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Research on teaching strategies of mathematics and specialized courses in secondary vocational schools

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Abstract: *With the development of The Times, the society has higher and higher requirements for talents, and secondary vocational education bears the heavy responsibility of cultivating high-quality technical talents for the society. In view of the current position of secondary vocational mathematics in the secondary vocational education system, it is better to realize the cultivation of students' vocational ability. We analyzed and discussed the teaching strategy of the integration of secondary vocational mathematics and specialized courses. Taking the learning of students majoring in environmental monitoring technology as an example, this paper aims to study the effectiveness of the integrated teaching strategy of mathematics and specialized courses in secondary vocational schools.*

Keywords: *New curriculum standard; Secondary vocational mathematics; Specialized courses; Integration; Environmental monitoring technology*

1. Introduction

According to the latest edition of the “Mathematics Curriculum Standards of secondary vocational schools”, the task of the mathematics curriculum of secondary vocational schools in the new period is to enable students to acquire the necessary mathematical knowledge, mathematical skills, mathematical methods, mathematical thoughts and activity experience for further study and career development. The fundamental purpose of secondary vocational education is to cultivate excellent technical talents with strong cultural quality, innovative ability and practical skills for the country and society through targeted vocational education. Compared with the teaching concept of ordinary high schools, secondary vocational education focuses on the cultivation of students' vocational ability. Therefore, how to organically integrate mathematics courses with professional courses? To make mathematics teaching better serve the professional teaching and realize the cultivation of students' vocational ability is a problem that must be considered in mathematics teaching in secondary vocational schools[1-2].

2. Analysis of the current situation of the integration of mathematics and specialized courses in secondary vocational schools

2.1 In terms of teaching content and teaching materials

At present, the mathematics curriculum and the professional curriculum are often separate and independent, and they are in a state of their own system, lacking a clear integration and connection. Mathematics courses mainly focus on the cultivation of basic concepts and computational ability, while professional courses focus on practical application and practical operation.

2.2 In terms of teaching methods and resources

The teaching methods of mathematics in secondary vocational schools are mainly taught by teachers and listened by students, and lack of diversified teaching methods and utilization of resources. The teaching methods of professional courses are more practical but often less integrated with mathematical knowledge.

2.3 In terms of students' learning motivation

Due to the low integration of mathematics and specialized courses, students often find it difficult to understand the practical application and significance of mathematics in their majors, and thus lack the

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motivation for mathematics learning.

2.4 In terms of the quality and teaching ability of teachers

Some secondary vocational teachers lack a deep understanding of the integration of mathematics and professional courses, and can not provide effective guidance and support for students[3-4].

3. The necessity of integrated teaching of mathematics and specialized courses in secondary vocational schools

3.1 Enhancing students' professional ability

Mathematics is a basic subject, which is closely related to most professional fields. Combining mathematical knowledge with professional courses can help students better understand and apply mathematical knowledge and enhance their professional ability in professional fields.

3.2 Cultivating students' comprehensive qualities

Mathematical thinking and problem-solving ability are important ways to cultivate students' comprehensive quality. By combining mathematics with specialized courses, students' ability of critical thinking, logical thinking and innovative thinking can be cultivated, so as to improve their comprehensive quality.

3.3 Improving students' practical application level

Mathematics knowledge plays an important role in practical application, through the organic integration of mathematics and specialized courses, students can better understand the practical application scenarios of mathematical knowledge, and learn to apply mathematical knowledge to solve practical problems.

3.4 Promoting interdisciplinary exchanges among students

Professional fields usually require not only professional knowledge, but also communication and cooperation with other disciplines. By combining mathematics courses with professional courses, it can promote communication and cooperation between different disciplines, cultivate students' comprehensive qualities and interdisciplinary abilities.

4. Integrated teaching strategy of mathematics and professional courses in secondary vocational schools: Taking environmental monitoring technology as an example

4.1 Innovation in teaching mode

By adopting new teaching models such as flipped classroom, split classroom and blended teaching, teaching activities are extended from classroom to extracurricular, and the second classroom is developed to guide students to solve practical problems with mathematical knowledge based on the principle of combining teacher leadership and student subjectivity. In the mathematics course, introduce problems related to the major, and help students discover the mathematical models and principles behind the problems, so as to stimulate students' learning interest and motivation. For example, combined with the five-in-one professional teaching characteristics of the environmental monitoring technology major of our school, function knowledge is used to calculate the relationship between sludge moisture content and sludge volume in water treatment engineering[5-7].

4.2 Interdisciplinary cooperation

By collaborating with mathematics-related disciplines, we co-design and implement projects, studies and experiments to solve practical problems. Through intersections with other disciplines, students deepen their understanding and application of mathematics. For example, integrated with the experiment of the core professional course "Environmental Microbiology", the mathematical software GeoGebra is

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used to draw the specific growth rate curve of microorganisms in the logarithmic growth phase of sewage treatment.

4.3 Integration of teaching resources

We make full use of network technology to integrate teaching resources, establish a database of mathematical material resources, build a teacher-student exchange platform by combining online and offline teaching mode, and link relevant materials of mathematical culture and professional materials, such as mathematical knowledge, mathematical tools and mathematical cases commonly used in professional practice, so as to expand students' knowledge through knowledge links. To help students better understand and use math knowledge. At the same time, students are encouraged to actively use these resources for learning and research.

4.4 Multi-assessment

The traditional teaching evaluation is divided by the weight of peacetime scores and examination scores, and peacetime scores mostly depend on students' daily homework. This evaluation method ignores the cultivation of students' practical ability and is not conducive to the improvement of students' vocational ability. Therefore, it is necessary to develop diversified evaluation methods, improve and optimize the original teaching evaluation system, combine students' professional characteristics and practical ability, conduct scientific and reasonable evaluation of students' learning situation, pay attention to the evaluation of students' practical application ability, scientifically allocate the proportion of theoretical teaching and practical teaching, and encourage students to cultivate their exploration, innovation and teamwork ability.

5. Example of integrated teaching design of mathematics and specialized courses in secondary vocational schools

5.1 Teaching content

Content introduction: "Mean and standard deviation of samples" is the teaching content of the "Probability and Statistics Preliminary" section in the "Mathematics (Basic Module)" course. The mean and standard deviation are widely used in data processing, data representation, and data analysis in many industries, and have significant statistical significance.

Analysis of learning situation: The teaching objects are first-year students majoring in environmental monitoring technology. They have active thinking, strong initiative and desire to express themselves, but lack the spirit of hard study, innovation and enterprise. As students in vocational schools, they are relatively weak in learning ability and self-control, but have strong practical ability and communicative ability. Therefore, in the course design, we can appropriately increase the links of students' demonstration and discussion to arouse students' enthusiasm. Compared with high school students, secondary vocational students do not accept the traditional theoretical classroom, but show strong interest in practice and discussion, and have a high degree of classroom activity. At the same time, students have a high degree of acceptance of new teaching techniques and have a strong desire for performance.

Focus: Calculation of mean and standard deviation.

Difficulty: The application of mean and standard deviation.

5.2 Teaching objectives

5.2.1 Knowledge and skill objectives

(1) Understanding the meaning of mean and standard deviation;

(2) Mastering the calculation method of mean and standard deviation;

(3) Applying mean and standard deviation analysis to solve practical problems.

5.2.2 Process and method objectives

Combined with specific professional practical cases, through the formation process of the concept of mean value and standard deviation, students start from specific tasks, which is conducive to the

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development of teaching and the expansion of students' thinking. Let students use the mean and standard deviation analysis to solve practical problems step by step, break through the difficulties of this lesson, deepen the understanding of concepts, and at the same time, apply what they have learned to achieve the purpose of consolidation and improvement[8-10].

5.2.3 Emotions, attitudes and values objectives

(1) Cultivating students' craftsman spirit of seeking truth, pragmatism and excellence;

(2) Cultivating students' professional attitude of hard-working, rigorous and meticulous, serious and focused;

(3) Cultivating students to practice quality standards and safety norms.

