Research on Teaching Reform of Hierarchical Classification of Complex Function and Integral Transformation Based on Integration of Science and Engineering

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Abstract. The course of complex function and integral transformation is a subject with strong theoretical and practical significance. The teaching mode of integrating science and engineering can not only improve the teaching effectiveness of the classroom, but also better meet the training goals of composite talents in higher engineering education in the new era. However, there are individual differences among students, and there are significant differences in their acceptance of the integrated teaching model of science and engineering. Therefore, putting students at the center, valuing their differences, teaching according to their aptitude, and carrying out hierarchical and classified teaching are of great significance. The article adopts a hierarchical and classified teaching reform based on the integration of science and engineering knowledge in the curriculum. Practice has proven that this attempt to teach has more purposeful and scientific effects, stimulates students' interest in learning, and enables them to better develop and grow. It is a new model of students' autonomous learning，it worth promoting.

Keywords: Complex function and integral transformation; Integration of science and engineering；Hierarchical classification teaching

1. Introduction

Complex variable functions and integral transformations are compulsory mathematical foundation courses for engineering related majors in our school. They are prerequisite courses for courses such as automation control principles, signal analysis, circuit analysis, and image processing. They are widely used in technical fields such as signal processing, circuit analysis, image recognition, and artificial intelligence [1]. Therefore, learning this course well is the voice of many students. How to learn this course well and lay a solid foundation for subsequent courses; How to improve students' innovation ability through this course and achieve the goal of cultivating versatile talents; This is an urgent matter to be solved. The article analyzes and explores the characteristics of the curriculum and students, and provides an attempt to integrate science and engineering teaching and hierarchical classification teaching.

2. The Course Characteristics and Teaching Status

2.1 Course characteristics. The courses on complex functions and integral transformations are offered in 18 majors at our school, including optics and electronic information, intelligent manufacturing, and data and computational science. Most of them are compulsory basic courses. This course is mainly offered in the third or fourth semester of sophomore year, with a total of 48 class hours. The course content includes complex numbers and complex variable functions, analytical functions, integrals of complex variable functions, series, residues, conformal mappings, Fourier transform and Laplace transform, etc. The course not only contains rich mathematical knowledge, but also many humanistic stories [2]; Some knowledge points of the course can be found in the engineering background in subsequent courses; The course has a wide range of applications, and some theories can also be implemented using software in specific applications; There are many engineering majors that offer courses, and students belong to different disciplines [3]. In response to this characteristic, the teaching method of integrating science and engineering is

a better choice.

2.2 Student characteristics. The teaching target is sophomore students, all of whom are born in the 2000s and have a mobile phone. They are the "trendsetters" of the information age[4], with strong ability to accept new things, fast learning speed, and a subjective desire to make progress in learning. On the other hand, due to individual differences in learning abilities, habits, and goals, after a year of learning, their grades have differentiated and their psychology has correspondingly changed. They are able to face their differences with others, actively adjust their goals, and have clearer academic and career plans. In addition, there is a general concern about the purpose of the course.

2.3 Teaching status. The most frequently asked question by students about the course of complex functions and integral transformations is "What is the use of learning?" The teaching mode of integrating science and engineering solves the problem of "what is the use of the course and how to use it" from a directional perspective. However, in classroom teaching, only a "one size fits all"[5] approach is adopted for the integration of science and engineering, which is detrimental to the cultivation of innovative and applied composite talents in our school. Because the integration of science and engineering means learning more knowledge, corresponding to occupying more time, and students' interests, academic planning, cognitive level, and learning ability are different. Implementing a "one size fits all" approach can lead to situations where some students "don't want to eat" and others "can't eat well"[6]. Moreover, the integration of science and engineering is not reflected in the assessment, so inert thinking leads to this link being almost non-existent.

Therefore, in order to achieve better teaching results in the teaching process of integrating science and engineering in this course, it is necessary to recognize individual differences and "teach students according to their aptitude". Conducting hierarchical and classified teaching is the best choice.

