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On the cultivation of reverse thinking ability in high school mathematics teaching

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***Abstract*—With the continuous deepening of the new curriculum reform, the teaching mode and methods of high school mathematics are undergoing significant changes. In this context, the cultivation of reverse thinking ability is particularly important. It fully reflects the student-centered teaching philosophy, aiming to enhance students' divergent thinking, think about problems from multiple perspectives, optimize choices, and comprehensively improve their learning ability.**

The cultivation of reverse thinking ability occupies a core position in high school mathematics teaching, and its importance is self-evident. It can not only effectively stimulate students' innovative potential, but also significantly enhance their analytical, problem-solving, and expressive abilities. In order to achieve this goal, teachers need to actively guide students to quickly understand and master the concept of reverse thinking, and gradually cultivate students' reverse thinking ability through diversified teaching methods such as formula deformation and example analysis.

On the basis of in-depth analysis of the practical application value of reverse thinking in high school mathematics, this article will demonstrate the unique advantages of reverse thinking in the problem-solving process through specific examples. Meanwhile, we will focus on exploring how to effectively cultivate students' reverse thinking ability in high school mathematics teaching, in order to lay a solid foundation for their future learning and development.

***Index Terms*—Reverse thinking, divergent thinking, creative thinking, curriculum reform, contrary evidence method.**

I. INTRODUCTION

In high school mathematics teaching activities, the teaching of concepts and basic knowledge, as well as the explanation of example problems, are two crucial parts of the entire mathematics teaching process. During the teaching process, these two parts usually adopt two methods: guiding and leading students to practice. During the teaching process, teachers need to constantly pay attention to students' understanding and thinking abilities.

Reverse thinking, as a way of thinking that is opposite and unified with traditional thinking, demonstrates the ability to solve problems from a unique perspective. In the current rapidly developing era, reverse thinking is particularly important. It encourages us to examine and analyze problems from a brand new perspective, in order to discover unique solutions and enable complex problems to be solved more effectively [1-9]. Reverse thinking ability, as the name suggests, refers to a certain thinking process that is different or even opposite to a normal thinking process. But this thinking process can achieve the same thinking results as normal thinking, and even surpass the thinking speed of normal thinking to obtain thinking results faster and draw conclusions. In addition, reverse thinking can go through a thinking process that normal thinking has not experienced before, making it easier to observe problems ignored by normal thinking, and can better find perspectives to solve problems. At the same time, it also has stronger innovative thinking ability compared to normal thinking.

There are also many applications of reverse thinking in daily life, such as Guang Sima smashing a jar. In normal thinking, when a companion falls into the water, they need to be rescued to make them leave the water, in order to achieve the goal of rescuing the person. However, Guang Sima chose to go the opposite way and smashed a large hole at the bottom of the water tank, causing water to flow out of the tank, thus achieving the goal of separating people and water, and successfully rescuing the companion. Throughout this process, Guang Sima's thinking has always maintained one goal: to separate people from water. But in the process of rescuing "companions" from "water", they were hindered, and from another perspective, they smashed the water tank, causing "water to leave companions". This is a typical application of reverse thinking.

Teachers can use various methods of reverse thinking in high school mathematics classroom teaching, making students have a clearer understanding of the teaching content and more proficient in using various formulas, improving their attention and classroom efficiency. Teachers should pay special attention to the cultivation of students' thinking abilities while imparting mathematical knowledge and skills, which is in line with the urgent need for comprehensive talents in today's society. In order to achieve this goal, special attention should be paid to the cultivation of reverse thinking ability, so that students can analyze and solve problems comprehensively and deeply from multiple perspectives, thereby achieving flexible thinking transformation. During the teaching process, teachers should always adhere to the educational philosophy of "student-centered", deeply understand the characteristics and learning status of each student, and implement teaching strategies tailored to their individual needs. This can not only effectively improve students' mathematical level, but also comprehensively enhance their comprehensive quality, especially their ability to solve practical problems, laying a solid foundation for their future learning and career development.

