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The cultivation of analytical, comprehensive, and technological innovation abilities among college students in higher mathematics teaching

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***Abstract*—In higher mathematics teaching, through careful teaching design by teachers, students are guided to actively acquire knowledge and stimulate their own awareness of technological innovation, thereby cultivating their analytical and comprehensive abilities and technological innovation abilities.**

***Index Terms*—Higher mathematics teaching; Analyze comprehensive abilities; Technological innovation capability.**

I. INTRODUCTION

Advanced mathematics is the most fundamental discipline in university education. In carrying out practical teaching work, the teaching objectives include two aspects: firstly, to improve the mathematical theoretical knowledge level of college students; The second is to cultivate the analytical and comprehensive abilities and technological innovation abilities of college students. In higher mathematics teaching, through the teacher's teaching design, students are encouraged to actively acquire knowledge, discover problems, propose problems, and try to solve them, thereby cultivating their analytical and comprehensive abilities and technological innovation abilities.

II. DEVELOPING COMPREHENSIVE ANALYTICAL ABILITIES

In higher mathematics teaching activities, after helping college students understand the background of mathematical knowledge, guiding them to analyze and compare various situations contained in the knowledge points, and facing comprehensive problems that apply the knowledge points, they can find clear solutions.

Example 2.1 Projection problem [2]. In the process of explaining spatial analytic geometry, we will talk about: (1) point to axis projection, point to surface projection. (2) vector to vector projection, vector to coordinate axis projection. (3) vector to coordinate plane projection, straight line to coordinate plane projection. (4) curve to coordinate plane projection. (5) spatial geometry to coordinate plane projection.

The teaching design of the teacher is as follows:

After finishing the above content, have students summarize and compare the search process of these projections to see what patterns they follow.

(1)What is the difference in the search process between point to axis projection and point to face projection? Is the projection result similar?

(2)What are the similarities in the search process between vector to vector projection and vector to coordinate axis projection? Is the projection result similar?

(3) Is there any similarity in the projection process between vectors onto coordinate planes and lines onto coordinate planes, and what are the differences in the projection results?

(4) How is the projection process from a curve to a coordinate plane different from the third scenario? What are the differences in projection results?

(5)How is the projection process from spatial geometry to coordinate planes related to the above projection methods?

The projection of spatial geometry onto a coordinate plane is relatively a comprehensive problem. Through this easy to difficult exploration method, college students can gradually deepen their understanding, thereby understanding and mastering the process and results of projection from spatial geometry onto a coordinate plane. Through this teaching method, students can develop their analytical and comprehensive abilities. [4] 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. [5] 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.

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III. THE CULTIVATION OF TECHNOLOGICAL INNOVATION ABILITY

Technological innovation capability refers to the ability to continuously create new theories, methods, and inventions in fields such as science and technology based on existing knowledge and theories. Technological innovation capability is the fundamental foundation for a nation to stand on. With the continuous development of society, the competition in society is actually the competition for talents, that is, the competition for talent creativity. Improving the technological innovation ability of college students is of great significance for the development of the entire society and the country. Therefore, cultivating the technological innovation ability of college students is a top priority in higher mathematics education.

In higher mathematics teaching, through the teacher's teaching design, it is not a cramming style, but a process of allowing students to learn and explore independently, constantly exploring in the ocean of knowledge, which is an innovative experience, awakening students' awareness of innovation and further possessing the ability of technological innovation.

Example 3.1 Integral problem [1-2]. In the study of integral, students understand that: (1) definite integral can calculate the area of a trapezoid with curved edges, the arc length of a plane curve, and the volume of a geometric body. (2) Double integral can be used to calculate the volume of a curved top cylinder and the mass of a flat sheet. (3) Triple integration can calculate the mass of a geometric body in space, and its significance is mainly manifested in physical terms.

The teaching design of the teacher is as follows:

Firstly, after learning multiple integrals, we can discuss with students and guide them to summarize the following patterns:

When calculating triple integrals, they are converted into a double product and a definite integral for calculation. Double integrals can also be converted into two definite integrals for calculation, using the dimensionality reduction decomposition technique, which is a decomposition technique from complex to simple and from difficult to easy.

Secondly, students can be asked the following four thinking questions:

(1)What other problems in advanced mathematics can be solved using decomposition techniques that range from complex to simple and from difficult to easy? What other problems in other disciplines and in daily life can be solved using this decomposition technique? Do you know any similar decomposition techniques?

(2)According to different thinking methods, when facing a certain problem, can we use either definite integral or double integral to solve it.

(3) Is it possible to use both double and triple integrals to solve a certain problem.

(4) Is there a problem that can be solved using definite integral, double integral, or triple integral?

(5) Further ask students the following question: Is there a triple or more integral, what does it mean, and how can it be calculated?

Integral is a highly applicable mathematical tool. By combining practical problems and exploring them in this way, students not only find joy in solving practical problems, but also guide them towards the path of technological innovation through the final step.

In summary, in higher mathematics teaching, through the teacher's teaching design, students are encouraged to actively acquire knowledge, learn and explore independently, gradually forming an innovative consciousness and further possessing the ability of technological innovation.

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