3. Research on Stratified and Classified Teaching of Complex Function and Integral Transformation Course Based on the Integration of Science and Engineering

Stratified and classified teaching refers to dividing students into different levels based on their source of students, knowledge foundation, intelligence level, interests, personality traits, and psychological tendencies, under the unified requirements of the syllabus. Teaching objectives are set differently, and different levels of teaching are implemented to fully mobilize the learning enthusiasm and initiative of students at different levels, so that each student can fully develop in their own "nearest development area", In order to achieve the goal of improving teaching quality on a large scale [7]. This article is based on the integrated knowledge module of science and engineering, and mainly conducts hierarchical classification research from several aspects such as teaching content, teaching objects, teaching methods, and course evaluation.

3.1. Classification of Teaching Content. The course content is rich, and in the integration of science and engineering, multiple channels can be used to search for information based on knowledge points such as humanities and history, engineering background, experimental operations, engineering cases, academic papers, etc., and further stratification can be carried out in the decomposition of teaching tasks and the arrangement of student learning tasks.

3.2. Classification of Students. Based on the integration of science and engineering, design a questionnaire survey and have discussions with some students. According to the students' development plan, knowledge foundation, and learning ability and combined with the professional training direction, students can be mainly divided into three categories from the perspective of curriculum: market management, professional technology, and academic research. As shown in Fig.1. Students consciously select a certain type based on their own characteristics, and then choose to complete the corresponding task.

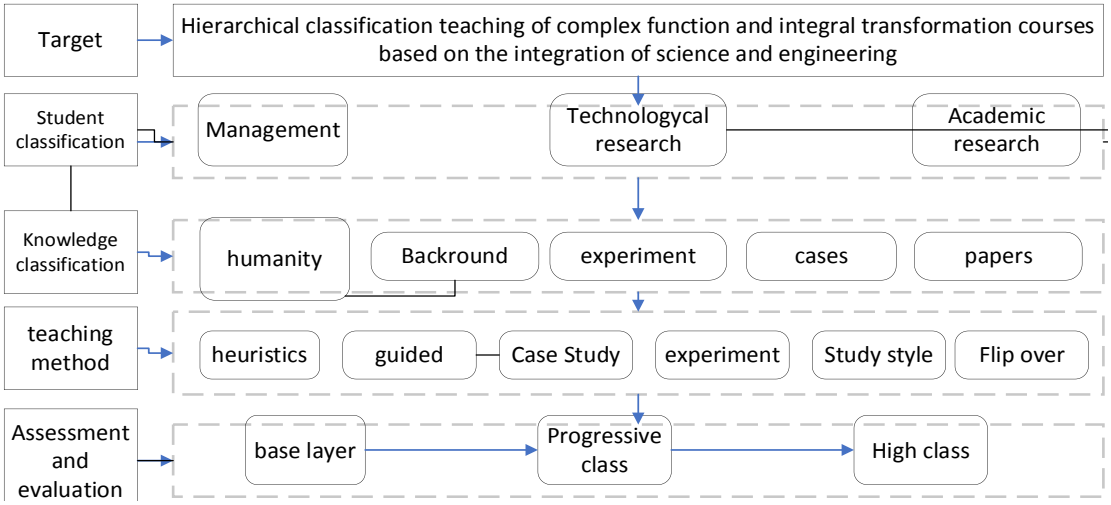

Figure 1. A Hierarchical Classification System for Complex Function and Integral Transformation Courses Based on the Fusion of Science and Engineering

1) Market management students[8]. These students have average learning abilities, but strong management abilities, and their goal is to pursue a career in a related field about marketing or management jobs, even those unrelated to the major, are also acceptable, with the goal of successfully obtaining a degree certificate and a good requirement for course grades. I need to have a good understanding of the integration of science and engineering. I prefer the theoretical introduction of humanities, history, and engineering background contained in the course.