II. THE ROLE OF REVERSE THINKING

Reverse thinking, as a novel mode of thinking, is unique in its ability to break free from the constraints of traditional frameworks and stimulate individuals' innovative potential to

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adapt to modern development. It encourages us to abandon fixed thinking patterns, unleash inner creativity, and explore unique solutions. Reverse thinking plays a crucial role in cultivating innovative thinking. When we use reverse thinking to examine problems, we often find that traditional ways of thinking have become inadequate in certain situations, unable to meet the needs and challenges of the new era. Reverse thinking provides us with a new perspective, guiding us to start from the opposite side of the problem. When seeking solutions to mathematical problems, the use of reverse thinking can bring us a more convenient and efficient approach, effectively avoiding tedious calculations and complex derivation processes. Especially when dealing with conventional mathematical problems, the advantage of reverse thinking is particularly significant. By inferring problems from the results, we can more directly reach the core of the problem, thereby gaining a deeper understanding and grasp of mathematical principles and concepts. This way of thinking not only improves problem-solving efficiency, but also promotes students' in-depth understanding of the essence of mathematics. This unique way of thinking not only helps us improve our problem-solving skills, but also enhances our overall grasp and understanding of the subject of mathematics.

A. Cultivate solid foundational knowledge for students

In mathematics teaching practice, if only relying on positive thinking, the classroom often appears monotonous and boring, and the teaching scope is easily limited by the textbook. Traditional teaching methods may sometimes make students feel bored, leading to a decrease in learning enthusiasm. However, the teaching method of introducing reverse thinking, with its unique dialectical and reverse nature, injects new vitality into mathematics teaching, thereby stimulating students' interest in learning. In the application process of reverse thinking, students need to deeply explore the essence and principles of the problem, and derive new conclusions through this speculative process. This teaching method not only requires students to master basic knowledge, but also encourages them to apply their learned knowledge for creative thinking, thereby building a more solid mathematical foundation., They also need to flexibly apply this knowledge. This in-depth thinking process encourages students to have a deeper understanding and memory of basic knowledge, thereby improving their mastery level.

Having a solid foundation of knowledge is crucial for students to perform well in the problem-solving process. Whether determining the definition range or value range of a function, it depends on these basic knowledge. The application of reverse thinking can help students discover and understand the internal logic and connections between knowledge, provide them with more problem-solving ideas and methods, and significantly improve problem-solving efficiency. Therefore, reverse thinking in mathematics teaching not only brings vitality to the classroom, but also effectively promotes the mastery of basic knowledge and the improvement of problem-solving ability of students.

Example 1. Find the domain of the function $f(x)=\sqrt{4-x^2}+\frac{1}{x+2}$.

Solution: According to the definition, the domain needs to satisfy $4-x^2\geq 0$ and $x+2\neq 0$, and thus the domain of the function $f(x)$ can be derived as $-2<x\leq 2$.

B. Cultivate creative thinking

In the teaching of high school mathematics, teachers focus on cultivating students' reverse thinking ability, helping them to explore mathematical knowledge and cultivate their skepticism. At the same time, students will not blindly believe in certain knowledge explained by teachers in the classroom [4], and can verify mathematical knowledge in the classroom through independent exploration, making students more flexible and conducive to innovative exploration of mathematical subjects [2].

In traditional high school mathematics classrooms, although students can understand the content taught by teachers, they often lack the ability to be flexible and reverse thinking when facing changes in question types, which to some extent affects the quality of teaching. In order to change this situation, teachers need to guide students to examine mathematical problems from the opposite or different perspectives, in order to stimulate their innovative thinking and independent exploration consciousness. In high school mathematics teaching, the appropriate use of reverse thinking can provide students with more entry points, ideas, and methods to solve problems. Reverse thinking encourages students to start from the opposite side of a problem or the opposite direction of the result, engage in reverse reasoning and exploration, and discover new problem-solving ideas and methods. This way of thinking can help students break through the limitations of traditional thinking, cultivate their innovative and independent thinking abilities.

Therefore, teachers should attach importance to the cultivation and application of reverse thinking in high school mathematics teaching, and guide students to use reverse thinking for thinking and exploration by designing challenging mathematical problems. At the same time, teachers should also encourage students to engage in more communication and discussion, share each other's problem-solving ideas and methods, in order to promote their thinking collision and innovation.

Example 2. Simplifies the result of $|1-x|-|x-4|$ to $2x-5$, and finds the range of values for x.

Analysis: The original formula is $|1-x|-|x-4|$.

According to the meaning of the question, $|1-x|-|x-4|$ needs to be transformed into $x-1-(4-x)=2x-5$.

From the perspective of absolute values, using reverse thinking to consider [3], the condition is derived as follows: $1-x\leq 0$ and $x-4\leq 0$,

The value range of x is $1\leq x\leq 4$.

C. Breaking fixed mindset

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The fixed thinking (inertia thinking) of students refers to some fixed thinking patterns or habitual thinking patterns formed during the learning process. In contrast, reverse thinking is a completely new and vastly different way of thinking, encouraging students to break free from conventional frameworks and examine and solve problems from different perspectives. Through the method of reverse thinking, students can start from the opposite side of the problem or the opposite direction of the result, and engage in logical reasoning and divergent thinking. This non-traditional way of thinking can stimulate students' creative potential and enable them to discover more innovative solutions. Teachers can design challenging and inspiring mathematical problems, encouraging students to think and solve from a reverse thinking perspective. When facing a difficult problem, they can first think about the opposite of the problem or assume that the problem has been solved, and then reverse deduce to find a way to implement this assumption.

This reverse thinking teaching method not only greatly enriches students' problem-solving ideas and significantly improves their problem-solving abilities, but more importantly, it can also effectively cultivate their innovative spirit and independent thinking ability. In the process of solving problems, students need to actively explore and deduce in reverse. This deeply participatory learning method enables them to understand the problem more deeply and propose unique solutions. We calculate the value of the parameter a by finding the maximum value of the function $f(x)$ with the known parameter a. For such problems, following the conventional approach may tend to classify and discuss parameters. However, when we re-examine the problem in detail, we realize that there is no need for tedious classification discussions, in order to find a more concise solution.

Example 3. Given that the minimum value of the function $f(x)=ax-\ln x$ is 3, find the value of the real number a.

Analysis: According to the meaning of the question, it is known that $f(x)=ax-\ln x\geq 3$ is always true, and the existence of a real number x makes the equal sign true, so

$$a=\left(\frac{3+\ln x}{x}\right)_{\max}.$$

However, using the derivative method, it is easy to know that

$$\left(\frac{3+\ln x}{x}\right)_{\max}=e^2,$$

so $a=e^2$.

III. Strategies for Cultivating Reverse Thinking Ability in High School Mathematics Teaching

In today's society, innovation and thinking abilities have become increasingly important competitive advantages. Reverse thinking, as a highly effective way of thinking, often breaks conventions and finds new ways to solve problems. However, cultivating reverse thinking is a process that requires long-term practice and patience.

A. The cultivation goal of reverse thinking

Firstly, it is necessary to challenge conventions. When students face a problem, they usually think according to habitual thinking. However, to cultivate reverse thinking, they need to try to approach the problem from the opposite perspective. Taking the opposite approach may bring different inspirations. Secondly, it is necessary to exercise the ability to solve problems. You can choose some challenging problems and try to solve them using methods different from conventional methods. This exercise can help students gradually master the technique of reverse thinking and cope with more complex problems. Next, you can learn example problems, and learning reverse thinking example problems is also an effective method. At the same time, it is necessary to maintain an open mindset. Due to the pressure of academic advancement, high school students generally tend to maintain the status quo and find it difficult to accept new understanding methods and problem-solving skills. This requires teachers to guide students in daily teaching activities, allowing them to accept and try new understanding methods and problem-solving skills. Do not immediately reject ideas that do not conform to conventional thinking, but try to understand them, which may lead to unexpected gains. In addition, curiosity should also be cultivated to cultivate an interest in learning reverse thinking. Interest is the best teacher and a necessary condition for reverse thinking. Maintaining curiosity about unknown things and being brave enough to explore unknown fields can help students discover new perspectives and perspectives, providing more possibilities for reverse thinking. The last and most important point is to constantly practice. Reverse thinking requires time and practice to cultivate and polish. Everyone will be confused and confused at the beginning when they are exposed to reverse thinking, because reverse thinking is opposite to normal thinking, which will make students repeatedly make mistakes in the process of trying. However, teachers should guide students not to expect to be proficient in using it immediately, but to have patience and continuous efforts. Through continuous practice and experimentation, we can gradually improve our reverse thinking ability and lay a solid foundation for future development.

