

# The Study on Cultivating Students' Mathematics Problem Consciousness in Senior High School Classroom Teaching

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## Abstract

Innovation education is the core and key of quality education. And the key of innovation lies in whether students have strong problem consciousness. The importance of problem consciousness in the mathematics teaching is becoming more and more prominent and has aroused much attention. However, from education status, we can see that senior high school students are severely lacking in mathematical problem consciousness. This paper focuses on the cultivation of senior high school students' problem consciousness in mathematics classroom teaching, which has four parts. The first part is the research background and the research status. The second part presents the survey data for the status quo of senior high school students' mathematical problem consciousness. The third part focuses on the reasons why senior high school students lack mathematical problem consciousness and carries on research from two aspects, which are students themselves and school education. The fourth part, which is the key of this paper, mainly discusses the teaching strategies of cultivating senior high school students' problem consciousness in mathematics classroom teaching. The fifth part is the summary and reflection.

## Keywords

Problem Consciousness, Mathematical Problem Consciousness, Classroom Teaching, Teaching Strategies

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## 1. Research Status and the Implication of Problem Consciousness

### 1.1. Research Background

At present, people are in a highly competitive and unpredictable society with rapid development of science and technology. Facing the challenge of the know-

ledge economy era, it has become the common direction of educational reform and development all over the world to cultivate innovative talents with practical ability, innovative spirit, humanistic quality and scientific accomplishment.

Innovation originates from innovative consciousness whose essence is problem consciousness. Tao Xingzhi has said, "Creation begins with problems, and when there are problems, they think. Only by thinking can we solve the problems in order to find the possibility of independent thinking." [1]. Therefore, all meaningful innovations come from whether students have a high problem consciousness. If there is no problem, there will be no innovation, let alone development.

## 1.2. Research Status

The attention to problem consciousness can be traced back to Confucius, the great educator and philosopher of ancient China. Confucius believes that "learning without thinking leads to confusion; thinking without learning is perilous". He also pointed out the relationship between learning and problem consciousness. Confucius adopted the heuristic teaching method during the long-term teaching practice. He says "Never try to enlighten him who does not feel urgent to get rid of the blocks in the way in his learning; never teach him proper words; never go on with your efforts to furnish him with anything new who cannot infer the other three corners of a square object though you have already provided him with sufficient knowledge about one corner." [2]. He believes that the duty of teachers is not only to impart knowledge, but also to teach students how to think, how to skillfully use knowledge. And the ultimate goal of education is to develop students' thinking.

Later, the ancient Greek philosopher Socrates proposed "Socrates method", also called "midwife". The so-called "Socratic Method" is that the teacher guides students to speak out their views on specific problems in the process of communication, points out the contradiction in students' discourse which enables students to identify that they know nothing about this issue, and then helps the students to recollect the knowledge. This method is like a midwife helps the puerpera to give birth to babies, which enables students to gradually master the definition and concept clearly [3]. This is a unique teaching method formed by Socrates in practice. This method attaches importance to the communication and interaction between teachers and students, which is conducive to the development of students' problem thinking. It also can help the students to form the self-concept and independent personality in the push of problem consciousness.

From the end of nineteenth Century to the beginning of twentieth Century, American pragmatism educator Dewey [4] put forward the theory of modern pedagogy against Herbart, advocating "education is life", "education is growth", "education is constantly changing experience", and "school is society". He paid attention to students' independent discovery and experience in the teaching process, which has a far-reaching impact on today's education.

After Dewey, there have been a lot of researchers and writings about problem

consciousness. Nowadays, the cultivation of senior high school students' problem consciousness has been paid more and more attention by educators. There are also a number of statements about the concept of problem consciousness. Now the widely used concept in China is proposed by Professor Yao Benxian of Anhui Normal University.

### **1.3. The Implication of Mathematical Problem Consciousness**

In his article "On the cultivation of senior high school students' problem consciousness", Professor Yao Benxian once said, "Problem consciousness refers to the doubtful, confused, anxious and psychological state which generates because of some doubts or practical and theoretical problems in cognitive activities. This state drives the people to think positively, to raise questions constantly and solve questions. It is the psychological quality of problems." [5].

As for mathematics, the mathematical problem consciousness refers to the psychological quality of exploring and discovering new knowledge. This psychological quality is formed by the reflection and re-ask of original mathematical problems or the thinking and exploration of new questions in the process of mathematics learning. Thus, mathematical problem consciousness not only means to propose and solve a mathematical problem, but also means the psychological state of students to the objective things. It is a discovery process to explain the connotation of problems. In short, mathematical problem consciousness is a kind of quality which can actively find problems, a kind of spirit which dares to doubt and a kind of consciousness which has the courage to explore.

