



Teaching Reform of Discrete Structures Based on Double Helix Model

Le Wei *, Qiuyun Zhao

School of Software Engineering, Chengdu University of Information Technology, Chengdu 610225, China.

Email: weile@cuit.edu.cn

Abstract. There exist problems in Discrete Structures, such as insufficient combination of theory and practice, failure to fully leverage the advantages of online and offline integration, and insufficient integration of ideological and political elements with professional knowledge. In response to these problems, a triple double helix model of 'theory-practice', 'online-offline', and 'ideological and political elements-professional knowledge' is proposed. This model is led by ideological and political and is based on a practical case library and a curriculum ideological and political library. The model realizes the knowledge goals, ability goals, and ideological and political goals of the course through the combination of theory and practice and the integration of online and offline.

Keywords: Discrete Structures, 'theory-practice' double helix, 'online-offline' double helix, 'ideological and political elements-professional knowledge' double helix

1 Introduction

Discrete structures (Discrete Mathematics) is a core basic theoretical course for computer majors. It is a mathematical discipline that mainly studies structures of discrete quantities and their interrelationships. It is an essential foundation for learning subsequent professional courses such as Data Structure, Operating System, Database Principles, Digital Logic, etc. Discrete Structures requires students to master the basic knowledge of mathematical logic, set theory, algebraic systems, and graph theory. The course cultivates students' logical reasoning ability, computational thinking ability, abstract modeling ability, and ability to analyze and solve practical problems.

Discrete Structures is characterized by a high degree of abstraction, strong logic, many concept definitions, and complex and profound content, which brings many challenges to teaching. The current teaching mode can no longer meet the requirements of new engineering and engineering education. This is mainly manifested in the following aspects. First, too much emphasis is placed on knowledge goals, and less is paid to the cultivation of abilities and qualities. After the course, they cannot apply knowledge to practice and solve real problems. They lack the ability to transfer knowledge and turn knowledge into productive forces, and the cultivation of student

quality is not well. Second, teachers and students consider Discrete Structures as a purely mathematical course and have not established a connection with professional knowledge. They emphasize theory and neglect practice or even have no practice. However, the practical link is an indispensable part when students turn knowledge into skills and apply theory to practice. This results in the course not effectively supporting professional training goals. Third, due to limited class hours, many contents are continuously reduced. Teachers only explain the most basic knowledge, and the breadth and depth of the course are insufficient to support the learning of subsequent courses.

In recent years, with the promotion of new engineering, engineering education, and the '101' plan, and around the higher education talent training goal of cultivating advanced specialized talents with social responsibility, innovative spirit, and practical ability, colleges and universities have carried out a series of educational and teaching reforms around Discrete Structures. Beihang University [1], Shanxi Agricultural University [2], Jiangsu Ocean University [3], Hefei University [4] and other schools have carried out explorations of ideological and political education in Discrete Structures. Qingdao University of Technology [5], Nanyang Institute of Technology [6], Shenyang University of Technology [7], Changchun Institute of Technology [8] and other schools have carried out research on blended teaching and flipped classroom of Discrete Structures. Jiangxi University of Finance and Economics [9] has carried out a teaching reform of Discrete Structures based on the cultivation of engineering quality. Hunan University of Science and Technology [10] has carried out a teaching reform of Discrete Structures based on practice and programming. These studies have played a good role in improving the teaching quality of the course and achieving teaching goals. However, the current research and practice also have problems such as fragmented results, insufficient comprehensiveness, depth, and systematization. Therefore, in view of the problems existing in Discrete Structures and combined with the course characteristics, this paper conducts research on the curriculum reform of Discrete Structures from three aspects of the combination of theory and practice, the integration of online and offline, and the integration of ideological and political elements with professional knowledge. It is of great significance for the achievement of knowledge goals, ability goals, and quality goals, as well as the improvement of training quality.

2 Connotation of triple double helix

The DNA double helix structure is formed by alternating connections of deoxyribose and phosphate groups through ester bonds. The two main chains are parallel to each other and run in opposite directions to form a double helix configuration. Bases form base pairs between the two main chains. Drawing on the DNA double helix structure, researchers have studied the double helix model from different angles. For example, Dominic Wyse [11] and others proposed a double helix of reading and writing. Berryman, Sue E. [12] and others studied the double helix model of education and economy. Ron Toomey [13] discussed the double helix and its impact on teachers'

professional lifelong learning. Wang Hui [14] and others proposed a dynamic double helix teaching mode based on the relationship between teaching and learning and practiced it in the course of theoretical mechanics. Considering the problems of insufficient combination of theory and practice, failure to fully leverage the advantages of online and offline integration, and insufficient integration of ideological and political elements with professional knowledge in the current Discrete Structures teaching, the double helix in this paper refers to the 'theory-practice' double helix, the 'online-offline' double helix, and the 'ideological and political elements-professional knowledge' double helix, which can be called as triple double helix.

The 'theory-practice' double helix emphasizes the combination of theory and practice. In the teaching of Discrete Structures, we should abandon the wrong understanding of regarding the course as a purely mathematical course in the past. Necessary practical links to the course and combine them with practical applications should be add in the field of computer. The course should achieve theory guiding practice, serving practice, and serving students' practical hands-on ability and engineering ability. Practice can promote students' secondary understanding of knowledge and solve some problems that cannot be solved in theoretical teaching.

The 'online-offline' double helix emphasizes the integration of online and offline. In the teaching of Discrete Structures, online teaching resources should be made full use of. The respective advantages of online and offline learning methods should be given full play to. Efficient integration and supporting each other of online and offline should be realized. Students' learning efficiency, learning ability, and thinking quality could be better improved, and the limitation of classroom hours could be effectively broken through. The breadth and depth of course knowledge transmission could meet professional requirements.

