

Research on the Problems and Countermeasures of Mathematics Teaching Connection between Secondary and Higher Vocational Education under the Background of Independent Enrollment

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Abstract: In recent years, the enrollment scale of higher vocational education in China has been continuously expanding. As an important enrollment channel for higher vocational colleges, independent enrollment has attracted an increasing number of students from secondary vocational schools to apply. The integrated schooling of secondary and higher vocational education has also become an important development direction for constructing a modern vocational education system. Under such circumstances, realizing a smooth connection of mathematics teaching between secondary and higher vocational stages can not only help students admitted through independent enrollment adapt to the learning rhythm of higher vocational colleges faster after entering higher vocational education, but also consolidate the foundation of talent cultivation in vocational education. Nevertheless, judging from actual teaching practice, students admitted via independent enrollment have obvious adaptation problems in mathematics learning after entering higher vocational colleges, and there are multiple disconnections in the mathematics teaching links between secondary and higher vocational education. In view of this, this paper first analyzes the problems existing in the mathematics teaching connection between secondary and higher vocational education under the background of independent enrollment, and then puts forward effective solutions, so as to provide certain references for relevant researchers.

Keywords: Independent enrollment; Secondary and higher vocational education; Mathematics teaching; Connection problems; Countermeasures

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1. Problems of Mathematics teaching connection between secondary and higher vocational education under the background of independent enrollment

1.1. Disconnected teaching objectives

Mathematics teaching in the secondary vocational education stage mainly takes serving students' professional skill learning as its core objective, focusing on cultivating basic computing ability and explaining simple and practical mathematical knowledge, with low requirements for systematicness, logic and abstract thinking of knowledge. To meet the demands of skill training, some secondary vocational colleges even delete a large number of complex mathematical deductions and extended contents, only retaining basic modules directly related to majors. Mathematics teaching in higher vocational education focuses on cultivating students' ability to solve complex problems in professional fields with mathematical thinking, which requires students to possess strong capabilities such as logical reasoning, abstract analysis and independent inquiry, as well as higher standards for the coherence and integrity of knowledge systems. Due to different positioning of teaching objectives, students admitted through independent enrollment can hardly adapt to the teaching requirements of higher vocational mathematics rapidly after enrollment, which undermines students' learning confidence and hinders the normal development of mathematics teaching ^[1].

1.2. Poor connection of curriculum content

The content arrangement of secondary vocational mathematics centers on basic application with few internal connections between knowledge points, and the depth only stays at memorization and simple application. Many students admitted through independent enrollment have only learned fragmented content related to their own majors without mastering a complete senior high school mathematics knowledge system. Higher vocational mathematics takes functions, limits, integrals and other contents as its backbone, and many knowledge points need to be extended and expanded on the basis of secondary vocational mathematics. For example, in calculus teaching, students are required to master the relevant properties of functions proficiently. Since many students admitted via independent enrollment have not systematically learned relevant content in the secondary vocational stage, they will encounter knowledge gaps and fail to keep up with the teaching progress when learning higher vocational knowledge.

In addition, there is no unified connecting compilation standard for secondary and higher vocational mathematics textbooks. Some secondary vocational textbooks repeat partial basic modules of higher vocational mathematics, while many higher vocational textbooks presuppose that students have mastered all core knowledge points of secondary vocational mathematics at the very beginning without setting transitional connecting contents. This further widens the gap in knowledge connection, making students with weak foundations admitted through independent enrollment unable to enter the learning state quickly ^[2].

1.3. Single teaching methods

Most mathematics teaching in secondary vocational colleges still adopts the cramming teaching mode of teachers lecturing and students listening. Classes mainly focus on explaining example questions, formula application and repeated exercises, with rare guidance for students to conduct independent inquiry, group discussion or problem-based teaching combined with professional scenarios. Over time, students admitted through independent enrollment get used to receiving knowledge passively and lack the habit of active thinking and independent construction of knowledge systems.

Higher vocational mathematics features a fast teaching rhythm and dense knowledge points. Many

teachers directly present abstract concepts and deduction processes, laying more stress on guiding students to understand and digest knowledge independently. Most students admitted through independent enrollment who have adapted to the slow-paced passive learning in secondary vocational schools cannot follow the teachers' teaching ideas in higher vocational colleges. They neither take the initiative to sort out the connections between knowledge points nor dare to raise questions, gradually falling behind in learning.

Apart from secondary and higher vocational teaching, stratified teaching activities tailored to differences in students' foundations are rarely designed in mathematics teaching for students admitted through independent enrollment. Uniform teaching methods can neither enable students with weak foundations to understand and absorb knowledge nor meet the ability cultivation requirements of higher vocational education, thus widening the gap between teaching and learning and impairing the effect of the mathematics teaching connection between secondary and higher vocational education ^[3].

2. Countermeasures to solve the problems of mathematics teaching connection between secondary and higher vocational education under the background of independent enrollment

2.1. Unify teaching objectives and construct a coherent objective system

The unification of teaching objectives is the premise of mathematics teaching connection. Secondary and higher vocational colleges shall strengthen communication and cooperation, and build a coherent, progressive and targeted mathematics teaching objective system for secondary and higher vocational education in accordance with the characteristics of talent cultivation via independent enrollment and major demands ^[4].

First, clarify the orientation of mathematics connection. The mathematics teaching objectives of secondary and higher vocational education shall be guided by the development needs and career development of students admitted through independent enrollment, adhere to the principles of consolidating foundations, improving abilities and matching majors, break the fragmented operation of individual schools, and establish a collaborative formulation mechanism of teaching objectives for secondary and higher vocational education.

The mathematics teaching objectives of the secondary vocational stage shall be based on consolidating basic knowledge, basic computing ability and the ability to cope with independent enrollment examinations. On this basis, basic requirements of higher vocational mathematics and major demands shall be incorporated, with emphasis on cultivating students' mathematical thinking ability and preliminary application ability to lay a foundation for their mathematics learning after entering higher vocational colleges.

The mathematics teaching objectives of the higher vocational stage shall fully take into account the mathematical foundations of students admitted through independent enrollment. On the premise of consolidating basic secondary vocational knowledge, they shall focus on cultivating students' mathematical application ability, modeling ability and innovation ability, highlight the integration of mathematics and professional courses, and satisfy students' demands for professional learning and career development ^[5].

Second, refine objective levels. In accordance with students' learning progress and the law of ability improvement, the mathematics teaching objectives of secondary and higher vocational education are divided into three levels: basic level, promotion level and application level.

The basic level corresponds to mathematics teaching in the secondary vocational stage, covering key points of secondary vocational mathematics examinations and basic knowledge points of higher vocational mathematics to cultivate students' computing ability and concept understanding ability.

The promotion level corresponds to mathematics teaching in the early stage of higher vocational education, focusing on knowledge connection and expansion to help students make up for knowledge gaps and gradually adapt to the learning rhythm of higher vocational mathematics.

The application level corresponds to mathematics teaching in the middle and later stages of higher vocational education, guided by professional application to cultivate students' ability to solve practical professional problems with mathematical knowledge and realize in-depth integration of mathematics and majors ^[6].

2.2. Optimize curriculum content and build a smoothly connected curriculum system

Optimization of curriculum content is the key to teaching connection. Starting from independent enrollment examinations and major demands, the mathematics curriculum content of secondary and higher vocational education shall be arranged as a whole to eliminate knowledge gaps and repetitions, and establish a naturally connected and targeted curriculum system ^[7].

First, sort out curriculum content. Secondary and higher vocational colleges shall jointly set up a mathematics curriculum connection team to sort out secondary and higher vocational mathematics curricula, identify overlapping and connecting parts, and reasonably divide teaching priorities.

For overlapping knowledge points such as sets, functions and trigonometric functions, secondary vocational teaching mainly explains basic concepts and basic operations, while higher vocational teaching expands and extends relevant contents and deepens application combined with major demands. For knowledge points with gaps such as basic calculus, complex numbers, and vectors, preliminary paving teaching shall be appropriately added in the secondary vocational stage to prepare students for higher vocational learning, and the difficulty shall be raised gradually on the basis of secondary vocational knowledge in higher vocational teaching to realize a natural transition of knowledge. For instance, when explaining functions in secondary vocational schools, teachers can appropriately introduce basic concepts and simple applications of derivatives to lay a foundation for calculus teaching in higher vocational colleges. For special mathematical knowledge required by majors such as electronics and surveying and mapping, relevant basic knowledge shall be supplemented in a targeted manner in the secondary vocational stage to ensure students can rapidly adapt to mathematics learning related to their majors after entering higher vocational colleges ^[8].

Second, strengthen the connection between curriculum content, independent enrollment examinations and major demands. The content of secondary vocational mathematics curricula shall center on examination points of independent enrollment examinations, highlight key points and break through difficult points, optimize the arrangement of teaching content, ensure high consistency between teaching content and examination requirements of independent enrollment, and help students improve their examination scores.

The content of higher vocational mathematics curricula shall be linked to major characteristics and adopt modular design. In accordance with different major demands, the emphasis and teaching depth of mathematical knowledge shall be adjusted, mathematical knowledge shall be integrated with practical professional problems, and the practicability and pertinence of curricula shall be strengthened.

For example, add content about the application of complex numbers and vectors for electronic majors; add extended application of trigonometric functions for surveying and mapping majors; add probability, statistics, and data analysis teaching for accounting majors, so that mathematics curricula can truly serve majors ^[9].

2.3. Innovate teaching methods to realize smooth transition of teaching modes

Innovation of teaching methods is an important means to achieve teaching connection. In accordance with the learning characteristics of students admitted through independent enrollment, teachers shall guide students to shift from passive learning to active learning so as to optimize teaching outcomes ^[10].

First, propose measures to improve mathematics teaching methods in secondary vocational schools. While retaining the advantages of traditional teaching methods, secondary vocational schools shall introduce inquiry-based and interactive teaching methods purposefully and systematically to cultivate students' awareness and ability of independent learning.

For example, teachers can take the initiative to combine real-life and professional cases to explain mathematical knowledge points, making mathematics vivid, intuitive and easy to understand so as to mobilize students' participation enthusiasm; organize classroom activities such as group cooperative learning, in-class questioning and class discussion to encourage students to think actively and speak up, and gradually develop the habit of independent learning; adopt multimedia teaching tools such as animations and videos to assist in explaining key and difficult points of knowledge, improving the fun and intuitiveness of classroom teaching.

Meanwhile, secondary vocational mathematics teaching shall cultivate students' learning methods, guiding them to master basic learning methods including previewing, attending classes, reviewing and finishing homework to lay a foundation for independent learning in higher vocational colleges ^[11].

Second, improve mathematics teaching methods in higher vocational colleges. In the higher vocational stage, teachers shall take the mathematical foundations and learning characteristics of students admitted through independent enrollment into consideration, and avoid blind teaching activities merely for the sake of teaching progress and innovative methods. Instead, they shall attach importance to the pertinence and practicability of teaching methods.

In the early stage of higher vocational education, teachers can retain teaching methods adopted in secondary vocational schools, and gradually adopt case teaching, project-driven teaching, mathematical modeling teaching and other methods to cultivate students' independent learning ability; arrange teaching content combined with practical professional cases, integrate abstract mathematical knowledge with practical professional problems, enable students to perceive the practicability of mathematics and arouse their learning initiative.

Taking calculus as an example, teachers can connect professional cases such as engineering cost calculation and output optimization in the teaching process, encourage students to apply calculus knowledge to solve practical problems, and adopt teaching tools such as mathematical simulation software and online teaching platforms to assist teaching activities, enabling students to gain a deeper understanding of complex mathematical concepts and improve learning efficiency ^[12].

2.4. Strengthen student training and improve students' learning adaptability

First, implement psychological guidance for learning. Secondary and higher vocational colleges should carry out targeted psychological counseling activities to address the psychological imbalance faced by students admitted through the separate recruitment program after they enter higher vocational colleges. At the secondary vocational stage, schools should attach importance to cultivating students' stress resistance and self-discipline, helping them view the separate recruitment examination and further education rationally and develop a correct attitude toward learning. At the higher vocational stage, freshmen orientation education shall be organized to introduce the teaching characteristics, learning requirements and significance of

higher vocational mathematics, enabling students to assess their own foundational math proficiency, set learning goals, overcome fear and overconfidence in study, and build up learning confidence. Schools shall establish student learning files to track their academic performance and mental state, and provide one-on-one tutoring for students with learning difficulties or emotional fluctuations to help them resolve academic and psychological challenges ^[13].

Second, strengthen guidance on learning methods. Mathematics teachers in secondary and higher vocational institutions shall deliver systematic guidance on mathematical learning methods tailored to students' academic status. At the secondary vocational stage, the focus is on teaching fundamental learning approaches including pre-class preview, in-class listening, after-class review and error sorting, so as to foster students' awareness of autonomous learning. At the higher vocational stage, teachers prioritize guiding students to master learning methods such as independent inquiry, collaborative learning and mathematical modeling, training them to analyze and solve problems and boosting their learning competence. Meanwhile, students should be encouraged to take part in extracurricular activities like mathematics competitions and math interest groups after class to broaden their knowledge scope and enhance their interest and ability in mathematics learning ^[14].

Third, set clear learning goals to stimulate learning motivation. Activities including major awareness education and career planning guidance shall be held to help students understand the connections between mathematics, professional coursework and career development, recognize the vital value of learning mathematics, and establish specific learning objectives. Students should integrate mathematics learning with professional practice and the improvement of vocational skills, perceive the practical value of mathematics through practical operations, and thereby ignite their internal motivation for learning ^[15].

3. Conclusion

In a word, the mathematics teaching connection between secondary and higher vocational education under the background of independent enrollment is an important subject to meet the talent cultivation demands of independent enrollment and improve the quality of higher vocational mathematics teaching. The connection problems existing in objectives, contents and methods of secondary and higher vocational mathematics teaching directly affect the learning experience and learning outcomes of students admitted through independent enrollment.

To tackle these problems, colleges can adopt strategies including unifying teaching objectives to build a coherent objective system, optimizing curriculum content to build a smoothly connected curriculum system, innovating teaching methods to realize a smooth transition of teaching modes, and strengthening student training to improve students' learning adaptability. These measures help students admitted through independent enrollment complete the transition of mathematics learning from secondary to higher vocational education smoothly, consolidate their foundation for professional learning, meet the requirements of mathematical core literacy for career development, and effectively improve the quality of mathematics teaching connection between secondary and higher vocational education.

Disclosure statement

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