school mathematical modeling teaching.

B. Purpose and significance of the study

(1) Purpose of the study

To investigate the teaching strategies of secondary school mathematical modeling and to cultivate the innovation ability of secondary school students.

(2) Theoretical significance

To explore the teaching strategies of secondary school mathematical modeling and cultivate the innovation ability of secondary school students for teaching design can not only enrich and improve the theories related to the teaching design of mathematical modeling courses, but also expand and improve the content related to mathematical modeling in textbooks, promote the development of secondary school students' innovation consciousness and innovation ability, and promote teachers to change and update the teaching design concept about mathematical modeling, therefore, the research of this paper has certain theoretical significance.

(3) Practical significance

This paper attempts to analyze the strategy of secondary school mathematical modeling teaching cultivation through research and analysis, further explore how to improve the teaching quality of teachers' mathematical modeling and effectively strengthen the cultivation of secondary school students' mathematical modeling ideas by combining the current situation of secondary school mathematics teaching, and the following is an example of mathematical modeling teaching for junior high school students to provide in-service teachers with a reference of teaching design plan of secondary school mathematical modeling teaching class under the perspective of innovative thinking. Therefore, the research done in this paper is of practical significance.

C. Research Problem

Based on the research purpose and research significance, this paper will explore the following questions.

(1) The current situation of mathematical modeling in secondary schools in China and the problems that exist.

(2) To explore the relationship between core literacy and mathematical modeling, and to discuss the status of mathematical modeling in the subject literacy of secondary school mathematics.

(3) In order to cultivate the innovation ability of secondary school students, we analyze the design principles and teaching strategies of secondary school mathematical modeling, and seek to provide reference for the majority of secondary school teachers to teach secondary school mathematical modeling.

II. AWARENESS OF MATHEMATICAL MODELING IN SECONDARY SCHOOLS

With the in-depth reform of China's new curriculum and the strategy of developing the country through science education advocated by the state, the new curriculum standard (2017 edition) clearly states that students are required to complete a research on a topic in mathematical modeling and mathematical investigation activities through teacher guidance or independent selection, which requires students to study new ideas, methods and results in depth. This requirement fully reflects the importance the country attaches to science education and strengthens the teaching of mathematical modeling, which is conducive to the cultivation of students' innovation ability. At present, most schools in China still adopt the traditional teaching mode, which is not conducive to combining the actual situation of students and cultivating their creative ability and innovative thinking. In order to better accomplish the teaching goal, teachers need to strengthen the communication with students.

Mathematical modeling is not only an important part of students' core literacy in mathematics, but also an important idea for solving mathematical problems. The cultivation of students' modeling literacy in junior high school mathematics teaching is conducive to the improvement of students' problem identification and problem solving abilities, and promotes the development of students' mathematical thinking. Therefore, it requires teachers to clarify the purpose of mathematical modeling, not only to ask students to explore the only solution to the problem, but also to seek multiple solutions and finally find the optimal solution to the problem. To stimulate students' interest in learning, students are guided to actively develop their thinking when facing mathematical modeling problems, to open their brains, to boldly and reasonably propose various hypotheses, and to jointly explore the most appropriate mathematical model through individual analysis or group discussion. In this mathematical modeling process, students' interest in solving practical problems is stimulated, and they dare to put forward their own opinions so as to improve their own innovation ability.

A. The current situation of mathematical modeling teaching in secondary schools in China

Through reading and studying the relevant literature at home and abroad, and combining with the relevant investigation on the current situation of mathematical modeling teaching in secondary schools during the internship, the following problems and attributions are obtained after studying and analyzing the current situation.

(1) Lack of mathematical modeling-related contents in teaching materials

Through reading the books on mathematical modeling teaching at home and abroad, I found that most of these books are only a simple list or answer to the problems or examples of mathematical modeling competition, and the problems are not related to the real life. Some of the journal literature also only gives a simple discussion on mathematical modeling activities in the classroom, and the process of how teachers should carry out mathematical modeling teaching in middle school is also very simple, and the content of mathematical modeling teaching in middle school is still rare. In addition, the content of mathematical modeling in middle school textbooks is not much, but only the basic knowledge is specified and elaborated, while the mathematical application ability, which has an important and long-term impact on learning, is only specified in principle, and there is a lack of necessary cases and abstract teaching purposes, which cannot provide an exact standard for scientific measurement and evaluation, analysis and comparison. Teachers continue to lack relevant literature on the mathematical modeling preparation process to teachers' classrooms. Therefore, the lack of mathematical modeling related content in the textbook, teachers in the teaching process about mathematical modeling teaching related courses will be greatly reduced, is not conducive to the cultivation of secondary school students' innovation ability.

(2) Traditional mathematical modeling teaching mode

In the current stage of junior high school mathematics teaching process, most of the mathematical modeling courses

tend to explain the knowledge through the indoctrination lecture method and let students combine the formulas to solve problems. In the classroom, most of the time is just the teacher teaching knowledge and students sit and listen to the lecture. This teaching mode, which does not stimulate students' interest in learning, also does not allow the application of mathematical models to solve practical problems. Over time, students' learning level and their ability to accept knowledge are affected, and students' understanding of knowledge is not thorough enough, lacking interest in learning mathematical knowledge and reducing the learning effect. In addition, the traditional teaching activities, teachers and students can not establish a good communication platform, students do not have the opportunity to raise their own questions and opinions, students have been in a passive position in learning, there is no training of their mathematical thinking, not to mention the training of innovative ability and innovative thinking.

(3) Students' own lack of innovative consciousness

Under the long-term traditional teaching mode, students have developed a strong dependence on the learning of knowledge. Whether in the classroom learning process or in the after-school review, students mostly follow the teacher's requirements, and in this process, students lack the awareness of independent thinking about problems, which has greatly hindered the formation and development of their independent creative consciousness and innovative ability. At the same time, the learning difficulty of middle school mathematics is more difficult than that of elementary school, and the characteristics of mathematics itself are very logical and abstract, which will lead to some students' lack of interest in learning mathematical knowledge, which will affect teachers' ability to cultivate and improve students' independent creative consciousness and innovative ability.

With the implementation of the Ministry of Education's new curriculum reform, junior high school teachers have made great changes to mathematics teaching, from the traditional "duck and fill" classroom to teachers actively changing the teaching mode and exploring methods suitable for secondary school students' thinking. In this process, they encountered many problems. Some young teachers are too innovative in their classroom teaching mode without considering the teaching effect and the actual situation of students, resulting in the teaching effect not reaching the expected goal set by teachers. For students in junior high school, each student has different learning abilities and each student has his or her own personality. In the process of mathematical modeling, students are not effective in teaching new learning methods because they do not have a firm grasp of basic knowledge; some teachers adopt radical learning methods, and students' learning ability is not only not improved, but also makes the teaching effect poor; some teachers, in order to make students have the ability to think and discriminate, blindly teach students a variety of problem solving methods when explaining exercises. In order to make

students have the ability to think and discriminate, some teachers blindly teach students multiple problem-solving methods when explaining exercises, which neglects the cultivation of students' logical thinking, independent thinking ability, and innovation ability.

(4) Teachers' creative thinking and innovative ability are limited

Through research and survey, only a few teachers in junior high school in China have participated in modeling competitions or training, but they only have a general understanding of the process of mathematical modeling and lack sufficient theoretical basis and practical experience, resulting in the hindrance of teachers in the development of mathematical modeling teaching. In junior high school teaching, most teachers simply do not put secondary school mathematical modeling in an important position, and teachers themselves do not have the consciousness of wanting to learn to teach mathematical modeling well, much less to achieve excellence in secondary school mathematical modeling teaching.

The lack of teachers' creative thinking and innovative ability makes the teaching level will directly affect the teaching efficiency of middle school mathematics classroom. At present, under the new curriculum reform education, most junior high school mathematics teachers adopt new teaching methods such as multimedia, micro-video and micro-course to carry out their teaching work, but they cannot give students sufficient guidance and help, and some teachers have limited ability to make PPT, which leads to low actual teaching efficiency. There are also some teachers in the process of teaching mathematics, the summary of knowledge points is not in place, and the cultivation of students' creative consciousness and innovation ability is not improved.

B. The status of mathematical modeling in the core literacy of secondary school mathematics modeling discipline

With the development of Chinese students' core literacy framework, each subject has conducted research and development of disciplinary literacy. The core literacy has also been formulated for mathematics subjects. Core literacy mainly refers to the necessary character and key abilities that students need to adapt to their lifelong personal development and social development, which are gradually formed in the process of receiving teaching of the corresponding school level. Innovative ability refers to the way of thinking and the ability to effectively use analogy, conjecture, reasoning, induction and other methods to observe things, find out the inherent patterns among things, and on this basis, make forward-looking thinking about the changes and development trends of things. The secondary school mathematics curriculum mission states that the core literacy of secondary school mathematics mainly includes mathematical operations, intuitive imagination, logical reasoning, mathematical

abstraction, data analysis and mathematical modeling, and emphasizes that through the learning of the mathematics curriculum, students learn to express the real world in mathematical language, use mathematical knowledge to construct models to solve practical problems, accumulate mathematical experience, enhance the sense of innovation, and develop the ability of innovation.

