On Mathematics Teaching Experiment of “Setting Situations and Posing Problems” in Middle and Primary Schools

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Abstract -To foster creative consciousness and practicing ability for students, a basic mathematics teaching model in middle and primary schools has been initiated. The mode is based on the concept of “setting situations and posing problems”. As the start and finish points of teaching and study, The goal is to strengthen students’ “problem consciousness ” and to improve the ability of posing and solving problems. A four-year teaching practice shows: it is a basic teaching mode, which can embody the new education idea and can be easily applied in middle and primary schools by teachers.

Keyword :situation, problem, teaching mode

1 An experiment retrospect

1.1 Proposition of the experiment

In the 21st century, the education of China faces the era challenge: economical internationalization, more educated, developing in science and technology at a high speed makes the human civilization move towards integration. “The rising and declining of a country depends on the education”. The modern school education plays a crucial role in training scientists and experts. The key quality of different experts is innovation consciousness and innovation ability. This comes from problems. Where there is no problem, there is no innovation. The discipline teaching is the main channel that the school educates. The discipline teaching of mathematics is an extremely important component of discipline teaching. So, no matter in order to solve the subject matter existing to mathematics teaching, or to realize the goal of mathematics teaching under the new form, mathematics teaching in middle and primary schools must be launched in order to train students’ mathematics problem consciousness and to improve students’ ability of posing and solving mathematics problems. So, the activity of posing and solving mathematics problems should be dissolved as an organic whole in mathematics teaching, showing the appearance that mathematics happens, develops and is created. This is the important supplement for solving problems in the past and the essential intension of the goal now in mathematics teaching. It is a key issue of the course reform of national mathematics at the same time.

Poliya attached great importance to the research that mathematics problems were solved in the early 20th century. He made enormous contribution to the teaching of solving problems. The mathematics course standard in America stipulated clearly mathematics problems were solved for the center of mathematics teaching of the school in the eighties of the 20th century. After the seventies of the 20th century, China promoted the extensive research that the students in middle and primary schools solved mathematics problems. We may make a general survey of recent developments that international mathematics educates. Then we can say, in the mathematics teaching of the school, the teaching that mathematics problems were solved has caused the general concern and got great achievements. On the contrary, the teaching of posing problem has not got the due attention. It has been ignored for a long time in China. In middle and primary schools, the students’ mathematics problem consciousness is weak and their ability of posing mathematics problems is very low. Even if the ability of solving mathematics problem seems single. It has been shown that they solved much routine and closed mathematics problems but little open mathematics problems. The phenomenon that the ability that the Chinese pupil posing mathematics problems is obviously less than the American pupil has been found by us and the professor of University of Delaware. It is
Teaching aim of this mode: Train students’ innovative consciousness and practicing ability.

Mode core: Let doubting and questioning, and strengthening students’ “problem consciousness” and improving the ability of posing and solving problems run through the whole course to teaching.

Inner link: It is a prerequisite to set mathematics situations; It is a focal point to pose mathematics problems; It is a core to solve mathematics problems; Applying mathematics knowledge is a purpose.

Teaching method: The teacher can adopt all kinds of teaching method in which inspiration is the center. Students take probing as their learning method in which dependent cooperation is the center. In the course of whole mathematics teaching, students’ subject status should be reflected; the teacher’s leading role should be emphasized even more, including teaching scientifically.

The teaching mode of “situation—question” is intercommunion chain of a circulation and organic and open system.
Posing problems goes forward hand in hand with solving the problem. Their shape shadows are accompanied. They cause each other. In the course of solving the problem and applying mathematics knowledge, the problem that has already been solved can be regarded as the situation in which the new problem is posed; the achievement of applying mathematics knowledge can be regarded as the situation in which the new problem is posed too. This teaching of “situation ——question ”, is a study chain, which is a good way of training students’ innovation consciousness and innovation ability in the course of learning and teaching. We ardent to expect all students in middle and primary schools have their own most thing to get at mathematics in the mathematics teaching of “situation ——question ”. We hope sincerely that mathematics teachers “ have students without questions be problematical ”, that they let the students in middle and primary schools find , pose meaningful mathematics problems consciously, that the teachers get them form the habit of posing problems and have stronger ability to pose and solve mathematics problems.

1.3 State and result of the experiment
The work of “ situation ——question” teaching experiment was launched in some middle and primary schools of Guizhou in January 2001 at first. Experiment schools have already expanded to more than 200 middle and primary schools of many areas, such as Sichuan province, Yunnan province, Chongqing city, Zhejiang province, Heilongjiang province, Neimenggu province, Guangdong province, Beijing city, etc. Experiment classes have already expanded to more than 500 classes from grade one of primary school to grade three of high school now. The teaching guide books of “ mathematics situations and mathematics problems” (One volume for middle school, the other volume for primary school, every volume has 100 cases.) were published in May 2001. The phased achievement of the experimental work of “research of the teaching of ‘setting situations and posing problems’ in middle and primary schools” (14 theses, 20 “situation ——question” teaching cases) was published in May 2002. Five groups of special column articles are published in the domestic key periodical, such as “journal of mathematics education”, “journal of Guizhou normal university” (natural science edition), include more than 30 theses and teaching cases altogether. We have carried on extensively spreading at international and national academic meeting, in more than ten institutions of higher learning, in several dozens middle and primary schools. A four-year teaching practice shows that it is a basic teaching mode embodying the new education idea that can be easily applied in middle and primary schools by teachers, and it makes good results, they behave mainly in following:

(1) Have improved the mathematics teaching quality in middle and primary schools. Among the teaching, students in middle and primary schools can firm to grasp mathematics foundation knowledge and obtain basic training of skill, at the same time, through the training of posing and solving questions from the situation, it trains students’ problem consciousness and innovation ability, and has facilitated students to obtain the beneficial development of the individual character in the independent and positive studying activities.

(2) Have brought about an advance in the mathematics teacher's specialization. Because teacher pays attention to leading students to put forward questions, and directs against students' questions to develop the activity of teaching in teachers and students interdynamic. the teacher naturally will teach students in accordance with their aptitude and guide students flexibly, alertly to study during probing into, so that , it promotes teachers themselves in mathematics and education development at the professional ability. Over the past four years, it trained nearly 300 the key mathematics teachers of middle and primary schools in the experimental school of Guizhou.

(3) Favor to the implementation of the mathematics course reform. Every school participating the mathematics teaching experiment of “ situation-—question “, with entering in mathematics course teaching of new round, the teachers can all develop better the activity of classroom instruction according to the new education idea, and promote the implementation of the course reform in order. Such as in the urban middle and primary schools of Xingyi Guizhou, their mathematics course reform is launched better. Now it has already been chosen as the experiment base of course reformed of Guizhou. In some schools, the teaching mode has been moved to other disciplines to experiment.
(4) Obtain favorable comment in the counterpart's expert and the society. The mathematics teaching experiment of "situation-question" has obtained favorable comments of experts, scholars and teaching and research department of the education circle of domestic mathematics. For instance; Tu--rongbao professor---the doctoral supervisor of the normal university of Nanjing,he pointed out: "The experiment of the teaching mode has very important meanings, it is a reform to direct against the traditional teaching mode. This teaching mode has already reflected the modern education thought idea of the scientific development view, it is also creative application and development to the modern education theory, especially the theory of constructivism and situated-learning. It is a classroom basic teaching mode with front, era and easy to operate."

In 2003, Chinese Education Society sanctioned this teaching experiment listing in 2003 subject of the programmer during the Tenth Five-Year Plan of Chinese Education Society. In order to enable the mode experiment to promote the sound development of the national middle and primary schools mathematics course reform, we are expanding "mathematics situations and mathematics problems" from two volumes to four (two primary schools, junior middle school, one high school). The four books will be published as "teacher's growth array series of books" by the publishing house of Beijing Normal University in July 2005. They can help national mathematics teachers in middle and primary schools carry on the classroom instruction according to the new education idea.

2. Experimental cases

Teaching case 1: Axial symmetry figure
Grade six class 4, Guiyang Nanming Primary School
Teacher: Fangling Ming

The situation surging and introducing interestingly
The courseware shows a group of beautiful kites. The teacher leads students to probe into the geometric figure characteristic of the kites, and express it. On the basis of this perceptual knowledge, the teacher guide students to reading the definition of the axial symmetry on the textbook.

Cooperate in operating
There is a piece of graph paper in each group, on which there are rectangle, square, triangle (including isosceles triangle), flat shape quadrangle, ladder-shaped (including isosceles ladder-shaped), round etc. The teacher requires students to fold them and find out the axial symmetry figures, draw the axis of symmetry and classify them according to a certain way.

Put forward the question: Is the parallelogram a axial symmetry figure?
During discussing, a group of students proposed: The parallelogram is also a axial symmetry figure, its reason is as follows:

While cut it off, it can be spelled and made up an axial symmetry figure

Student A refute: The parallelogram is not an axial symmetry figure, because it does not accord with the definition on the book. Don't cut it off and piece together, using the original flat shape quadrangle, and it is not coincident while discounted along the dotted line or any other straight lines.

The teacher praised the refuting effectively of student A at first, said: In fact, the parallelogram is also a symmetrical figure, it is not the axial symmetry figure that we are studying, but it is the symmetrical figure of the
centre that we will study.

**Pay attention to knowledge application:** The courseware shows a group artistic works of the folk paper-cut. The teacher leads students to distinguish which is an axial symmetry figure according to the axial symmetry definition, and points out its axis of symmetry.

**Operate again:** And then, the teacher divides students into groups and organize them to do the paper-cut homework--Show, intercommunicate and point out the symmetrical characteristic of the cutting figures.

**Open up the using space:** Finally, The teacher show a group of world-famous symmetrical building pictures through the courseware (dubbing with background music). One of them is the beautiful picture of the Capitol of U.S.A. and its inverted image in water.

Teacher: Is this picture an axial symmetry figure?
Most students do not say just: But some students answer, because the mansion and its inverted image in water present axial symmetry, and the axis of symmetry is the water interface.