2) Professional and technical students. These students have strong hands-on skills, especially in computer software learning. Their goal is to engage in industries related to this major, if you want to go to a better unit, the requirements for grades are relatively high. You hope to achieve good grades in more subjects. Considering that this course is more commonly used in subsequent professional courses, They hope to learn the professional courses well and lay a solid foundation. Prefer certain experimental sections, engineering cases, or academic competitions in the course.

3) Academic research oriented students. These students have strong learning abilities and enjoy specialized research on certain issues, with the goal of further deepening their studies through the postgraduate entrance examination Graduate students pursuing majors in related fields have high requirements for academic performance and a good understanding of the importance of courses. Although the courses are not part of the postgraduate entrance examination, they hope to learn all the subjects well, so as to take the lead in both the postgraduate entrance examination and the postgraduate entrance examination. They enjoy researching academic papers and have a strong interest in academic competitions.

3.3.Classification of Teaching Methods. For different types of science and engineering integration knowledge, some can be explained in the classroom, but some are more suitable for handling after class due to class time constraints or varying difficulty levels of problems[9]. At this time, we can make full use of pre class and post class time to do a good job in dividing science and engineering integration tasks. Teaching methods such as heuristic, guided, case based, flipped, and study based methods can be adopted.

3.4.Hierarchy on Assessment and Evaluation. The most motivating aspect for students in each course is their grades[10]. The integration of science and engineering should be included in the assessment and evaluation process. Based on different types of students and their level of knowledge mastery, hierarchical tasks and evaluation indicators are set according to the basic, advanced, and high-level levels. The integration of science and engineering accounts for 20% of the total score, as shown in Tab.1.

Table 1. Layered Assessment and Evaluation Form for the Integration of Science and Engineering

Assessment and evaluation	Market and Management	Professional Technology	Academic research
Requirements for Basic layer requirements（50 points）	Understand: cultural history, engineering background; Software implementation operation; Engineering cases; Relevant discipline competition requirements; Related academic papers	Same requirement as above	Same requirement as above
Requirements for advancement（30 points）	Can retell the application of a certain knowledge point in the course	Can use software to implement certain existing program operations	Can conduct framework analysis on a certain academic paper
Requirements for High class requirements （20points）	Choose a theme, record a video explaining the application of the course, edit and process it, and present it in the form of a video	Based on one's own interests, find a certain knowledge point to program and implement, or model and implement a certain engineering problem	Write a standardized essay on a certain issue, or participate in an academic competition (achieving good results)

4. The Effect of Teaching Reform in Course Stratification and Classification

Since the construction and implementation of a hierarchical classification system based on the integration of science and engineering, the course has received unanimous praise from students, peers, and experts. The students' interest in learning has been stimulated, and they have understood that the application of knowledge is practical, and their ability to apply theory to practice has been greatly enhanced; The pass rate and excellent rate of course grades have shown good changes compared to previous years; Mathematical cultural literacy has also been improved to a new level; The ability to learn independently has improved; The number of people willing to participate in subject competitions has increased by 10% year-on-year, and the number of people planning to take the postgraduate entrance examination has also increased; Professional course teachers have reported that students are significantly more relaxed when learning professional courses.

5. Conclusion

The hierarchical classification teaching based on the integration of science and engineering actively responds to the training requirements of innovative and applied composite talents in universities, and has received strong support from the school and relevant departments. This method closely follows professional needs and social development, stimulates students' learning enthusiasm and subjective initiative, and enhances their ability to integrate theory with practice. This course is taught according to students' aptitude, respects differences, develops individuality, improves students' mathematical literacy, and scientifically and reasonably promotes students' comprehensive development. Practice has proven that the teaching effect of this method is good, and this teaching

reform can be promoted in more teaching classes in the future, in order to cultivate more high-quality talents.

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