

Inquiry into Mathematics Teaching in Senior High School

—Taking "Planar Analytic Geometry" as an Example

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Abstract—Analytical geometry was an important course in high school mathematics learning, and innovative teaching was the main direction of curriculum reform. Therefore, how to innovate in analytic geometry teaching was one of the important problems in high school mathematics teaching. Based on the teaching content and practice, and comparing with the teaching methods of analytic geometry in foreign countries, the key and difficult points of analytic geometry teaching in senior high school mathematics are clarified by studying the main contents of analytic geometry in senior high school and its teaching significance. On the premise of paying attention to the knowledge base, it is proposed that geometric intuition should be taught in combination with reasonable reasoning and deductive reasoning. On this basis, the geometric sketchpad should be fully utilized as a supplement, and mathematical stories should be appropriately interspersed to arouse students' interest.

Keywords—*Innovative teaching; Plane analytic geometry; Plausible reasoning; Deductive reasoning; Geometer's Sketchpad*

I. INTRODUCTION

Creative thinking mainly refers to creative, innovative and creative thinking. If this way of thinking is introduced into senior high school mathematics teaching, it means that students are good at analyzing and thinking independently in the process of learning mathematical theory knowledge, instead of following the old and clinging to the old rules, they should carefully and conscientiously carry out it. The cultivation of creative thinking can not only help students solve abstract learning content in mathematics, but also stimulate students' desire to explore knowledge, help students solve difficult problems in learning and improve students' autonomy. Therefore, it is of great significance for the growth and development of students to cultivate their creative thinking ability in high school mathematics teaching [1].

The establishment of plane analytic geometry has introduced a series of new mathematical concepts, especially

variable mathematics, which has brought mathematics into a new period of development and promoted the development of mathematics. At present, the teaching of plane analytic geometry in our country pays attention to the teaching of combination of numbers and figures, but there are some shortcomings of too complex design content. How to innovate teaching better is a major problem in current education. Based on the current teaching situation at home and abroad and the idea of optimizing teaching, three teaching suggestions are put forward [2].

II. RESEARCH BACKGROUND AND SIGNIFICANCE

A. Research background

The great development of mathematics since the seventeenth century owes much to analytic geometry. It can be said that differential calculus and integral calculus cannot be imagined without the advance development of analytic geometry. The creation of plane analytic geometry as a branch of mathematics is attributed to French mathematicians Descartes and Fermat. Its basic idea is to use coordinate method to unify the spatial figures (points, lines and surfaces) reflecting the same motion law with the quantitative relations (coordinates and the equations they satisfy), thus reducing the geometric problems to algebraic problems. As a branch of analytic geometry, plane analytic geometry is indispensable for research and discussion.

B. Research significance

Planar analytic geometry mainly studies the knowledge of straight lines and conic curves. These contents are of great significance for judging the geometric characteristics and mathematical laws of functions. The transition of students' geometric computing ability from linear binary quadratic equations to circular binary quadratic equations highlights the process of solving geometric problems by algebraic methods,

and emphasizes the geometric significance of algebraic relations. By letting students experience the process from "special" to "general" and constantly embodying the idea of "combination of numbers and figures", students are gradually trained to solve geometric problems by algebraic methods.

III. TEACHING STATUS OF PLANE ANALYTIC GEOMETRY IN SENIOR HIGH SCHOOL

A. *Domestic current situation of plane analytic geometry teaching in senior high school*

The content of plane analytic geometry in senior high school mathematics mainly includes the knowledge of straight line and conic curve, which makes the students' geometric calculation ability transit from linear binary equation to conic binary quadratic equation. China's "Standard" places the field of "geometry" in compulsory modules and elective series [3]. The content of geometry is more profound and difficult, and there are higher requirements for students to achieve in learning here. However, at present, the material sources of plane analytic geometry textbooks are relatively single. Its geometric knowledge is presented in the form of algebra, which only pays attention to the difficulty of knowledge, but does not take into account the breadth of knowledge.

