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# Research on the Construction of Case Teaching Model Based on Quality Education in High School Mathematics Class

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***Abstract*** **– Under the influence of the thought of "mathematics for the public", our country puts forward the viewpoint of changing from "examination-oriented education to quality-oriented education". In order to seek the deep integration of high school mathematics education and quality education, the case teaching model can be properly implemented in high school mathematics teaching activities. This paper expounds four characteristics of case teaching model based on quality education, introduces the three steps of constructing case teaching model and takes the concept teaching of definite integral as an example to illustrate the construction of case teaching model. Finally, the significance of constructing case teaching model based on quality education is discussed.**

***Keywords*** **– Quality Education, Case Teaching Model, High School Mathematics.**

## I. INTRODUCTION

Since the 1980s, as an international trend of thought, "mathematics for the public" has made mathematics education a wise choice for the public. All countries in the world are actively acting under the impetus of this trend. This not only puts forward new requirements in mathematics design, but also has a far-reaching impact on mathematics education. The "Mathematics Popularization" movement is a significant change in the view of mathematics education from elite-oriented to mass-oriented. It is more in line with the development trend of modern society and it makes mathematics education more mature and rational.

Under the influence of this trend of thought, China put forward the viewpoint of changing from "examination-oriented education to quality-oriented education" and "education facing the world, future and modernization" has become the reform direction of mathematics education [1]. At the same time, under the influence of "popular mathematics", school comprehensively improves the quality of students. That is to say, mathematics education is no longer aimed at the entrance of a small number of students, but at improving the mathematical quality of the whole people.

At present, classroom teaching is the main link of school teaching in China's education, and school education is basically implemented through classroom teaching. Therefore, quality education needs to be implemented through classroom teaching. In order to seek the deep integration of high school mathematics education and quality education, the case teaching model can be properly implemented in high school mathematics classes. Case-based teaching model can be defined as that teachers select representative cases to create problem situations for students according to the needs of teaching objectives and contents, guide students to analyze and discuss cases, master theoretical knowledge in situations, summarize rules, and creatively combine knowledge with practice so as to enable students to comprehend book knowledge, cultivate emotion will, innovative thinking, enhance comprehensive ability of a kind of teaching model [2]. Case teaching emphasizes learner-centered cooperative learning, and its core idea is that students are the leading role in learning process. On the basis of traditional

teaching, case teaching combined with students' professional knowledge can stimulate students' interest and thirst for knowledge, reduce the difficulty of learning in the process of student discussion, help students broaden their thinking, strengthen mathematical thinking and mathematical application awareness, improve the ability of high school students to analyze and solve practical problems. It also plays an important role in improving the quality of talent training.

## II. Characteristics of Case Teaching Model Based on Quality Education

### A. *The Integration of Teaching Objectives*

The case teaching model needs to position the teaching objectives of high school mathematics in the overall development of students. Establish an optimized mathematics teaching goal based on the attention to the overall quality of students. Emphasizing the integration of high school mathematics teaching objectives is the inherent need of education development, and it is also in line with the basic trend of the world education reform to shape students' perfect personality [3]. In the process of formulating the goal of quality education classroom teaching, the teaching is based on the basic knowledge and skills, and the core of psychological quality and ability is the core. It is necessary to attach importance to the development of the cognitive level, but also attaches importance to developing emotional level in order to promote their overall development.

### B. *The Overall Nature of Educational thought*

The case teaching model of high school mathematics based on quality education should have the characteristics of subjectivity, comprehensiveness, democracy, development and openness. The key problem to be solved in constructing the case teaching mode under the concept of quality education is how to give full play to students' subjective initiative, enthusiasm and creativity in the process of mathematics learning, and truly change passive learning into active learning. Teachers are transformed from the instructors of knowledge to the organizers, instructors, helpers and facilitators of active learning [4]. Therefore, we should pay attention to the overall situation of educational thought in the teaching process of high school mathematics.