Mathematical modeling is a bridge to connect mathematics and practical problems. Strengthening mathematical modeling teaching to secondary school students enables them to learn mathematical thinking and methods while consolidating the knowledge they have learned, so that they can establish a correct view of mathematics and enhance their awareness of mathematical modeling, thus further improving their ability to analyze and solve problems.

Therefore, the cultivation of students' modeling literacy in junior high school mathematics teaching is conducive to the improvement of students' problem identification and problem solving abilities, and promotes the development of students' mathematical thinking.

C. The importance of strengthening mathematical modeling teaching and cultivating the innovation ability of middle school students

(1) It is conducive to the implementation of China's strategic goals of science and education to meet the needs of social development

The improvement of a nation's innovative ability cannot be separated from the cultivation of innovative talents. Education is the cornerstone of national revitalization and social progress, and it is the fundamental way to improve national quality, cultivate innovative talents and promote all-round development of people. Therefore, when carrying out mathematics teaching activities in junior high school, it is necessary to cultivate students' creative thinking and innovative ability, so that they can apply such thinking and ability in various disciplines and fields to meet the needs of social development.

(2) Help stimulate students' interest in learning mathematics and establish a correct outlook on learning

Students at the junior high school level already have certain thinking skills, and because of their age, they have a lot of novel ideas, the sky is the limit, and they have a very high potential for innovation, but the junior high school mathematics curriculum is relatively boring compared to other subjects, the content is abstract and the learning capacity is large. Therefore, most students are not willing to spend more time to learn mathematics except for the mathematics classroom, and some students may even become bored with the learning of mathematics knowledge. Teachers can adopt appropriate teaching methods of mathematical modeling to stimulate students' interest in learning and make them feel that mathematical

modeling is an interesting subject, so that they are willing to contact mathematics. At the same time, schools can also carry out mathematical modeling activities to attract students to enroll in them, so that students will be interested in mathematics as a learning subject and find interest in the relatively boring mathematics learning.

(3) It helps to cultivate students' independent innovation ability

Teachers strengthen mathematical modeling teaching, build a good independent learning platform for students, or introduce innovative teaching activities in teaching, and then let students use discussion, thinking and other means to solve problems, and develop students' thinking ability, which is conducive to students' own development of the importance of the formation and enhancement of students' independent innovation ability, at the same time, teachers cultivate students' innovation ability in mathematics teaching, can make students establish Confidence in exploring problems, flexible application of learned knowledge to life, a rational attitude to mathematical problems, thus stimulating the students' sense of innovation, inquiry ability, so that the students' mathematical level has been significantly improved to promote the development of junior high school mathematics teaching. In the continuous development of modern society, innovation ability has become an important indicator to evaluate the level of students' comprehensive quality. A student without innovation ability cannot get the favor of excellent enterprises and cannot let his or her value be maximized, so it is very important to cultivate students' independent innovation ability.

III. STRATEGIES FOR CULTIVATING STUDENTS' CREATIVE THINKING AND INNOVATIVE ABILITY IN TEACHING MATHEMATICAL MODELING IN SECONDARY SCHOOLS

Under the new curriculum reform, junior high school teachers are required to actively think about how to cultivate students' innovative thinking and creative abilities in secondary school mathematics modeling teaching, and through practical teaching, identify problems, solve them, summarize teaching experience, and stimulate students' interest in learning. Teachers should give students the space and time to think independently, encourage them to mobilize their thinking skills to solve problems, and constantly innovate, so as to enhance their creative ability and innovative thinking and really improve the quality of mathematics teaching.