B. *Foreign current situation of analytical geometry teaching in high school mathematics*

The American Standard positioned plane analytic geometry as an important part of core mathematics. Its textbook contains a wider range of knowledge. It emphasizes that geometry knowledge should be taught in accordance with practice. The teaching of plane analytic geometry in the United States pays attention to the breadth of knowledge, but the depth is not enough. In terms of textbooks, American textbooks are better than Chinese textbooks. Their examples and exercises are rich in background, close to life, the pictures are colorful, the number is huge, and information technology is also integrated into them. Their geometry knowledge is presented mainly by intuitive geometry, and the presentation means are quite diverse [4].

C. *Suggestions on teaching plane analytical geometry in senior high school*

The teaching of plane analytic geometry in senior high schools in China should pay more attention to the breadth of knowledge, emphasize the connection between mathematics and real life, so that students can fully feel the connection between geometry and reality in learning, and set up exercises at different levels to help all students carry out targeted training.

IV. TEACHING CHARACTERISTICS OF PLANE ANALYTIC GEOMETRY

"General High School Mathematics Curriculum Standards" put forward clear requirements for the teaching of plane analytic geometry in senior high school mathematics. The teaching of plane analytic geometry in senior high school

mathematics should have three teaching characteristics: hierarchy, logic and practicability [5].

A. *The design of curriculum content is hierarchical*

High school mathematics plane analytic geometry has obvious hierarchy in the course content design. First, the geometry concept is explained. Secondly, the position relationship between straight line and conic curve is derived by combining point, line and surface. The transition from first-order equation (equation of straight line) to second-order equation (equation of conic curve) is not only explained here. Students should be prompted about the change of geometric figure, and the similarities and differences between quadratic equation and conic equation should be emphasized, so that the number of intersections and the positive and negative values of intersections can be taken into account when judging the position relationship between straight line and conic curve.

B. *The design of curriculum content is logical*

The biggest characteristic of plane analytic geometry in senior high school lies in the combination of numbers and shapes. The course is based on axioms. When teaching the characteristics of geometric figures, the intuitive teaching method is generally adopted, which is easy to understand. However, most of the problems of analytic geometry have many obstacles, so it is difficult to get the answer directly. For example, it needs to add auxiliary lines frequently. Come to conclusion. Especially in the chapter of the relationship between the position of straight line and circle, it is difficult to solve it accurately only with textbook knowledge. After the equations of straight line and circle are composed of equations, the number of intersection points can be judged according to the discriminant of the root of the equation. This requires students to master the relationship more skillfully. Pay attention to the expansion of knowledge.

C. *Course content design is practical*

High school plane analytic geometry is a part of high school mathematics on the surface. In essence, it is closely related to high school mathematics itself and other courses in high school. For example, it is related to high school function content and high school physics dynamics content. Therefore, teachers must actively grasp analytic geometry in teaching. What content, clearly tell students analytic geometry and other courses in high school content relevance [6], stimulate students' interest in learning.

V. DIFFICULTIES IN TEACHING PLANE ANALYTIC GEOMETRY

The teaching difficulties of plane analytic geometry in senior high school mainly include the process of students' understanding of basic theorems, the thought of combining numbers and figures, and the process of problem extraction. Students have no thoughts and no way to start when facing the problem, and they can not reasonably use the thought of "combination of numbers and figures".

A. Understanding and application of basic theorems

The basic theorem is the basic content of high school mathematics, which is usually regarded as the simplest content by teachers and students. Therefore, teachers neglect to exercise students' problem understanding ability in their lectures and only adopt the indoctrination teaching method. As a result, many students do not understand the basic theorem thoroughly and swallow dates. Students only regard the basic theorem as a criterion. Rote memorization. But when solving practical problems, it requires not only mastering the content of basic theorems, but also mastering the application direction, special usage and the type of questions. Therefore, students can not apply knowledge and special situations skillfully when solving problems, and can only find a foothold and confusion.

B. Master the thought of combining number and shape

The most important idea of plane analytic geometry is the combination of numbers and shapes. It also needs the combination of geometric problems and mathematical problems in the solution of propositions. In practical teaching, students' ability to convert geometric problems into mathematical problems is insufficient. For example, when solving the distance between intersections of straight lines, we can not think of binary first order equations. The reason for this deficiency is that the characteristics of analytic geometry are not systematically understood in teaching, such as the intersection of straight lines, the problem of points on the surface of straight lines, but essentially each straight line corresponds to a binary first-order equation, which can be transformed into solving the intersection of two equations. Points greatly simplify the burden of thinking and the level of logic.