B. Strategies for cultivating reverse thinking

Many concepts in mathematics need to be taught to students to think and understand from both positive and negative perspectives. Among them, thinking in the opposite direction is reverse thinking. Thinking in the opposite direction is reverse thinking. So, how to apply for effective cultivation of reverse thinking in high school mathematics teaching?

(1) Cultivate reverse thinking ability while strengthening the understanding of mathematical concepts and knowledge

Concepts are the essential attributes of objective things that have been accumulated through long-term practice and reflected in people's minds, usually presented in the form of a summary of one or two sentences. When understanding mathematical concepts, if we use "reverse" thinking, we can

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explore the conditions, features, and characteristics contained in the concepts, which helps us to have a deeper understanding of the essence of the concepts.

In high school mathematics learning, students will encounter numerous concepts, both intuitive and abstract, the latter often being more challenging. In order to help students deeply understand and firmly grasp these core concepts, teachers must adopt a teaching approach that is both scientific and rational, and pay attention to heuristic teaching. Direct and positive explanations can sometimes be difficult for students to fully understand certain complex concepts, and may even lead to misunderstandings. Faced with this challenge, teachers should deeply analyze the characteristics of these difficult knowledge and flexibly adjust teaching strategies. Reverse thinking is an effective tool that can help students understand concepts from another perspective and gradually build a comprehensive understanding of concepts. Through reverse thinking, students can construct their knowledge structure more clearly, accurately grasp the essence and meaning of concepts, and significantly improve the effectiveness of concept teaching.

For example, in the teaching of sets, teachers should let students know that when set A is a subset of set B, set A intersects set B, which is equal to set A. Conversely, when set A intersects set B, which is equal to set A, it is known that set A is a subset of set B. Teachers can use this to exercise students' reverse thinking.

(2) Cultivate students' reverse thinking ability in the application of mathematical formulas

When analyzing and explaining formulas, students can also be trained in reverse thinking, which is beneficial for solving certain problems and enabling them to have a clearer understanding of the essence of formulas, enabling them to learn knowledge efficiently. In high school mathematics, students often encounter formulas closely related to problem judgment, but due to differences in their knowledge structure and personal ability levels, their understanding of these formulas is often uneven. When teachers use traditional positive explanations, some students may feel confused or difficult to understand. In order to help students better grasp these formulas, teachers can cleverly use reverse thinking to guide students to understand the meaning of the formulas from another perspective. Reverse thinking can break traditional thinking patterns, allowing students to start from the results, deduce the formation and application of formulas in reverse, and thus gain a deeper understanding of the mathematical principles and logic behind them. In order to deepen students' understanding, teachers can use the teaching method of giving examples. By carefully selecting several typical examples, teachers can enable students to experience the application of formulas in specific problem situations, thereby gaining a clearer understanding of the expression methods and application scenarios of formulas. These examples should be representative and cover different uses and variations of formulas, so that students can comprehensively master the application skills of formulas. In short, by using reverse thinking and examples as teaching methods, teachers can help students better understand and master the relevant formulas in middle school mathematics, improve their mathematical abilities and thinking levels, and lay a solid foundation for their future learning and career development.

When memorizing formulas, it is not only necessary to remember them from a positive perspective, but also to learn to "reverse remember" and "reverse write". In order to effectively cultivate students' reverse thinking ability, teachers need to develop a comprehensive and systematic training plan. Reverse thinking, as a valuable thinking habit and skill, is not formed overnight, but requires long-term practice and exercise. In curriculum planning, teachers should consciously incorporate reverse thinking training activities.