The 'ideological and political elements-professional knowledge' double helix emphasizes the organic integration of ideological and political elements with professional knowledge. 'Cultivating people with morality' should be taken as the fundamental task of education. Curriculum dual functions of cultivating abilities and ideological and political education should be taken. The world outlook, life outlook, and values to college students is built through professional knowledge. Students' correct world outlook, outlook on life, and values, in turn, promote better learning of professional knowledge. students' ability to analyze things based on facts and distinguish right from wrong would be comprehensively improved. students could become with both moral integrity and professional competence and all-round development.

3 Strategies for constructing triple double helix

3.1 Strategy for constructing 'theory-practice' double helix

For teaching content of Discrete Structures, a practical case library was established from shallow to deep, from point to area, and in a step-by-step manner. The case library includes application cases related to theoretical knowledge, such as practical problems that can be solved by using equivalent calculus, main normal forms, inference theory, shortest paths, and special graphs. Program cases related to theorems and

algorithms, such as constructing truth tables, finding principal disjunctive normal forms, set operations, counting finite sets, and judging equivalence relations and partial order relations. Practical cases applied in the field of computers, such as the application of relations in relational databases, the application of order relations in project management, the application of propositional logic in binary logic devices and statement logic, network optimization algorithms, polynomial coding methods, etc.

Based on the practical case library, and through the combination of online and offline, in-class and out-of-class, cases could be introduced in classroom explanations, after-class assignments, computer practice, and knowledge expansion. Students are required to apply knowledge to establish mathematical models and solve practical problems. And Students initiative were prompted. Ultimately goals of 'consolidating the theoretical foundation, improving programming application ability, and cultivating innovative practical ability' were achieved.

3.2 Strategy for constructing 'online-offline' double helix

Blended teaching comprehensively uses different teaching theories, different teaching technologies and teaching methods. It is a new teaching mode that combines 'traditional classroom + online learning + flipped classroom'. In this mode, students are at the center in the teaching process to cultivate students' ability to think independently and learn autonomously. And it emphasizes teacher guidance and strengthens the management, feedback, supervision and assessment of students' learning process. According to the characteristics of online and offline blended teaching and the content of Discrete Structures, tasks and activities to be completed could be determines in the early, middle and late stages of the course. And the course teaching process was designed and optimized. First, the teaching week was taken as the axis and the teaching content was implemented into activities such as online videos, offline teaching, offline experiments, and flipped classrooms. The tasks to be completed in each week were clarified. Secondly, the strategy of 'creating social presence, establishing identity and sense of belonging, and forming a friendly and active communication atmosphere' was adopted. Blended learning activities were designed in the early stage of the course. Then, the strategy of 'creating teaching presence and guiding students to learn effectively' was adopted. Blended learning activities were designed in the middle stage of the course. Finally, the strategy of 'creating cognitive presence, self-reflection and evaluation' was adopted. Blended learning activities were designed in the later stage of the course.

In order to measure the teaching effect, taking students as the center, in accordance with the principles of combining course evaluation and implementation evaluation, combining process evaluation and result evaluation, diversifying evaluation subjects and evaluation indicators, and comprehensively evaluating evaluation content and evaluation methods, the quality of blended teaching was clarified for the basic process of evaluating. An index system for evaluating the quality of blended teaching was constructed. And the evaluation method for the quality of blended teaching was determined.

3.3 Strategy for constructing 'ideological and political elements-professional knowledge' double helix

Curriculum ideological and political is education for students through curriculum construction and classroom teaching. It emphasizes integrating into various courses with ideological and political education elements, including theoretical knowledge, value concepts and spiritual pursuits of ideological and political education. It is to subtly influence students' ideological consciousness and behavior. Curriculum ideological and political education requires based on the concept of collaborative education, using scientific and innovative thinking and a combination of explicit and implicit methods to achieve the multiple unification of knowledge, value shaping and ability cultivation. Ultimately the goal of cultivating people with morality could be achieved. Guided by Marxism, the moral education elements were fully excavated in Discrete Structures in terms of political beliefs, ideals and beliefs, value concepts, moral sentiments, spiritual pursuits, scientific thinking, and craftsman spirit. And a curriculum ideological and political case library was built. According to the knowledge goals, ability goals and ideological and political goals, teaching was carefully designed. The entry point of ideological and political education was found and the corresponding teaching methods and carriers were offered. Ideological and political elements were organically integrated into teaching content, assessment methods and evaluation standards. The entry point was found in all links of course review, introduction, teaching, summary, homework and experiments. Learning by doing and doing by learning was realized. Curriculum ideological and political education was strived to enter the mind and heart.

4 Conclusion

The combination of theory and practice was an effective way to enhance learning effects. Online and offline blended teaching was an effective method by which students' ability to think independently and learn autonomously was cultivated. Curriculum ideological and political education was an important means by which students were educated and talents were cultivated. This paper combined the DNA double helix structure with Discrete Structures. And a triple double helix model of 'theory-practice', 'online-offline' and 'ideological and political elements-professional knowledge' was constructed. At the same time, relevant strategies for constructing triple double helix were proposed. Through practical case design and the combination of cases and theory, the purpose of mutual promotion of theory and practice and equal emphasis on knowledge and engineering practice ability was achieved. Through exploring and practicing blended teaching, the limitations of traditional classrooms were broken and a virtuous cycle of 'online and offline, in-class and out-of-class' was realized. Through the construction of curriculum ideological and political cases, the design and implementation of curriculum ideological and political programs, the organic combination of knowledge and value shaping was realized.

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