### C. *Full Membership of Teaching Objects*

The basic connotation of quality education is to teach all students. In the high school mathematics classroom teaching process of implementing the case teaching mode, the primary problem is to solve the basic goal of truly facing the whole, to improve the quality of all the students, highlight the main body participation, the interaction between teachers and students, and achieve effective classroom management [5]. The purpose of school teaching itself is to pay attention to the individual characteristics of each student, create opportunities for students to get the education that suits their growth, develop the unique potential of each student, and enable each student to fully learn and develop in school.

### D. *Dynamics of the Teaching Process*

High school mathematics class based on quality education is a dynamic process of interaction between teachers and students. In the process of implementing the case teaching mode of high school mathematics, the status relationship between teachers and students should be well handled, and students should become the main body of mathematics teaching activities, actively participate in various teaching activities, and create a pleasant, relaxed, democratic, harmonious, equal and cooperative teaching environment [4]. Teachers should change students'

passive and static learning methods, break through the limitations of schools, classrooms and books, strengthen students' subjective activities, and incorporate them into the scope of mathematics teaching, strive to cultivate students' innovative spirit and autonomous ability, encourage students to think, discuss and explore by themselves, encourage students' creative learning and development, and make teaching activities open [3]. With the development of modern educational technology, teachers must learn to integrate advanced methods into classroom teaching, especially the use of multimedia computers, which can provide an ideal teaching environment for building case teaching models.

## III. The Steps of Constructing Case Teaching Model in High School Mathematics Class

### A. *Preparation Period*

Teachers need to select cases, set teaching objectives and learning tasks, and analyze students' learning situation. Students need to preview the course to understand their own cognitive level.

### B. *Implementation Phase*

Teachers need to design case introduction to inspire students to discuss the case later. Students propose solutions to the problems in the case, and then summarize the implementation plans obtained by each group. Finally teachers assist students and supplement them to achieve the purpose of learning and understanding the conceptual knowledge involved in the problem.

### C. *Evaluation and Feedback*

Evaluation among students, evaluation and reflection by teachers, evaluation of curriculum design. The specific design flow chart of the case teaching mode is shown in Figure 1.

