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# Teaching Innovation Achievement on Discrete Mathematics

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**ABSTRACT:** The purpose of the report on the teaching innovation achievements of the Discrete Mathematics course is to summarize and reflect on the innovative measures and effectiveness of the course in teaching practice. The report focuses on the reconstruction of curriculum content, the innovation of teaching methods, the creation of teaching environment, and the reform of teaching evaluation, and presents the results of teaching experimental research. Through a series of innovative practices, the course significantly improves students' logical thinking, abstract expression and problem-solving skills, enhances students' sense of innovation and teamwork ability, and provides strong support for talent training in the fields of computer science and information technology. Based on the real problems in teaching practice, the report adopts the paradigm of teaching experimental research to solve teaching problems through the reconstruction of course content, the innovation of teaching methods, the creation of teaching environment, and the reform of teaching evaluation. The practice of teaching innovation has achieved remarkable results, and students' interest and enthusiasm in learning have been improved, and the learning effect and ability training have been strengthened. The promotion value of teaching innovation achievements lies in disseminating educational concepts, learning from teaching methods, sharing teaching resources, promoting teacher training and exchanges, improving educational equity and quality, and promoting the reform of talent training models. The conclusion emphasizes that the teaching innovation practice of Discrete Mathematics has achieved remarkable results, which provides strong support for the cultivation of talents in the new era. We will continue to deepen curriculum reform and explore more innovative measures to contribute to improving the quality of education and teaching.

**KEYWORDS:** Teaching reform; Innovation; Achievement; Discrete Mathematics

## I. BACKGROUND

In today's information age, the development of computer science and information technology is changing with each passing day, and it has become an important force to promote social progress. As a fundamental discipline in these fields, the importance of discrete mathematics is self-evident. It not only provides theoretical tools and methodologies for computer science, but also plays a vital role in algorithm design, data structure, network communication, information security, etc. In the face of the demand for talent training in the new era, the traditional teaching mode of "Discrete Mathematics" course has been difficult to meet the requirements of industry development. To this end, we have carried out an innovative reform of the "Discrete Mathematics" course, aiming to solve the problems existing in traditional teaching, improve the teaching quality and students' comprehensive ability.

The Discrete Mathematics course has a long history in our school, and since its inception in the 80s, it has undergone many reforms and developments. Especially after changing its name to Taishan University in 2012, this course has officially become a compulsory course for Major in Information and Computing Science. From infrastructure construction to exploration and innovation, and then to diversify mixing, curriculum construction has gone through three main stages:

- (1) Capital construction (2012-2017), clarify teaching objectives and build a teaching system.
- (2) Exploration and innovation (2018-2019), implement the reform of OBE teaching mode, and launch the application on the Fan Ya online teaching platform of Taishan University.
- (3) Diversified and mixed (2020-present), approved as an online open course for colleges and universities in Shandong Province and a first-class course in Taishan University, integrating curriculum ideology and politics, increasing





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information-based teaching methods, adding computer-based experiments, and building a diversified evaluation system.

In this process, the college has always adhered to the student-centered and result-oriented, and constantly adjusted the teaching content and methods, in order to cultivate more high-quality talents with innovative spirit and practical ability.

### II. PROBLEMS EXISTING IN TEACHING PRACTICE AND EFFECTIVE SOLUTIONS

In the process of teaching practice, we found the following problems and put forward corresponding solutions:

(1) The course content is too theoretical and out of touch with practical application

The traditional Discrete Mathematics course focuses on theory and lacks practical application cases, which makes it difficult for students to apply what they have learned to practical problems, and their interest and motivation in learning are insufficient.

(2) The teaching method is simple, and it is difficult to stimulate students' interest and enthusiasm

The traditional lecture-based teaching method ignores the subjectivity of students, and the classroom interaction is insufficient, which makes it difficult to stimulate students' interest and enthusiasm in learning.

(3) The teaching environment is not conducive to students' active learning and teamwork

Traditional classroom layouts and teaching processes limit students' active learning and teamwork, and students often passively accept knowledge and lack opportunities for practice and inquiry.

(4) The teaching evaluation system pays too much attention to test results and ignores process evaluation and ability training

The traditional teaching evaluation system relies too much on the final examination results, ignores the learning process and ability training of students, and is not conducive to the improvement of students' comprehensive quality.

Through a series of curriculum and teaching reforms, this achievement effectively addresses these problems:

(1) Reconstruct the course content to enhance the practicality

In order to solve the problem of disconnection between the course content and practice, we have restructured the course content and added the modules of practical case analysis and hands-on experiments. By combining theoretical knowledge with practical problems, students learn and master discrete mathematics in the process of solving specific problems.

(2) Innovate teaching methods to increase student engagement

We have adopted a blended teaching model that combines online and offline, including flipped classrooms, group discussions, project-based learning, etc. These methods increase students' participation in the classroom and stimulate students' interest and motivation to learn.

(3) Create a diverse teaching and learning environment that fosters active learning and teamwork

We revamped our classroom layouts, set up multi-purpose labs, and provided an online learning platform to create an environment conducive to active learning and teamwork for our students. Students are better able to explore and practice in such an environment.

(4) Reform the teaching evaluation system, focusing on process and ability assessment

We have established a diversified teaching evaluation system, which includes students' usual performance, computer experiments, project assignments, etc., into the assessment scope, and reduces the dependence on final exam results. Such an evaluation system pays more attention to students' process performance and ability development, which is conducive to the comprehensive evaluation of students' learning outcomes.

Through the above measures, the problems existing in teaching practice are effectively solved, the teaching quality of Discrete Mathematics is improved, and the all-round development of students is promoted.

### III. TEACHING INNOVATION MEASURES

#### (1) Reconstruction and implementation of curriculum content

1) Restructuring of course content

In view of the problems existing in teaching practice, we have comprehensively reconstructed the content of Discrete Mathematics, aiming to improve the practicality, application and interest of the course, so as to better cultivate students' logical thinking, abstract expression and problem-solving ability.



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**Modular design:** The course content is divided into five theoretical modules and five hands-on experimental modules, each of which revolves around a core knowledge point. Theoretical modules include: Mathematical Logic, Set Theory, Binary Relations, Functions, and Graph Theory. The hands-on experiment module corresponds to the theory module, which aims to deepen the understanding of theoretical knowledge through practical operation.

**Case-driven teaching:** In each theoretical module, we introduce a large number of practical cases, which are derived from real life and the field of computer science, so that students can intuitively see the application scenarios of discrete mathematical knowledge, so as to increase the interest and motivation of learning.

**Interdisciplinary integration:** In order to broaden students' knowledge horizons, we have integrated interdisciplinary content into the curriculum, such as algorithm analysis and data structures in computer science, so that students can learn about discrete mathematics while also understanding its application in other disciplines.

### 2) Implement a strategy

**Combination of online and offline:** We have adopted a combination of online and offline teaching mode, using MOOC and SPOC platforms to provide a wealth of online resources, including video lectures, interactive tests, discussion forums, etc. Offline classes are mainly used for answering questions, group discussions, and hands-on experiments.

**Flipped classroom:** In the classroom, we have implemented a flipped classroom approach, where students learn theory on their own through online resources before class, while the class focuses on discussions, applications and experiments, and teachers play the role of facilitators and mentors.

**Hands-on experiments:** Hands-on labs are an important part of the curriculum, and we have designed lab projects that match the theoretical modules to allow students to solve real-world problems through programming in a laboratory setting, thereby deepening their understanding of discrete mathematical concepts.

**Project-based learning:** The course encourages students to engage in project-based learning, working in teams to complete a complete discrete mathematics project, from problem formulation to solution design to presentation of results, the whole process is designed to develop students' independent thinking and teamwork skills.

**Continuous feedback and improvement:** We have established a feedback mechanism to collect feedback from students and teachers on a regular basis, and adjust the teaching content and methods according to the feedback, so as to ensure that the course content is always in line with the teaching objectives and the learning needs of students.

Through the above reconstruction and implementation strategies, we have successfully made the Discrete Mathematics course closer to practical application, improved students' learning enthusiasm and effectiveness, and laid a solid foundation for cultivating students with a solid mathematical foundation and innovative ability.

### (2) Innovation in teaching methods

In order to improve the teaching quality of Discrete Mathematics, we have made the following innovations in view of the shortcomings of traditional teaching methods:

#### 1) Blended online and offline teaching

**Make full use of online resources:** We have built a rich online resource library, including instructional videos, animated demonstrations, interactive exercises, and simulation labs, which provide students with flexible learning styles that are not limited by time and place.

**Online and offline interaction:** Through the online platform, teachers can monitor students' learning progress in real time, and students can also ask questions and participate in discussions online. Offline classes focus on face-to-face communication, solve difficult problems in online learning, and achieve effective interaction between online and offline.

#### 2) Flipped classroom teaching model

**Pre-class preview:** Students preview the content of the new lesson by watching teaching videos and reading textbooks before class to complete the absorption of basic knowledge.



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In-class deepening: In the classroom, teachers no longer repeat the basic knowledge, but guide students to deepen their understanding and improve their thinking ability and problem-solving ability through questions, discussions, case analysis, etc.

### 3) Project-based learning approach

Project design: Teachers design a series of projects related to practical applications, and let students apply discrete mathematics knowledge to solve real-world problems in the projects.

Teamwork: Students work in small groups to develop their communication skills and collaborative spirit through teamwork.

### 4) Case-driven teaching

Case selection: We have carefully selected a number of representative cases, which cover all knowledge points of discrete mathematics, so that students can intuitively see the practical application of theoretical knowledge.

Case discussion: In the classroom, teachers guide students to conduct in-depth discussions on cases, so that students can master theoretical knowledge and improve their ability to analyze and solve problems in the process of analyzing cases.

### 5) Introduction of experimental pedagogy

Hands-on experiments: Combined with the theoretical knowledge of discrete mathematics, we have designed a hands-on experiment course to allow students to verify theories and improve practical operation ability by writing code and running programs.

Experiment report: Students are required to write an experimental report and summarize the experimental process and results, which not only exercises students' writing ability, but also deepens their understanding of experimental principles.

### 6) Diversified evaluation system

Process evaluation: We emphasize the importance of process evaluation, and incorporate students' classroom participation, online assignments, online tests, and online discussions into the evaluation system, accounting for 50% of the final comprehensive grades, so as to make the evaluation more comprehensive.

Ability assessment: In addition to the traditional written test, we have also added assessment methods such as project performance, comprehensive training, and experimental reports, and paid more attention to the cultivation and evaluation of students' abilities.

Through the innovation of the above teaching methods, we have effectively improved the teaching effect of the Discrete Mathematics course, stimulated students' interest in learning, cultivated students' independent learning ability and innovation ability, and laid a solid foundation for students' all-round development.

### (3) Creation of a teaching environment

In order to better implement the teaching method innovation of the "Discrete Mathematics" course, we have created the following teaching environment:

#### 1) Online learning platform

We have established a complete online learning platform, including: the establishment of the Wisdom Tree MOOC platform, the Chaoxing learning platform, the upload of nearly 2,000 courseware, nearly 1,000 minutes of teaching videos, about 400 test question banks, about 300 homework questions, about 20 reference papers, more than 60 academic papers, more than 10 links to related websites, and a number of external course learning websites. These platforms provide a wealth of teaching resources, such as instructional videos, animated demonstrations, interactive exercises, and simulation experiments, so that students can flexibly plan when and where they study. At the same time, teachers can monitor students' learning progress in real time through the platform, answer students' questions in a timely manner, and achieve effective interaction online and offline.

#### 2) Multi-purpose classrooms

We renovated traditional classrooms and built multi-purpose classrooms. These classrooms are equipped with modern teaching equipment such as projectors, computers, stereos, etc., providing a good learning environment for students. In



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the classroom, teachers can use multimedia equipment to display teaching content, carry out group discussions, case studies and other activities to improve students' interest and participation in learning.

### 3) Laboratory environment

We set up a laboratory environment, equipped with computers, network equipment, etc. The laboratory is mainly used for computer-based laboratory courses, allowing students to verify theories and improve practical operation ability in practical operations. The laboratory environment helps to develop students' practical and innovative skills, laying the foundation for their future development.

### 4) Project Studio

We have set up a project studio to provide students with a free and open environment for innovation. Here, students can form teams, work together on research projects, and develop teamwork skills and innovative spirit. The project studio provides a platform for students to showcase their talents and realize their self-worth.