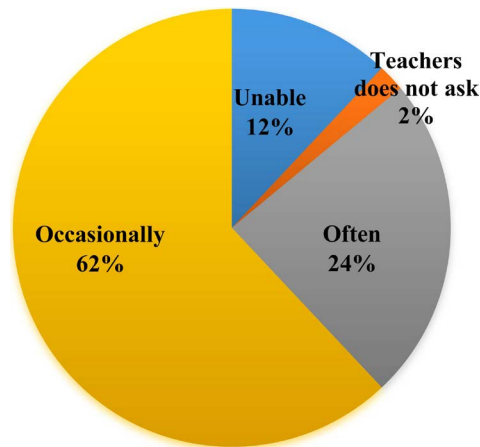
## **2. A Status Survey of Students' Problem Consciousness in Senior High School Mathematics Classroom Teaching**

In order to know the basic situation of the students' problem consciousness in senior high school mathematics classroom teaching clearly, and to study the reason of lacking of mathematical problem consciousness, I use questionnaire method to do the survey. I randomly selected 100 students from a senior high school and launch an investigation from three aspects: the status of students answering questions, the status of students thinking and asking questions actively and the reasons of not asking questions. And the data obtained were analyzed and processed to make a true and objective investigation. The findings are as follows and the contents of the questionnaire are shown in **Appendix**.

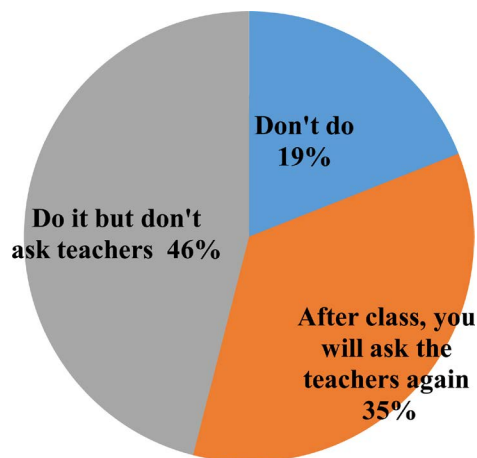
### **2.1. Senior High School Students Have Less Initiative to Ask Questions and Less Consciousness of Problems**

**Figure 1** shows that 62% of the students only sometimes answer the teacher's questions; only 23% of the students frequently answer the teacher's questions; and 15% of the students even can't answer the teacher's questions.

For the questions that teachers have no requirement, it can be found in the **Figure 2** that only 35% of the students can take the initiative and can study after



**Figure 1.** The status of students volunteering to answer questions in math class.



**Figure 2.** Students' practice for the questions that teachers have no requirement.

the class. And half of the students take the attitude of trying. If they can't do it, they will not ask their teachers. 19% of the students even do not take the initiative to think about these questions.

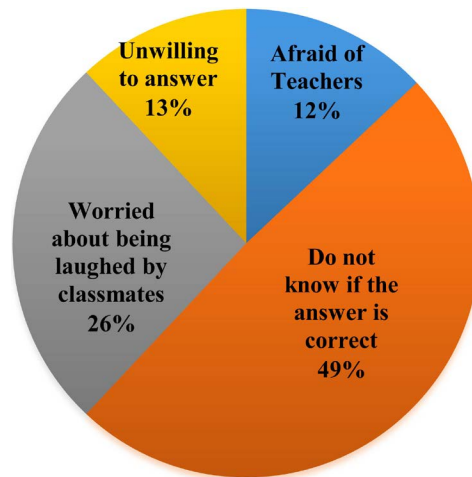
Thus, the initiative and problem consciousness of senior high school students are very weak.

## 2.2. The Main Reason Why Senior High School Students Fail to Ask Questions in Class Is Because They Are Not Confident

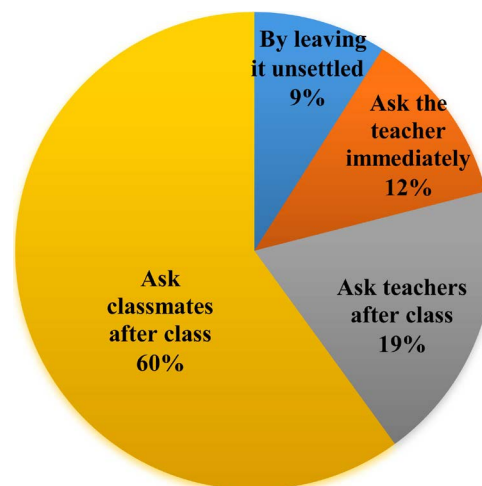
**Figure 3** shows that nearly 50% of the students can't ask the teacher's questions because they are not sure whether their answers are correct; 26% of the students are afraid of being laughed by their classmates; and 12% of the students were afraid to answer; 13% of the students are reluctant to answer.