For example, when teaching mathematical formulas, in addition to conventional derivation and application explanations, teachers can design some challenging reverse thinking problems. These questions can require students to start from the conclusion of the formula and deduce its possible sources or prerequisites in reverse, thereby forcing students to examine the problem from a new perspective. Through group discussions or independent thinking, students can gradually develop the habit of reverse thinking in the process of solving problems. At the same time, teachers also need to guide students to understand the logic and assumptions behind mathematical formulas. In practical applications, these assumptions may not always hold, so teachers can encourage students to use reverse thinking and think about how to make necessary adjustments or improvements to the formula to adapt to different application scenarios. This teaching method not only cultivates students' innovative thinking, but also enhances their knowledge transfer and problem-solving abilities. In short, through carefully designed reverse thinking training programs, incorporating training activities into the curriculum, and guiding students to think creatively, teachers can effectively enhance students' reverse thinking abilities, help them understand mathematical knowledge more deeply, and improve their ability to solve practical problems.

Teachers can explain the characteristics of basic mathematical formulas and allow students to deduce advanced formulas in reverse from basic mathematical formulas. For example, in trigonometric functions, after correctly understanding the rising power formula

$$\cos^2 a = \frac{1+\cos 2a}{2},$$

teachers can guide students to use the double angle formula to deform and reverse derive

$$\sin^2 a = \frac{1-\cos 2a}{2}.$$

In order to deepen students' understanding of mathematical formulas and encourage them to discover the internal connections and patterns between formulas, teachers can cleverly introduce reverse thinking training. This training strategy not only helps significantly improve students' reverse thinking ability, but also effectively improves their learning efficiency and ability to independently solve problems.

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Taking the derivative formula in high school mathematics as an example, teachers can guide students to engage in deep learning through reverse thinking training. In this training mode, students will no longer just passively accept formulas and conclusions, but will start from the known derivative results and deduce the original function in the opposite direction. This reverse derivation process will force students to delve deeper into the logical relationship between derivatives and the original function, thereby gaining a more comprehensive understanding of the essence and application of derivatives. Through reverse thinking training, students will learn to examine problems from a new perspective and discover the patterns and patterns behind mathematical formulas. This training method can not only stimulate students' interest and curiosity in learning, but also cultivate their innovative spirit and critical thinking. When solving practical problems, students will be able to apply their learned knowledge more flexibly and propose innovative solutions. Therefore, teachers should actively explore effective methods of reverse thinking training in mathematics teaching and integrate them into daily teaching activities. Through carefully designed reverse thinking training questions and cases, guide students to think deeply and explore, thereby comprehensively improving their mathematical literacy and problem-solving abilities.

Example 4. Simplify

$$\sin 12^\circ \cos 48^\circ + \cos 12^\circ \sin 48^\circ.$$

Analysis: Students are usually accustomed to using positive thinking to solve problems. Teachers should guide students to use reverse thinking to come up with problem-solving methods, using the formula F $\sin(A+B) = \sin A \cos B + \cos A \sin B$ to obtain

$$\begin{aligned} &\sin 12^\circ \cos 48^\circ + \cos 12^\circ \sin 48^\circ \\ &= \sin(12^\circ + 48^\circ) \\ &= \sin 60^\circ \\ &= \frac{\sqrt{3}}{2}. \end{aligned}$$

So as to quickly and effectively solve the answer. When explaining formulas, teachers should not only explain from a positive thinking perspective, but also guide students to transform their practice from positive thinking to reverse thinking. This transformation helps students to have a more comprehensive understanding of formulas and cultivate their ability for reverse thinking.

(3) Cultivate reverse thinking ability by using the method of contradiction in solving high school mathematical problems

The method of contradiction is an important manifestation of reverse thinking, commonly used in the process of proving or solving problems. The core step of proof by contradiction is to construct a hypothesis that is contrary to the expected conclusion, followed by logical deduction and verification. During the derivation process, if it is found that the hypothesis contradicts known axioms, definitions, propositions, or theorems, it can be proven that the original hypothesis is not valid, thereby confirming the correctness of the original conclusion. This method effectively proves the authenticity of the conclusion through reverse logic.