### 5) Online Discussion Forum

We have set up online discussion forums, including forums, QQ groups, WeChat groups, etc. Students can share their learning experiences and exchange questions in the discussion forum, and teachers can also participate in discussions and answer students' questions. The online discussion forum helps to increase students' interest in learning and promote communication and cooperation among students.

By creating the above teaching environment, it provides strong support for the innovation of teaching methods in the course of Discrete Mathematics. Students can make full use of online resources for self-directed learning, offline classes focus on teacher-student interaction and hands-on activities, and laboratories and project studios provide a platform for students' practice and innovation. Such a teaching environment helps to improve students' learning outcomes, cultivate their self-directed learning ability and innovation ability, and lay a solid foundation for their future development.

## (4) Reform of teaching evaluation

In order to evaluate students' learning outcomes more comprehensively, we have reformed the traditional evaluation system and built a diversified evaluation system, focusing on process evaluation and ability assessment.

### 1) Process evaluation

We emphasize the importance of process evaluation, and incorporate students' classroom participation, online assignments, online tests, and online discussions into the evaluation system. This helps to motivate students to learn and increase their interest and motivation to learn.

### 2) Competency assessment

In addition to the traditional written test, we have also added assessment methods such as project performance, comprehensive training, and experimental reports, and paid more attention to the cultivation and evaluation of students' abilities. This helps to get a comprehensive picture of the student's knowledge and practical application.

### 3) Peer evaluation

We have introduced a peer assessment mechanism to involve students in the evaluation process. Through peer assessment, students can learn to evaluate others objectively and fairly, and develop their critical thinking and teamwork skills.

### 4) Teacher evaluation

Teachers conduct comprehensive and detailed evaluations of students, including learning attitudes, classroom performance, and homework completion. Teacher evaluation helps to identify students' problems in a timely manner and give targeted guidance and help.



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### 5) Comprehensive evaluation

We combine students' process evaluation and ability assessment to form a comprehensive evaluation system. The comprehensive evaluation system not only focuses on students' learning process, but also pays attention to their ability development, which helps to comprehensively evaluate students' learning outcomes.

Through the above-mentioned reform of teaching evaluation, we have effectively improved the teaching quality of the Discrete Mathematics course, stimulated students' interest in learning, and cultivated their independent learning ability and innovation ability. This has laid a solid foundation for the all-round development of students and contributed to the development of higher education in China.

## IV. TEACHING EFFECTIVENESS

Through a series of teaching innovations and practices, we have achieved remarkable teaching results, which are manifested in the following aspects:

### (1) Students' learning effectiveness is improved

Students' interest and enthusiasm in learning have been significantly improved, and their participation in the classroom has increased significantly. In recent years, the pass rate of the examination has remained at 100%, and the test score and passing rate of the course have been significantly improved.

### (2) Cultivation of innovation ability and practical ability

The cultivation of teaching innovation and practical ability has been significantly strengthened. Through project-based learning and hands-on experiments, students develop innovative thinking and practical skills, and are better able to solve practical problems. The students' scientific and technological innovation activities have repeatedly achieved good results, and the students' practical application ability is high, and they have been repeatedly praised by the internship units, supporting the students' employment in well-known universities and enterprises.

### (3) Improve teamwork and communication skills

Students develop teamwork and communication skills through group discussions and project research. They learned how to work with others to complete tasks together, improving their communication skills and teamwork skills.

### (4) Increased student satisfaction

Student satisfaction has increased significantly. According to the questionnaire survey of students, the recognition rate of online and offline courses has reached more than 96% every year, and students are satisfied with teaching innovation and practice, believing that the reform of teaching methods will help improve learning effectiveness and interest.

### (5) Improvement of teachers' teaching ability

The teaching capacity of teachers has been significantly improved. The team teachers have won a number of provincial and school-level teaching competitions and teaching achievement awards. Through the practice of teaching innovation, I have mastered new teaching methods and skills, and improved my teaching level.

### (6) Recognition and promotion of teaching achievements

The teaching results have not only been recognized by peers and experts, but also received online course selection by Chinese students at home and abroad. Since the course was launched in Wisdom Tree, it has been open for 7 semesters, with a total of 1,323 course candidates, 55 schools to which public learners belong, and a total of 14,000 interactions. Our teaching reform practice has achieved a good reputation in the industry, and provides reference for the teaching reform of other related courses.