## 2.3. The Communication between Students and Teachers in Math Class is Insufficient

**Figure 4** shows that there are only a few students in the math class who will ask the teacher immediately when they meet questions that don't know; 19% of the students will ask the teacher after class. However 60% of students choose to



**Figure 3.** The reasons for not being able to ask questions in math class.



**Figure 4.** Students' practice to solve the difficult problem in math class.

communicate with their classmates; and even 9% of the students don't care about the problem.

Therefore, teachers and students can't communicate well.

#### **2.4. The Communication between Students and Teachers in Math Class is Insufficient**

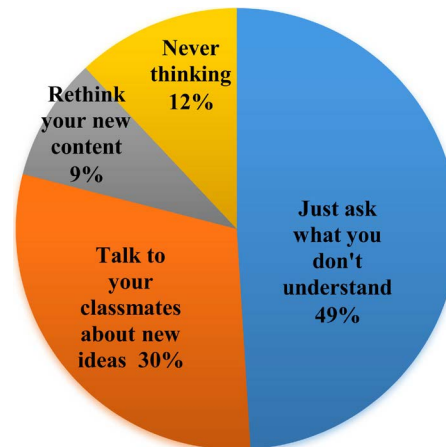
It can be found in **Figure 5** that less than 10% of the students will rethink their new content. Nearly half of the students only ask questions they didn't understand; 12% of students just study in the class and never think after class.

It can be seen that senior high school students have poor self-reflection and comprehension.

### **3. The Reasons for Senior High School Students Lacking of Mathematical Problem Consciousness**

#### **3.1. Students Themselves**

For the reasons of students themselves in lacking of mathematical problem con-



**Figure 5.** The status of rethinking what they've learned after class.

sciousness, I mainly study from two aspects which are the learning motivation and learning attitude.

Motivation is mainly divided into two aspects: intrinsic motivation and extrinsic motivation. Intrinsic motivation means that the student's learning goal points to the learning activity itself. Learning activities can make students get emotional satisfaction, arouse their interest in finding and asking questions, and make them produce a sense of happiness [6]. Therefore, an important reason for senior high school Students lacking of mathematical problem consciousness is that their intrinsic motivation of mathematics learning is not enough.

In addition, learning attitude can reflect the initiative of a student. Some students just imitate teachers' behavior in math class, who are reluctant to think. They have great inertia and have bad learning motivation, which leads to "can not ask". Some students are afraid to affect their thought, so they do not dare to express even if they have questions, which results in "do not dare ask". Besides, some students worry about the question is too simple or worthless, which might cause the teacher and classmates ridicule. Thus, their inner inferiority and cowardice lead to "not willing to ask". Over time, due to these reasons, students' mathematical problem consciousness is becoming more and more lacking.

### 3.2. School Education

On the one hand, many teachers in the traditional mathematics teaching focus on the solution of questions but ignore the reflection. Plus mathematical knowledge is highly required for abstractive thought and logical thinking. Students have to remember and imitate mechanically teachers' steps in problem-solving, so that they will become a puppet under the examination-oriented education system, which lead to students' mathematical problem consciousness is weak. On the other hand, some teachers adopt many teaching methods like training inflexibly by stuffing exercises and grade-oriented practices in order to pursue high enrollment rate. So that most senior high school students focus on fractions and lose their hands-on skills, which is not only can't reach the purpose of effective education, but also easy to cause students' rebellious attitude, leading to they

fear of learning.

#### **4. Strategies of Cultivating Students' Problem Consciousness in Senior High School Mathematics Classroom Teaching**

Problem-solving as one of five standard competences in mathematics mentioned by NCTM (National Council of Teachers of Mathematics) [7] not only develops individuals' conception about aspects of mathematics, but also it helps to adapt to various problems in many aspects of their lives [8]. However, The premise is that you have a good problem consciousness if you want to solve the problem. "It is the question that inspires us to learn, to develop, to practice and to observe," says by Popper, a British famous scientific methodology scholar. Therefore, math teachers should optimize the classroom teaching in time, cultivate students' mathematical problem consciousness and improve their ability of solving problems.

##### **4.1. Update the Educational Concepts and Cultivate Students' Innovation Consciousness**

The lack of mathematical problem consciousness in senior high school is partly due to the long-term impact of examination-oriented education. A slight incompetence teacher in teaching lead to an enormous impact on the students' lack on mathematical ability [9]. Therefore, teachers must change the educational ideas and update the educational concepts to change this situation.