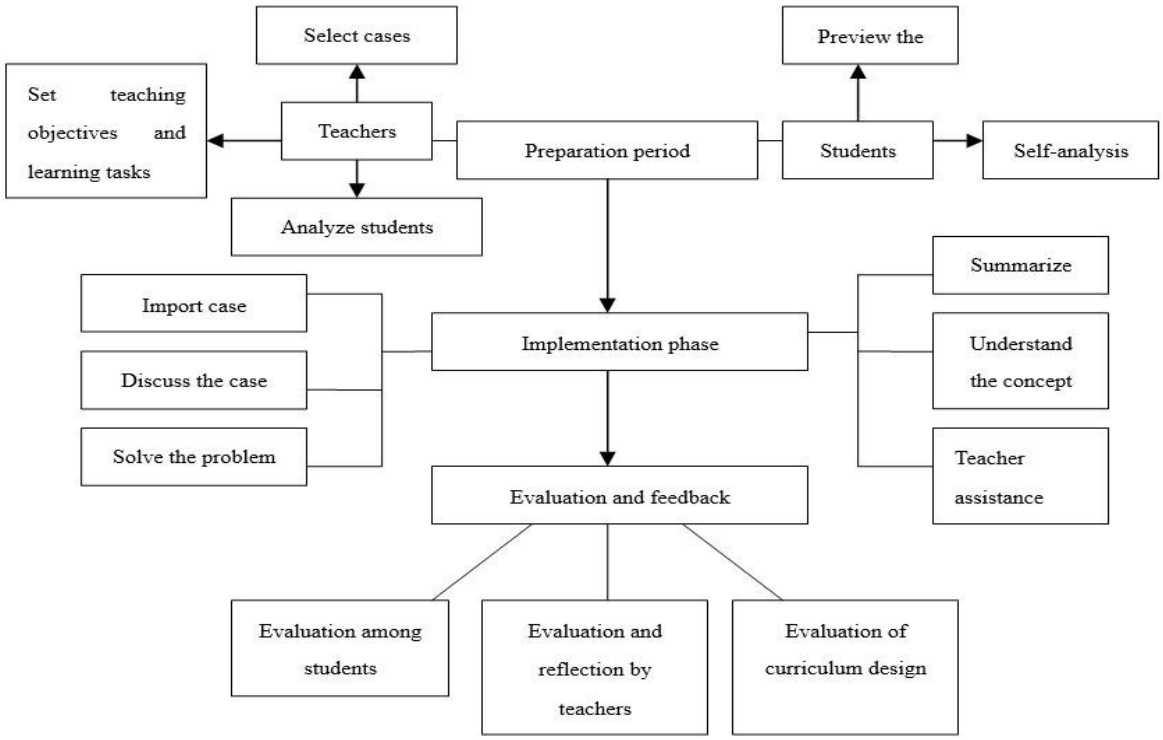


Fig. 1. Design process of case teaching mode.

## IV. Implementation of Case Teaching Model in High School Mathematics Class

Take the concept teaching of the fifth section of Chapter 1 of Elective 2-2 as an example to explain the implementation of the case teaching mode in the high school mathematics class.

### A. *Preparation Period*

#### a. *Teacher's work*

(i) Select case: Concept of Definite Integral.

Teacher uses PPT to show the irregular lawn pictures in front of the teaching building and ask students to calculate its area. This lawn is very familiar to every student. In the process of calculation, students can further feel the application of mathematical knowledge in every corner of life.

(ii) Teaching Objectives: To understand the concept of definite integral; to express some geometric quantities using definite integrals.

(iii) Case content.

Course Resources: In addition to textbooks, teachers need to collect relevant information before class. For example, background knowledge about definite points.

In the 3rd century BC, mathematician and physicist Archimedes combined method of exhaustion and atomic theory point of view, the graph of the parabola quadrature method "and" on spiral ", with the aid of geometry, calculate the arch area into a regional area and around the spiral of Archimedes, its thought method is divided sum, successive approximation, although there were no the concept of limit, do not admit, but his quadrature method has the definite integral germ of an idea. Until the 16th century, the idea of integration has been around the development of "quadrature problem". It consists of two aspects: one is the area of the plane graph and the volume surrounded by the surface; the other is the weight and the pressure of the fluid in the statics. German astronomer and mathematician Kepler, in his book New Science of Measuring the Volume of Wine Barrels, thinks that the given geometric figures are composed of infinitesimal figures of the same dimension. By adding up the areas or volumes of these small figures in a specific way, he can get the required area or volume. He is the first mathematician to use infinitesimal method in quadrature. In the mid-17th century, French mathematicians Fermat and Pascal used the viewpoint of "dividing and summing" and infinitesimal nature to quadrature, which is closer to the modern method of definite integral [7].

Learning tasks: Including basic concepts and exercises.

Concept of definite integral: Let the function $f(x)$ be continuous in the interval $[a,b]$ and divide the interval $[a,b]$ into n sub-intervals $[a,x_0]$, $(x_0,x_1]$, $(x_1,x_2]$, …, $(x_i,b]$, it can be seen that the lengths of each interval are in the order of $\Delta x_1 = x_0 - a$, $\Delta x_2 = x_1 - x_0$, …, $\Delta x_i = b - x_i$. Take one point $\xi_i$ (i = 1, 2,…, n) in each sub-interval $(x_{i-1},x_i)$, make the sum (see the figure below). Set $\lambda = \max\{\Delta x_1, \Delta x_2, \cdots$ ($\lambda$ belongs to the maximum interval length). Then when $\lambda \to 0$, the sum is infinitely close to a constant, which is called the definite integral of function $f(x)$ in the interval $[a,b]$, and is recorded as: $\int_a^b f(x)dx$. That is

$\int_a^b f(x)dx=\lim_{\lambda\to 0}\sum_{i=1}^{n} f(\xi_i)\Delta x_i$ . Among them: $a$ is called the lower limit of integration, $b$ is called the upper limit of integration, interval $[a,b]$ is called the integral interval, function $f(x)$ is called the integral function, $x$ is called the integral variable, $f(x)dx$ is called the integral expression, and $\int$ is called the integral sign.