C. Essential extraction and equation construction of geometric problems

Mathematical geometry problems are abstract, students can not extract the problems in place, how to teach students to extract mathematical problems from general problems, how to better enable students to understand mathematical geometry is a major problem in the current teaching of mathematical geometry. In order to achieve the effect, teachers must abandon the monotonous mathematical language in the past, understand how to communicate students' observation strategies, and guide students to understand the relationship between geometry and equations, so that students can construct equations more smoothly. In addition, the position of plane analytic geometry varies a lot, the way of problem solving is complex and the regularity is low, which limits students' understanding ability. Therefore, students should be trained to master the analytical expressions of geometric position relations, so as to accurately construct equations, thus reducing the difficulty of analytic geometry problems.

VI. TEACHING EXPLORATION AND CONCLUSION

The teaching of plane analytic geometry in senior high school mathematics must insist on innovation, adhere to the principle of student-centered, pay attention to practice on the basis of theory, enhance the understanding and application of basic theory, in order to deal with the problem of analytic

geometry accurately and efficiently, which requires teachers to carry out both teaching ideas and teaching methods. Continuous innovation and exploration.

A. Make full use of geometric sketchpad

The most useful way for students to solve geometric problems is to use the combination of physical objects and figures. Therefore, in the innovation of teaching methods, special attention should be paid to the application of geometric sketchpad. In high school mathematics teaching, teachers have been able to apply geometric sketchpad skillfully, greatly simplifying the teaching links and improving classroom efficiency [7]. The application of Geometric Sketchpad can make the boring mathematical knowledge more vivid. For example, when teaching the equation of straight line, we can express the change of geometric position relation caused by the change of variable numerical value through geometric sketchpad, so as to better grasp the students' interest in learning. When teaching the position relation of straight line and circle, we can freely use the geometric sketchpad. Change the slope of the straight line so that students can establish the relationship between geometric problems and equations by observing the change process.

B. Pay attention to the penetration of mathematical stories

The knowledge of plane analytic geometry is too boring, and the mathematic story is more vivid and interesting. Therefore, some interesting mathematic stories can be appropriately interpolated in the teaching of plane analytic geometry to cultivate students' mathematic culture and interest in learning. For example, in the part of plane analytic geometry, we can mention the mathematical stories of its founders Descartes and Fermat, and then interpolate the relevant knowledge points of plane analytic geometry according to their stories, so that students can learn knowledge in the process of listening to the stories, not only rigid but also vivid. In order to let students further understand their mathematical thinking, we can let students "role-play", give them a plane analytic geometry problem, let them say what two people will have different understanding and performance. Such small games enable students to learn knowledge and develop interest in learning while playing.

C. Geometric intuition combined with reasonable reasoning and deductive reasoning

At present, the most commonly used teaching method of mathematics is geometry intuition. Its teaching should be organically combined with reasonable reasoning and deductive reasoning. When solving mathematical problems with intuitive diagrams, reasonable reasoning helps to explore the thinking of solving problems and discover conclusions; deductive reasoning is used to prove the correctness of conclusions. The cultivation of geometric intuition should be accompanied by the development of reasoning ability, which runs through the whole process of junior high school mathematics learning.

VII. CONCLUSION

Through the analysis of the research significance, teaching status quo and teaching characteristics of plane analytic geometry in senior high school mathematics, this paper summarizes that the current teaching difficulties of plane analytic geometry lie in the accurate understanding and skillful application of basic theorems, the mastery of the idea of combining numbers and shapes, the extraction of key points of geometric propositions and the construction of equations. The teaching of plane analytic geometry in senior high school mathematics must insist on innovation.

ACKNOWLEDGMENT

This paper is the stage achievement of Jinan University Graduate Education Innovation Project "Research on Evaluation Criteria and System of Graduate Education Quality for Professional Degrees in Shandong Province under the Background of "Double-first-class"Construction" (No. JDY1601) and "Research on Construction and Implementation of Quality Guarantee System for Graduate Education of Master of Education" (No. JDY1707).

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