First, teachers should set up a positive and correct view of mathematics education and teaching. Mathematics education should not only teach students the basic knowledge of mathematics, but also guide them to explore independently and get methods of solving problems. It is so called "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime".

Second, teachers must set up a new view of mathematics teaching, and break the teaching mode of spoon-feed teaching. Besides, teachers should change "teaching centered" into "learning centered" and achieve "teaching material" to "teaching with teaching materials". By this way, teachers can fully explore and use the rich resources of "mathematics in life" and "interesting mathematics" to guide students to raise and explore questions.

At the same time, teachers must set up a new type of evaluation and fully understand the process and result of senior high school students' math learning, which is beneficial to the cultivation of students' mathematical problem consciousness, the improvement of the ability of solving problems and even the development of a variety of intellectual potential and perfect personality.

##### **4.2. Create a Good Classroom Atmosphere and Inspire High School Students' Curiosity**

According to Suherman [10] mathematics is a formation of affectives mathematics towards to the formation of cognitive area, although sometimes the opposite occurs [9]. So, teachers should fully respect students' principal status in

the mathematics classroom teaching, create a harmonious, democratic and relaxing classroom atmosphere in order to eliminate students' tension and anxiety in class and cultivate students' mathematics problem consciousness.

First, teachers should construct a harmonious teacher-student relationship, and treat each student equally. Meanwhile, teachers should focus on students' individual differences and cultivate their divergent thinking. Second, math teachers should give praise and correct guidance when students raise questions at ordinary times. Meanwhile teachers should encourage students to question boldly and raise more valuable questions. Through this, the teachers can improve students' mathematical problem consciousness. In addition, teachers should also actively create a good questioning atmosphere and guide students to think independently and find the problem in the classroom, which really puts the student as the main body.

### **4.3. Create Reasonable Problem Situation and Inspire Students to Ask Questions**

As the saying goes, "Inquiry begins with the problem, and the problem arises from the situation." Teachers should take cultivating senior high school students' mathematical problem consciousness as the goal to create a reasonable mathematical situation, to stimulate students' curiosity and thirst for knowledge and to encourage them to imagine, think and explore actively. Through this, teachers can arouse students' interest in learning mathematics and wake up their mathematical problem consciousness.

"Teaching is a science and an art". The creation of the problem situation should also pay attention to art and strategy. Teachers should be guided by the principles of being close to life, to students and conforming to the logic of mathematics. And they should also dig out the relationship between situations and problems deeply. The creation of a mathematical problem situation should be highly targeted, guided, interesting and interactive. Teachers can first create problem situations of life. The teachers can let students fully realize the close relationship between mathematics and real life and feel that mathematics originates from the life and serve life based on the actual application of mathematics in daily life, which can stimulate students' mathematical problem consciousness. Second, teachers can create a problem situation of interesting plots. The interesting stories can make students think actively and arouse students' curiosity and thirst for knowledge.

### **4.4. Grasp the Time and Leave Full Time for Students to Think**

Teachers must grasp the time in the class. They should not only teach knowledge, but also give students enough time and space to think and to consolidate the new knowledge. Besides, teachers should consciously leave students some problems which need students to jump to solve and let students themselves explore so as to continuously improve the students' mathematical problem consciousness.



In addition, the lack of opportunities for hands-on and social practice also leads to the lack of senior high school students' consciousness and ability to ask problems. Therefore, the school needs to arrange teaching time reasonably, set up self-practice activities in different sections and encourage students to participate, which can leave students some time to participate in practical activities. This can not only make students experience the pleasure of practice and achieve success, but also improve their mathematical problem consciousness.

#### **4.5. Pay Attention to the Reflection in Mathematics Classroom Teaching Process**

Posner illustrated the importance of reflection by means of mathematical formula "growth = experience + reflection". Based on the investigation of the students' mathematical consciousness, it can be found that the students' level of reflection in the course of mathematics teaching is poor. So, teachers should focus on improving students' reflective ability in the process of mathematics teaching and leave proper time for students to comprehend and reflect. Meanwhile, teachers should organize students themselves to summarize contents and methods of the classroom before teachers conclude. In this way, students not only can understand the knowledge as a whole and take the initiative to accept new knowledge, but also be more active in reflection, questioning, summarizing and developing. At the same time, teachers should take the language of doubt to strengthen students' consciousness of reflection in the process of mathematics classroom teaching, such as "Is there a better way to this question?" or "Can this method solve other mathematical questions?" or "Who can sum up the contents and the methods of this lesson?". So that, students can raise more questions and then improve their mathematical problem consciousness.