The cultivation of reverse thinking in students can provide excellent opportunities in problem-solving. When assigning homework, teachers use reverse thinking as a way to help students solve problems and achieve the cultivation and training of reverse thinking. Reverse thinking is often an effective strategy in solving judgment and proof problems. Teachers should give students sufficient time to think and analyze when introducing such question types. When students face difficulties, teachers should provide timely guidance on their thinking and encourage them to use reverse thinking to analyze and answer questions. This method not only exercises students' thinking ability, but also enhances their ability to use their thinking to solve practical problems, making them more efficient in the problem-solving process.

Example 5. How to prove that the minimum positive period of a sine function is 2π ?

Analysis: 2π is a period of a sine function. To prove that 2π is the minimum positive period of a sine function, simply prove that any positive number less than 2π is not a period of the sine function. So, using the method of proof by contradiction, the following proof is provided:

Let T be a positive number less than 2π , T is the period of a sine function. According to the definition of a periodic function, when x takes a value within the domain, there is always $\sin(x+T) = \sin x$. Taking $x = \frac{\pi}{2}$ yields $\sin\left(\frac{\pi}{2} + T\right) = 1$, which means $\cos T = -1$. Furthermore, according to the definition of cosine function, the equation holds when $T = (2k+1)\pi \ (k \in Z)$, and regardless of any integer k takes, there is $T = (2k+1)\pi (k \in Z)$, which contradicts $0 < T < 2\pi$. This contradiction is due to the assumption that there is a positive number T smaller than 2π that can become the period of a sine function. Therefore, any positive number less than 2π is not the period of a sine function, that is, the minimum positive period of a sine function is 2π .

(4) Cultivate students' reverse thinking ability through counterexamples in the process of mathematics teaching

Constructing counterexamples is a commonly used reasoning method in the teaching process. When we solve a mathematical problem, we can give an example for necessary verification, and then verify the correctness of our thinking, which is also a manifestation of rigorous thinking. By using counterexamples, students can learn to think in reverse. Counterexamples are a commonly used problem-solving method in mathematics for students, which often helps them break free from established thinking patterns, break

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traditional thinking patterns, and improve problem-solving efficiency. [10] examined the development and refinement of possible mathematical models for the intellectual system of career guidance. Mathematical modeling of knowledge expression in the career guidance system, Combined method of eliminating uncertainties, Chris-Naylor method in the expert information system of career guidance, Shortliff and Buchanan model in the expert information system of career guidance and DempsterSchafer in the expert information system of career guidance method has been studied. The algorithms of the above methods have been developed. [11] discussed that according to the observations in this paper, an existing mathematical model of banking capital dynamics should be tweaked. First-order ordinary differential equations with a "predator-pray" structure make up the model, and the indicators are competitive. Numerical realisations of the model are required to account for three distinct sets of initial parameter values. It is demonstrated that a wide range of banking capital dynamics can be produced by altering the starting parameters. One of the three options is selected, and the other two are eliminated.

Example 6. Proves that two intersecting chords of a circle that are not diameters cannot be divided equally.

Analysis: It is difficult for us to prove from the front, and we can use the method of proof by contradiction. Assuming that the two intersecting chords of a circle O that are not diameters can be divided equally. In circle O, the chord AB intersects with the chord CD at point P, and, $AP = BP$, $CP = DP$, Connect OP.

Since $AP = BP$, so $OP \perp AB$ (the diameter of the half chord is perpendicular to the chord).

Similarly, it can be inferred from $CP = DP$ that $OP \perp CD$.

Therefore, there are two different lines, AB and CD, perpendicular to OP when passing through point P, which contradicts the assumption that there is only one line perpendicular to the known line when passing through point P. Therefore, the hypothesis does not hold and the original proposition holds.

(5) Cultivate reverse thinking ability through reverse variant training in teaching

In mathematics classroom teaching, the bidirectional nature of mathematical definitions provides rich avenues for problem-solving. With a deep understanding of mathematical definitions, teachers are able to accurately grasp their true meaning and apply it to the problem-solving process. However, many students are often unfamiliar with the reverse application of definitions. In order to effectively enhance their reverse thinking ability, teachers need to strengthen training in the application of reverse definition. In this process, teachers can guide students to learn how to freely transition between definitions and conclusions, and gain a deeper understanding of the inherent relationship between positive and negative definitions. Through such training, students can better master the technique of reverse thinking, improve problem-solving ability and mathematical literacy.