A. Contextual-Teaching Strategy

The contextual-teaching strategy is to create a vivid teaching situation with problems as the main element, so that students can play innovative thinking in the context created by

mathematical problems, learn to think creatively and solve mathematical problems, stimulate students' interest in learning, through learning mathematical theoretical knowledge and apply it to real life. Therefore, in the actual teaching, teachers should design reasonable mathematical modeling problems, design suspense, thus creating problem situations, so that students can use their own reserves of mathematical knowledge to observe and analyze real-life problems, and language into mathematical problems, to find out the laws and connections between mathematical knowledge and real-life situations, and to develop students' creative thinking, which can improve the efficiency of knowledge acquisition. For example, in teaching "Application of functions in real life", we introduce the sharing of electricity bills, telephone bills, water bills, financial income and expenditure, daily consumption management, cab billing and other life problems to guide students to learn more about life in general, there are a lot of life in the students' living environment, so as to stimulate students' cognitive needs, interest in learning and exploration. The students' cognitive needs, interest in learning and motivation to explore, and at the same time to develop students' core literacy such as mathematical abstraction and mathematical modeling.

For example, when teaching the activity lesson of "primary function" in the second book of the eighth grade of junior high school mathematics, the teacher of junior high school mathematics can first tell students a mathematical problem closely related to life: there are three types of Internet access charges: mobile, Unicom and telecom, which are recorded as A, B and C. Table 1 gives the charges of these three types of Internet broadband.

TABLE I:THREE TYPES OF INTERNET ACCESS CHARGES FOR MOBILE, UNICOM AND TELECOM

Charging method	Monthly usage fee (yuan)	Package time for Internet access (hours)	Over time fee (yuan/minute)
A	30	25	0.05
B	50	50	0.05
C	120	Cunlimited time	

After the teacher narrates the above life situation, let students think independently and ask questions, asking: Which way can you choose to save money on Internet? Give reasons. The teacher can fully mobilize students' learning enthusiasm and let them actively participate in teaching activities through the teaching method of situational pottery. This teaching method can not only deepen students' understanding of knowledge, but also stimulate students' interest in learning and creative thinking, and cultivate

students' good habits of independent learning.

This topic is the extended and improved part of the whole chapter of Chapter 19 of the textbook. It is presented in the form of an inquiry study. This is a typical mathematical modeling optimization problem, which demonstrates the application value of functions and highlights the thinking and practical significance of building mathematical models. For middle school students, this topic is highly comprehensive, and it is difficult for students to give a quick answer in a short time. At this point, the teacher can continue to guide students to think about how to use their knowledge to build equations to solve the problem. The teacher can select any student to raise their hand to show their solution, thus making all students focus on trying to solve the problem. During this process, the teacher will correct those students who have the wrong solution and encourage them to follow the teacher's pace of learning mathematics. If one of the students gives the correct answer, then the teacher can allow that student to share his or her analysis, thus increasing student motivation. Teachers can also improve students' independent thinking skills by encouraging them to explore that knowledge on their own and asking them to find out if there is a better way to solve the problem. Continue to guide students to think about how to use their mathematical knowledge to build a function model to solve the problem.

In conclusion, the contextual-potential teaching model starts from building a good classroom teaching context and organizes based on students' experiences, reflections, and perceptions to achieve life-to-life communication and exchange between teachers and students. This process strengthens the interactive influence of human and environment in order to produce teaching resonance and achieve the purpose of increasing students' interest in participation, stimulating creative potential and promoting internalization of learning outcomes.

B. Heuristic Teaching Strategies

Due to the limitations of middle school students' experiences and abilities, students cannot solve problems accurately and quickly when modeling mathematics, which makes them timid about modeling problems. For this reason, in mathematics classroom teaching, teachers should penetrate modeling ideas, inspire students to think, analyze and solve problems effectively, combine the teaching strategy of classroom questions, inspire students to think about problems, improve students' awareness of mathematical problems, students can only solve problems by constantly asking questions and finding problems, and train students' innovative thinking in mathematics.

For example, in the problem "Someone buys 13 eggs, 5 duck eggs and 9 quail eggs for a total of 9.25 yuan; if he buys 2 eggs, 4 duck eggs and 3 quail eggs for a total of 3.20 yuan, how much does it cost to buy just one egg, one duck egg and one quail egg each?" In the problem, due to the different problem solving habits of the students, they will use different

problem solving methods such as the rounding method, the principal element method, the elimination method, the parametric method, the method of coefficients to be determined, and so on.

The method is as follows.

Solution: Let the unit price of chicken, duck and quail eggs be x、 y、 z dollar respectively, then according to the question, we get

$$\begin{cases} 13x+5y+9z=9.25 & (1) \\ 2x+4y+3z=3.20 & (2) \end{cases}$$

Analysis: This system of equations is a ternary system of equations. Since there are only two ternary equations, it is impossible to find the x、 y、 z values separately, but note that the algebraic sum is $x+y+z$ sought, therefore, we can get a variety of solutions by deformation and transformation.