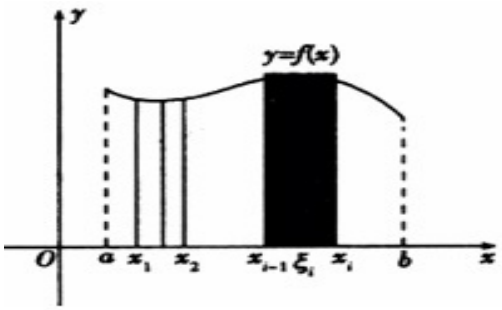


Fig. 2. Definite integral.

Exercise: Use definite integral to represent the area of the graph enclosed by curves $y=e^x$ , $y=e^{-x}$ and $x=1$ .

Academic Analysis: Understand students' basic knowledge of mathematics, basic skills, and emotional attitudes and values.

b. *Students' work*

(i) Preview course: Before case teaching, students can be arranged to preview the relevant background knowledge of definite integral after class.

(ii) Self-analysis: What is the understanding of differential knowledge? Can you introduce Hui Liu, his outstanding mathematician, and his "cutting technique"? What is the thinking method of "circle cutting" ?.

B. *Case Implementation Stage*

In the process of case implementation, the teacher first divides the students of different levels into several groups, and the members of each group have different levels of mathematics, which is helpful for them to discuss problems.

The teacher leads the students to understand the development history of definite integral and the production process of definite integral. After having a certain understanding of definite integral, teachers introduce cases to achieve the purpose of creating a good teaching environment for students. The teacher shows the irregular lawn in front of the teaching building to the students on the PPT, and gives the corresponding sketch, and asks the students to calculate its area.

Teacher asks questions: We have worked out the area of many plane graphics. Now let's have a look at it. Will you find the area of this lawn? Students think about this problem at their own cognitive level. Students will think of using simple graphics instead of irregular graphics, so that the irregular lawn can be converted into rectangle for calculation. Teacher asks: How to transform it? Student answer: Take a number of horizontal and vertical lines to divide the lawn, and then you can calculate the inner rectangular area. Teacher asks: How to find the area of the curved trapezoids around it? Students give different answers, and then let the students discuss the question in groups.

Teachers patrol in groups to encourage students to operate and make their own sketches. Teachers can give inspiration to each other by discussing in groups. (Can we turn curved trapezoids into straight trapezoids? What graphics should be selected to minimize the error of substitution? How to segment graphics? How many copies are divided?) Choose the best method in the group to present to the whole class, and introduce their own ideas and implementation plan.

Students in different groups summarize the conclusions and report on the process of problem solving. Students divide it into many small sections, and then divide the curved trapezoids into some small curved trapezoids. For each small curved trapezoids, "straight instead of curved", that is to say, the area of the small curved trapezoids is approximated by the area of the rectangle instead of the area of the small curved trapezoids. The approximate value of the area of each small curved trapezoids is obtained by summing up these approximate values, and the approximate value of the area of the curved trapezoid.

After the students' report, the teacher makes comments and supplements, and emphasizes some points that need to be paid attention to. In the segmentation, we should pay attention to the partition interval, in order to facilitate the processing, to take the bisection. In the learning process, let the students realize that the method of "dividing - approximate replacing - summing - taking the limit" is transformed into the method of finding the sum of the area of the small rectangle, and the idea of directly substituting the curve, invariant substituting and infinite approximation is adopted. Finally, with the help of the teacher, the students get the concept of definite integral, and carry out consolidation exercises through exercises.