Through the above teaching results, we have proved the application value of pedagogical innovation in the curriculum of Discrete Mathematics. Teaching innovation not only improves students' learning effectiveness, cultivates their innovation ability and practical ability, but also improves teachers' teaching ability. This has contributed to the development of China's higher education and provided strong support for the cultivation of high-quality talents.





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### V. THE PROMOTION VALUE OF THE RESULTS

The teaching innovation achievements of Discrete Mathematics have a wide range of application value and promotion significance, which are embodied in the following aspects:

#### (1) Dissemination of educational ideas

The promotion of teaching innovation is conducive to the dissemination of student-centered and outcome-oriented educational concepts. This concept emphasizes the cultivation of students' active learning and innovation ability, which is of great significance for improving the quality of education.

#### (2) Reference of teaching methods

Our pedagogical innovations provide a rich teaching method for other related courses. Through online and offline blended teaching, flipped classrooms, project-based learning and other methods, other courses can better stimulate students' interest and enthusiasm in learning and improve the teaching effect.

#### (3) Sharing of teaching resources

We have built a rich online resource library that can be shared with other courses to support other teachers. This will help to improve the utilization efficiency of teaching resources and promote the optimal allocation of teaching resources.

#### (4) Teacher training and communication

The promotion of teaching innovation can promote the training and communication among teachers. By sharing teaching experiences and discussing teaching methods, teachers can learn from each other, improve their teaching abilities, and promote teaching reform throughout the education industry.

#### (5) Equity and quality improvement in education

The promotion of teaching innovation achievements will help promote educational equity and allow more students to enjoy high-quality educational resources. Through the combination of online and offline teaching mode, students can choose the appropriate learning method according to their own needs and conditions to improve the learning effect.

#### (6) Reform of talent training model

The promotion of teaching innovation achievements is helpful to promote the reform of talent training mode. By focusing on process evaluation and ability assessment, we can evaluate students' learning outcomes more comprehensively and cultivate high-quality talents with innovative spirit and practical ability.

Through the above promotion value, we believe that the teaching innovation of Discrete Mathematics will make greater contributions to the development of higher education in China and provide strong support for cultivating more high-quality talents.

### VI. THE INNOVATION OF ACHIEVEMENTS

The teaching innovation achievements of the "Discrete Mathematics" course have the following innovations:

#### (1) Reconstruction of teaching content

Through a comprehensive restructuring of the course content, we have made it more relevant to practical application to improve students' interest and motivation in learning. Through case-driven teaching, interdisciplinary integration and other methods, the course content is enriched and vivid.

#### (2) Innovation in teaching methods

We have adopted innovative methods such as online and offline blended teaching, flipped classrooms, project-based learning, case-driven teaching, and experimental teaching methods to enable students to participate more actively in learning and improve their thinking ability and innovation ability.





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### (3) Creation of a teaching environment

We have created an online learning platform, multi-functional classrooms, laboratory environments, project studios and other teaching environments to provide a good learning environment for students. These environments help to enhance students' learning outcomes and develop their practical and innovative abilities.

### (4) Reform of teaching evaluation

We have reformed the traditional evaluation system and established a diversified evaluation system, focusing on process evaluation and ability assessment. This helps to comprehensively assess students' learning outcomes and increase their motivation and motivation to learn.

### (5) Students' ability development

We focus on cultivating students' self-directed learning, innovation and practical skills, so that they can better adapt to the needs of the future society. Through project-based learning, computer experiments and other methods, students can apply theoretical knowledge to practical problems and improve their practical operation ability.

### (6) Teacher team building

We attach great importance to the construction of the teaching team and encourage teachers to participate in the practice of teaching reform. In the process of teaching innovation, the teaching team continuously improves their teaching ability and provides strong support for the all-round development of students.

Through the above innovations, we have effectively improved the teaching quality of Discrete Mathematics, stimulated students' interest in learning, and cultivated their independent learning ability and innovation ability. This has laid a solid foundation for the all-round development of students and contributed to the development of higher education in China.

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