5.3 Teaching design and implementation

5.3.1 Preparing before class, creating situations

Teacher publishs tasks through the platform:

Task 1: The class is divided into four groups to determine the concentration of total volatile organic pollutants (TVOC) in two classrooms and two laboratories in the school, and the distribution and determination methods were carried out in accordance with the "***Standards indoor air quality*** (GB/T18883-2022)".

Task 2: The class is divided into two groups to collect and test the chemical oxygen demand (COD) of water samples at fixed points on fixed sections of two rivers in the city for 10 consecutive days (sampling once a day at 17:00). The collection of water samples is carried out in accordance with the "***Technical specifications for surface water environmental quality monitoring*** (HJ 91.2-2022) ". The determination of COD in water samples shall be carried out in accordance with the "***Environmental quality standards for surface water*** (GB 3838-2002) ".

5.3.2 Introducing new course, exploring new knowledge

(1) Collecting monitoring data of students' pre-class task 1.

(2) Task 1 according to the layout requirements of "***Standards indoor air quality*** (GB/T18883-2022)", our classrooms and laboratories must be arranged with 3 to 5 sampling points, and 4 groups of students have been arranged with 5 points to meet the standard requirements.

(3) Question: Can we compare the TVOC concentration between classroom 1 and laboratory 1?

(4) Introducing new knowledge: If the sample data are x_1, x_2,... x_n, so the sample mean or the mean is

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

5.3.3 Advancing gradually in due order, continuing to explore new knowledge

(1) By learning the sample mean, we can calculate the average concentration of TVOC (mg/m^3) in two classrooms and two laboratories.

(2) Which laboratory has more uniform TVOC distribution?

(3) Analysis: In this case, it is necessary to compare the deviation degree of TVOC concentration value relative to the sample mean at each point in the two laboratories. The greater the degree of deviation, the more dispersed the TVOC distribution; The smaller the deviation, the more evenly TVOC is distributed.

However, careful students will find that the deviation of the concentration value of TVOC at each point relative to the sample mean is positive and negative. If directly added, there will be a situation where the deviation will cancel each other, and can not objectively reflect the degree of deviation. At this time, what method can be used to describe this degree of deviation?

(4) Introducing new knowledge: If the sample consists of n numbers x_1, x_2,... x_n, where $\bar{x}$ is the sample mean, so the sample variance is

$$s^2 = \frac{1}{n-1}[(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots (x_n - \bar{x})^2]$$

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Since the unit of variance is the square of the unit of the data, it is inconvenient to use, so the arithmetic square root of the sample variance is often used to represent the degree of deviation between the individual and the sample mean, which is called the sample standard deviation.

$$s = \sqrt{\frac{1}{n-1}[(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots (x_n - \bar{x})^2]}$$

5.3.4 Learning to apply, consolidating and improving

(1) Collecting monitoring data of students' pre-class task 2.

(2) Problem: Judging the quality and fluctuation of water quality of river A and river B.

(3) By comparing the mean value, we can judge which river has better water quality, and by comparing the standard deviation, we can judge which river has greater water quality fluctuation.

5.3.5 Practical exercise, review and summary

(1) Practical exercise: The forging workshop of an enterprise randomly selects 10 parts from a batch of parts for length measurement (unit: mm), and the measurement data are as follows: 105, 99, 101, 103, 96, 98, 100, 105, 95, 104, and the average length and standard deviation of these parts are calculated.

(2) Review summary: In this lesson, we have learned the mean and standard value of the sample, review the two statistical concepts and their formulas. Where can I use the mean and standard values of the sample in my study, work and life? Give an example.

6. Conclusion

The purpose of secondary vocational education is to train students to become knowledgeable, development-oriented and high-quality technical skills talents with the basis of career development. As a basic subject, mathematics plays an important role, especially in science and engineering. Promoting the integration of secondary vocational mathematics and professional courses is helpful to improve students' understanding of the application of mathematical knowledge, cultivate students' ability to solve practical problems, and enhance students' professional quality and vocational ability. The integration of secondary vocational mathematics and specialized courses is a process of continuous exploration and improvement. At the same time, we also need to continue to pay attention to the progress of teaching reform and the support of relevant policies, so as to better provide the environment and conditions for the integration of secondary vocational mathematics and specialized courses.

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