Method 1. Rounding method

Solution 1: $[(1)+(2)]\div 3$, we get

$$5x+3y+4z=4.15 \qquad (3)$$

$(2)+(3)$ gives $7(x+y+z)=7.35$.

So $x+y+z=1.05$. Above all, we get the conclusion: Buy only one egg, one duck egg, and one quail egg each, for a total of 1.05 yuan (all answers after the solution below are omitted).

Solution 2: The original system of equations can be deformed to

$$\begin{cases} 13(x+y+z)-4(2y+z)=9.25, \\ 2(x+y+z)+(2y+z)=3.20. \end{cases}$$

Solving this yields $x+y+z=1.05$.

Method 2. Principal element method

Solution 3: Consider x、 y as the principal and z as the constant, solve (1) and (2) to obtain.

$$x=y-0.05, z=1.1-2y,$$

$$\therefore x+y+z=y-0.05+y+1.1-2y=1.05.$$

Solution 4: Consider y、 z as the principal and x as the constant, solve (1) and (2) to obtain.

$$y=0.05+x, z=1-2x.$$

So we have

$$x+y+z=1.05+x-2x+x=1.05.$$

Solution 5: : Consider x、 z as the principal and y as the constant, solve (1) and (2) to obtain.

$$y=0.05+x, z=1-2x.$$

So we have

$$x+y+z=1.05+x-2x+x=1.05.$$

Method 3. "Elimination" method

Solution 6: Let $x=0$, then the original system of equations can be reduced to

$$\begin{cases} 5y+9z=9.25 \\ 4y+3z=3.20 \end{cases} \Rightarrow \begin{cases} y=0.05, \\ z=1. \end{cases}$$

Thus we get

$$x+y+z=1.05.$$

Solution 7: Let $y=0$, then the original system of equations can be reduced to

$$\begin{cases} 13x+9z=9.25 \\ 2x+3z=3.20 \end{cases} \Rightarrow \begin{cases} x=-0.05, \\ z=1.1. \end{cases}$$

So we have

$$x+y+z=1.05.$$

Solution 8: Let $z=0$, then the original system of equations can be transformed into

$$\begin{cases} 13x+5y=9.25 \\ 2x+4y=3.20 \end{cases} \Rightarrow \begin{cases} x=0.5, \\ y=0.55. \end{cases}$$

Thus we get

$$x+y+z=1.05.$$

Method 4. Parametric method

Solution 9: Let $x+y+z=k$, then

$$\begin{cases} 13x+5y+9z=9.25 & (4) \\ 2x+4y+3z=3.20 & (5) \\ x+y+z=k & (6) \end{cases}$$

$(1)-(2)\times 3$ give us

$$x-y=-0.05. \qquad (7)$$

Then $(3)\times 3-(2)$ gives

$$x-y=3k-3.20 \qquad (8)$$

From (7) and (8), we get $3k-3.20=-0.05$. Therefore, we have

$$k=1.05, x+y+z=1.05.$$

Method 5. method of coefficients to be determined

Solution 10: Let

$$x+y+z=a(13x+5y+9z)+b(2x+4y+3z)$$
$$=(13a+2b)x+(5a+4b)y+(9a+3b)z \qquad (9)$$

Compare the coefficients of the corresponding terms on both sides and obtain

$$\begin{cases} 13a+2b=1 \\ 5a+4b=1 \\ 9a+3b=1 \end{cases} \Rightarrow \begin{cases} a=\dfrac{1}{21}, \\ b=\dfrac{4}{21}. \end{cases}$$

Substituting it into (9), we get

$$x+y+z=\frac{1}{21}\times 9.25+\frac{4}{21}\times 3.20=\frac{1}{21}\times 22.05=1.05.$$

Although different methods of solving problems have different efficiency, they are a reflection of students'

individual thinking. By protecting students' individual thinking, it can make students more willing to explore multiple solutions to a problem, thus improving their mathematical problem solving skills and developing their own mathematical modeling ideas and problem solving thoughts.

C. Cooperative Learning Teaching Strategies

Cooperative learning has been a major teaching strategy for junior high school mathematics teachers, which emphasizes students to play the role of collaboration among peers and to carry out joint investigation and learning of cooperative learning contents. In the past, teachers usually use cooperative learning activities to cultivate students' cooperative and investigative skills, but in fact it has also become an important vehicle for cultivating students' innovative abilities.