As a teaching method, "reverse transformation" generates new types of questions similar to the original proposition through the mutual transformation of known and proven, which helps to cultivate students' reverse thinking [5]. In order to effectively implement "reverse variant" teaching, teachers need to take a series of training measures. Firstly, clarify teaching objectives to ensure that students master core knowledge and methods. Secondly, design reverse tasks, such as asking students to answer the opposite of a problem or infer the reason from a result, to challenge their thinking ability. At the same time, provide necessary support and feedback to help students correct errors and deepen understanding. Finally, summarize and evaluate the performance of students to guide them in improving their learning methods. When solving trigonometric function problems, it is particularly important to apply the definition in reverse. By reverse thinking about definitions, students can be more flexible in solving related problems, improving problem-solving efficiency and accuracy. Therefore, teachers should strengthen the explanation and training of the inverse application of trigonometric function definitions in teaching, help students cultivate reverse thinking, and improve problem-solving abilities.

(6) Cultivating Students' Reverse Thinking Ability through Proposition Transformation

In the process of solving high school math problems, teaching fish is better than teaching fishing. Instead of only teaching mathematical knowledge and problem-solving methods, it is better to guide students to establish a mathematical way of thinking, guide them to analyze and explore problems from various perspectives, and help them clarify their problem-solving ideas and improve their problem-solving abilities. Proposition is a common problem in the process of solving high school mathematics problems, whether it is the original proposition, inverse proposition, negation proposition, or inverse negation proposition. So we can gradually cultivate students' reverse thinking ability through proposition transformation. For example, it is difficult for students to find a breakthrough point from a positive thinking perspective when dealing with an original proposition. Therefore, teachers can guide students to explore from different perspectives. For example, when encountering propositions of trigonometric functions, design some inverse propositions for students to make judgments and guide them to use reverse thinking to break away from inherent thinking patterns, so that students can activate their thinking from the perspective of changing propositions and improve problem-solving abilities.

(7) Strengthening Students' Reverse Thinking Training

Reverse thinking training is a unique thinking method aimed at cultivating students' innovative thinking by transforming known and proven problems into new problems similar to the original problem but with different perspectives. In the process of researching and solving problems, students are no longer limited to traditional linear thinking patterns, but are guided to explore in the opposite direction of habitual thinking. The core idea of reverse thinking training is: when forward reasoning encounters

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difficulties, try reverse reasoning; If a direct solution cannot solve the problem, consider other non-traditional thinking paths.

Example 7. If x_1, x_2 is the two roots of equation $x^2 - 3x + 1 = 0$, find the value of $x_1^2 + x_2^2$.

Analysis: This problem can be solved more easily by simply using definitions forward or backward, and combining them with the relationship between roots and coefficients. In order to accurately understand and grasp many aspects such as definitions and concepts, it is necessary to think from both positive and negative perspectives, such as the definition of square roots; The influence of k, b on image distribution in the first-order function $y = kx + b$, and the influence of a, b, c on image opening direction, intersection with x and y axes, and symmetry axis in the univariate quadratic function $y = ax^2 + bx + c$. I will not list them one by one here.

IV. CONCLUSIONS

In high school mathematics teaching, the training of reverse thinking has a significant effect on improving students' problem-solving ability. This type of training enables students to flexibly apply various mathematical concepts and knowledge, associate more innovative methods and ideas, and explore more sophisticated and in-depth problem-solving strategies. This greatly expands the path and perspective of students in solving mathematical problems.

High school mathematics places high demands on students' thinking and logical abilities due to its depth and breadth. In order to cultivate these key abilities of students, teachers should fully recognize the importance of reverse thinking training and actively guide students in this area of training. Through the training of reverse thinking, students can not only achieve better grades in mathematics learning, but also apply this way of thinking to learn and understand new knowledge in daily life, improving learning efficiency.

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