### C. *Evaluation and Feedback*

a. Evaluation among students: After each group reports the results, other groups can raise questions or supplement them, and the groups can evaluate each other.

b. Evaluation and reflection by teachers: In the process of teaching, teachers can check the leaks and make up for the deficiencies of students' knowledge. They can also lead to new problems. Finally, they should make a summary and evaluation of students' reports.

c. Evaluation of curriculum design: Including the introduction of definite integral concept, the causes of difficulties, the explanation of key problems and the arrangement of courses [6].

## V. THE CONSTRUCTION SIGNIFICANCE OF CASE TEACHING MODEL

### A. *Conducive to the Improvement of Ideological Quality*

In senior high school mathematics class based on quality education, according to the connotation of educational purpose, the emphasis should be placed on the cultivation of scientific spirit in the cultivation of students' ideological quality. In the design process of high school mathematics case teaching model, according to the central goal, put forward key problems, through discussion and analysis to solve problems, pay more attention to the occurrence and development of knowledge. From the emergence, proposition, abstraction, analysis and solution of various mathematical problems, especially in the extensive application of life practice, students can understand the great power of science, enhance the intrinsic motivation of students to love mathematics and advocate science, and make students understand the difference and connection between scientific thinking and empirical intuition through rigorous reasoning process [8]. Let students to understand and analysis, comprehensive, inductive,

deductive and abstract, analogy and other mathematical methods of important value, inspire the enthusiasm of students in learning task and learning process, cultivate interest in learning.

### B. *Conducive to the Cultivation of Ability and Quality*

High school mathematics class mainly trains students' ability of observation and imagination, logical reasoning, analysis and problem solving, operation and spatial imagination. All these abilities can be cultivated in the quality education classroom. In the implementation of case-based teaching mode, teachers actively implement heuristic and discussion-based teaching, strengthen the guidance of learning methods, improve students' ability of independent thinking and self-learning, and let students learn how to observe and imagine, and how to analyze and solve problems with rigorous logic [8]. In the process of hands-on operation, students have mastered the ability of analyzing and solving problems, allowing them to design, practice and improve their learning strategies independently, so as to improve their learning ability. Case teaching model provides students with an innovative teaching situation, which enables them to compare, summarize, think, comprehend, analyze and make decisions, to integrate real background information, to use curriculum resources comprehensively, to investigate and analyze problems from multiple perspectives, to grasp the key of the problems, and to make reasonable answers according to known conditions.

### C. *Conducive to the Development of Emotional Attitudes and Values*

In the process of implementing the case teaching model, we should cultivate students' independence, divergence, creativity and willpower quality of patience and decisiveness. For the cultivation of independence, we should cut off the dependence of students' answers and leave enough time for students to think independently after putting forward questions in the classroom of mathematics teaching [8]. By commenting on other people's reports, answering other people's queries and evaluating between groups, students can constantly reflect on their own answers and improve their ability to reflect on mathematics. In addition, in the reporting process, students have increased the opportunity to use mathematical language to communicate with others. In group discussions, they have also learned to communicate with others in mathematics, which is helpful to improve students' communicative ability and promote their understanding of mathematical knowledge [9].

## VI. CONCLUSION

Constructing a case teaching model based on quality education is an inevitable prerequisite for quality education to go deep into the classroom, and it is also a basic guarantee for the quality education to be truly implemented. In the implementation process of high school mathematics case teaching mode, not only should we attach importance to imparting knowledge, but also pay attention to the penetration of mathematics learning methods, especially the cultivation of students' innovative spirit and practical ability. Only in this way, the quality education classroom will show a vigorous vitality, can truly improve the quality of teaching, and cultivate high-quality and high-quality socialist builders and successors.

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