For example, in the study of "primary functions", teachers set up the following problem: the cab fare in a city is as shown in the figure, the price remains the same within 3km, starting at 5 yuan. For the problem setting needs to be divided by the ability of different groups. For example, for the weaker groups, the teacher should simply ask: How much does it cost per 1km of travel after the starting mileage? For the more able groups, the teacher can ask a more difficult question: A foreign guest takes a cab to visit the city and the fare is 31 yuan, so find the mileage of the cab. For this problem, students need to build a mathematical model, segment the function, i.e., below 3km and above 3km, and then list the equations to find the answer.

In the group discussion session, each group member is allowed to express his or her views on the problem and the solution idea, and the representative of each group is chosen to report to the teacher. The difficulty of the project need not be too high, only that the students can get a good solution based on their knowledge and other information, but in this process, the teacher should ask each student to be responsible for one part of the project, and the combination of the parts that each group member is responsible for can become the innovative project. In this process, each group member will actively participate in the innovation project, which will cultivate students' sense of participation and exercise their creative thinking and innovation ability.

D. Reverse thinking teaching strategy

Mathematical thinking is of many kinds, including the ability to think in reverse. Mathematical concepts, definitions are always two-way, so in the teaching of concepts, in addition to let students understand the concept itself and its conventional application, but also good at guiding to inspire students to think in reverse, so as to deepen the understanding of the connotation and extension of the concept. As a mathematical proposition of definition, its inverse proposition always holds. Therefore, learning a new concept, if you pay attention to ask questions from the reverse direction, learning not only to identify the concept more clearly, understand more thoroughly, but also can develop students to develop a good

habit of considering the problem in both directions. However, not all the inverse propositions of theorems are correct, among which the Pythagorean theorem, the discriminant theorem of the roots of the quadratic equation, and the inverse theorem of Veda's theorem all exist and are widely used. Guiding students to explore the correctness of the converse proposition of the theorem not only completes what they have learned, but also inspires them to explore new knowledge.

For example, the example in Chapter 17, Section 2, "The converse of the Pythagorean Theorem" in the second book of the eighth grade of the Human Education Edition. As shown in Figure 1, a port P is located on the east-west coastline. "The ships "Voyage" and "Sea and Sky" leave the port at the same time, each sailing along a fixed direction. "One and a half hours after leaving the port, they are at points Q and R respectively, and are 30n miles apart. "Which direction is the Sea and Sky sailing?
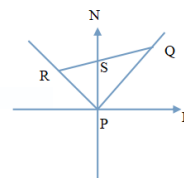

Fig. 1

The topic is a nautical problem in daily life designed as a mathematical problem, students first need to convert the language words into mathematical symbols, in this process, the teacher inspires and guides students to build geometric models, students will find in the established geometric model, the problem set actually gives the conditions of the three sides of the triangle, its form and the conclusion of the Pythagorean theorem in the same form, you can use the inverse theorem of the Pythagorean The inverse of the Pythagorean theorem can be applied to solve this real-life problem. In the process of solving the problem, teachers should give students space and time for independent thinking, encourage them to mobilize their own thinking skills to solve the problem, and constantly innovate so as to enhance their creative ability and innovative thinking.

IV. CONCLUSION

Teaching mathematical modeling in junior high school is an important part of junior high school mathematics teaching. In the process of teaching middle school mathematics, teachers should seize the requirements of modeling teaching, keep close to the problem, guide students to analyze the meaning of the problem, understand the known conditions and problems in the topic, choose a suitable mathematical modeling method, and finally answer the problem correctly. At the same time, in the process of modeling teaching, teachers should take students as the main body and let them model in the form of cooperative inquiry.

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Authors' biography with photos
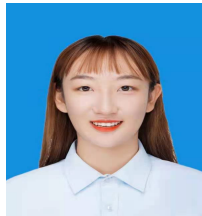
Xiao Yuan is a undergraduate in College of Mathematics and Statistics,Taishan University. She majored in math and applied mathematics (normal, no. 2017064022) and was in grade 2017. Her research interest is applied mathematics.

Liang Fang is a professor at Taishan University. He obtained his PhD from Shanghai Jiaotong University in June, 2010. His research interests are in the areas of cone optimization, and complementarity problems.