### **5. Summary and Reflection**

Sukhomlinsky once said: "There is a deep-rooted need in the depths of the human mind, which is that you want to be a discoverer, a researcher and an explorer. And the need is particularly strong in the spiritual world of children." [11]. If a student has a clear consciousness of problem, he will not be mediocre. And, he's not going to be a conformist. He does not want to simply imitate the steps of others. He will exert his own subjective consciousness, dare to think independently, and explore the creation. Meanwhile, he will take the initiative to find questions, to ask questions, to analyze questions and to solve them.

In short, teachers should focus on cultivating students' mathematical problem consciousness and improving students' ability of solving problem in the senior high school mathematics classroom teaching.

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## Appendix

### The Status Quo of Problem Consciousness of Senior High School Students in Mathematics Classroom Teaching

Dear classmates:

Hello! In order to understand some basic facts in mathematics classroom teaching, we invite you to take part in the survey. Thank you for your cooperation, please choose the appropriate answer to each question according to your actual situation, note that only one answer. These following questions, whatever the consequences are, are only used for scientific research. We will be absolutely confidential about the result of answer, please be sure to carefully and answer each question, your answer is very important for our study.

Thank you very much for your cooperation.

#### Basic Information

School: \_\_\_\_\_ Level: \_\_\_\_\_ Gender: \_\_\_\_\_

#### Survey project

1. Can you take the initiative to answer the teacher's questions in math class?  
A. Can't      B. Occasionally  
C. Often      D. Teachers don't ask questions
2. Do you often ask questions in math class?  
A. Always      B. Often      C. Occasionally      D. Never
3. Do you like the teacher to give you a clue when you do some hard work in math class?  
A. Like      B. Don't like      C. Can't be sure      D. Hate
4. Do you dare to ask questions in math class?  
A. Don't dare      B. Occasionally dare  
C. Dare      D. Ask questions after class
5. What would you do if you didn't understand what the teacher said in math class?  
A. Ask teachers      B. Ask classmates      C. Ask parents      D. Don't care
6. Do you think teachers in math class treat every student equally?  
A. Yes      B. General      C. Not      D. Very good
7. The teacher responds to the student's answers in a timely and appropriate manner in math class.  
A. Agree      B. Basically agree      C. Do not agree      D. Don't know
8. What will you do with your teacher's undemanding thinking and exploration?  
A. Do it after class      B. Do but don't ask teacher  
C. Discuss with classmates      D. Don't do

- 
9. Do you like your teacher asking you to go to the blackboard to do your exercises?  
Like it very much      B. Like    C. Don't like    D. Don't care
10. Can the teacher motivate students to express their ideas enthusiastically when you are afraid to ask ?  
A. Always      B. Often      C. Sometimes      D. Never
11. What way do you generally take for questions in math class?  
A. Brain thinking and express ideas positively  
B. Let others answer  
C. Hope the teacher to explain  
D. Have nothing to do with themselves
12. How will you deal with the question that won't happen in math class?  
A. Immediately ask the teacher      B. Ask teacher after class  
C. Ask classmates after class      D. Don't care
13. Can your questions be approved by teachers and classmates?  
A. Get recognition      B. Be ignored by the teacher  
C. No question      D. Classmates can laugh at them
14. What's the reason that you don't raise your hand and ask or answer questions in math class?  
A. I don't know if the answer is correct    B. Afraid of teacher  
C. Afraid of being joking      D. Do not want to answer
15. When the group discusses, you will( ).  
A. Actively participating in the discussion  
B. Mainly listening to others  
C. Do your own thing  
D. Depending on whether the teacher is here
16. What kind of way does your teacher choose to ask questions in math class?  
A. Ask a single student  
B. Ask the whole class  
C. Teachers and students discuss them together  
D. The teacher doesn't ask questions
17. How does your math teacher explain the new lesson?  
A. Always draw new knowledge from the our life  
B. Teach the new knowledge after reviewing the relevant knowledge  
C. Explain new knowledge directly
18. If you like math class, the reason is ( )?  
A. The teacher explains the lecture very well  
B. The teacher is very humorous in class  
C. The teacher is very enthusiastic about his lecture  
D. The math teacher is nice

19. Do you like to think under the teacher's question, or find the problem and solve it by yourself?
- A. Like to think under the teacher's question
  - B. Like to find the problem by myself
  - C. Both like
  - D. It does not matter
20. What will you do if the teacher's explanation is inconsistent with your own ideas in class?
- A. Raise your own ideas in time
  - B. Communicate with the teacher in private after class
  - C. Communicate with classmates after class
  - D. Listen to your teacher and don't ask



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