**Teaching case 2:** Application of the simple equation
Junior one class 3 ,the 4th Middle school of Guizhou Xingyi ,
Teacher : Huiling Kong

**Mathematics situation:** Mother gave Xiao-hong 20 yuan to buy the study articles. In the shop, one note-book is 3 yuan , one pen is 2 yuan , ……
There are 66 students in the class, 47 students put forward more than 30 questions, the teacher chose and wrote 10 questions among them on the blackboard ,and discussed the following three questions emphatically:
How many note-books and pens are bought to use up 20 yuan?
How much will it remain after buying 3 note-books and 5 pens?
Buy more than 10 note-books, and it will be sold by 90% discount, so how much will it leave even to buy 13 note-books?

**Routine question:** (answer omitted)

**Expansionary question:** Suppose that there are x yuan left.
\[20-x=3\times13\times90\% \quad (x=-15.1)\]

**Exploratory question:**
\[3x+2y=20\]

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The mathematics teaching experiment of “setting situations and posing problems in middle and primary schools” shows: It pays attention to not only the forming of students' mathematics question consciousness , but also the cultivation of the ability of students' putting forward mathematics questions; It cares about not only the improvement of the ability of students’ solving mathematics problems , but also the enhancement of the ability of students’ solving practical problems by applying mathematics knowledge. It has already paid attention to obtaining the mathematics knowledge, probing into the way of thinking of mathematics, and it has stressed the opening of developing the activities of mathematics and mathematics course.

We think such mathematics teaching will be value to students to get the development, with overall, harmoniously and individually in knowledge, ability, emotion, attitude, and mathematics view. It is one teaching experiment with characteristics of Chinese, which plants in the native country of China, and reflects the new educational idea.
3 Reviews

As the shortage of time for experiment and study, the teaching model remains to improve and to be perfect in theory and practice. Reviewing the teaching practice in more than four years, in order to make great improve, we suggest that teachers should set and apply mathematics situation properly, should be good at inducting students to pose questions.

3.1 Set and apply mathematics situation properly
There are many ways to set and apply mathematics situations, such as:
- From the material close to the social society and life of reality;
- From the mathematics historical facts, Chinese and foreign famous questions, questions in textbooks.
- From the material of literature and natural science;
- From the material of native and national culture characteristic;
- And we can also utilize and transform the situations in textbook properly, etc.

The purpose for setting situation, which we must illustrate especially, is exciting students' problem consciousness and leading students to put forward and solve the mathematics question. So mathematics situation should not break away from teaching goal and only pursue for superficial situation and courseware. We must pay attention to guiding the mathematics information in “fictitious situation”; and deal well with the relationship between key long knowledge and student's interest etc.

3.2 Be good at inducting students to pose questions
The question lies in the mathematics teaching as a key, so the teacher should be good at guiding students to put forward the questions. There are many ways of leading students to put forward the mathematics question, such as:
- Enclosing the class instruction goal, review and mate, query and question;
- Catch mathematics information to put forward the question from the situation;
- Assign “situation homework” for the classroom, guide and seek and doubt that questions in “doing mathematics”;
- Guide and query and questions in cooperative study;
- Guide and query and questions in “retrospect- review”; Guide and query and questions in the relevant knowledge (adjoined discipline);
- From teacher’s demonstrates the question of putting forward, guide and query and questions;
- From the problem that has already been solved, guide and query that question;
- Respecting student's individual character difference, make the best use of the situation to query and questions; etc.

We hope the chain of “posing question --solving problem” run through the teaching practice. During the process of leading students to put forward questions, we should pay attention to some problems, such as: Don't influence the solving problem because of paying attention to proposing the problem; Don't tow students hard to enter the teaching track that a teacher preserves; Don't pursue the lively atmosphere of “cooperated in studying ” as surface form; Don't give up the teacher's essential explanation; Heavy course teaching can't ignore the study of the knowledge result; Deal with the present problem and problem difficult; Pay attention to the strange problem that students put forward (or answer),etc.

3.3 use the teaching mode flexibly in teaching practice
(1) The basic teaching mode can be open up
Mathematics Teaching by Using the Mode of Mathematical Situations and Posing Problems in High School and Primary Schools a basic teaching mode, and can widely to be open up and derive out other teaching modes, such as “situation-question-discuss–appraise”; “situation-question-introspection-question”; “question–discuss-teach-question”; “teach-question-discuss-review”, etc.

(2) Use teaching mode synthetically
The teaching mode is varied, and it is non- single to change. While using the teaching mode, we should follow discipline characteristic, cognitive level and the teacher's self- situation. In order to make the teaching mode flexibly and properly, we must apply other model synthetically.

(3) Realize no-mode teaching
We study the mode of teaching. We make teaching from unordered to move towards in order. We hope break through the mode at the same time. We hope cross over the mode and reach the supreme realm of teaching. We call for characteristic teaching. There are some models, but there are some certain models in teaching. Where there is no mould of model, there is the best model.

Reference:


