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

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Abstract. New engineering is a new concept for the development of higher engineering education in China in the new era. The construction of new engineering should promote the cross integration of engineering and other disciplines, and the integration of science and engineering is a common form of discipline integration in science and engineering colleges. The course of complex function and integral transformation not only has rich mathematical and physical knowledge, but also has a strong engineering practice background. The development of the integration of science and engineering is related to the quality of course teaching, as well as the achievement of our school's goal of cultivating innovative and applied composite talents. By analyzing the teaching characteristics and current situation of the course, the article constructs a science engineering integrated teaching system for the course from several aspects: teaching content, teaching resources, teaching methods, subject competitions, teaching teams, and course evaluation. Practice has proven that the implementation of the integrated teaching model of science and engineering has improved students' innovative and practical abilities, achieving good teaching results. This teaching model can be extended to more teaching classes, with the aim of better improving the quality of talent cultivation.

Keywords: Complex functions and integral transformations; New engineering; Integration of science and engineering

1. Introduction

The "New Engineering" is a new concept in higher engineering education in the new era, aimed at cultivating innovative and applied composite engineering practical talents. The interdisciplinary integration is an important way to build and develop new engineering disciplines, among which the integration of science and engineering is a common way for engineering colleges to carry out disciplinary integration. The integration of science and engineering must go deep into specific curriculum levels in order to achieve a deep integration [1].

The integration of science and engineering not only requires a solid mathematical foundation, but also a broad background in engineering applications [2]. Complex Functions and Integral Transformations is a compulsory mathematical foundation course for engineering related majors in our school. Many mathematical theories and methods are given in the course, which have wide applications in other natural sciences and various engineering fields. The integration of science and engineering in the teaching process is of great significance for the cultivation of innovative and applied talents in our school.

2. Teaching Background of Complex Functions and Integral Transformations

Complex functions and integral transformations are offered in related majors such as optics and electronic information, intelligent manufacturing, and data and computational science in our school. This course has a total of 48 class hours and is mainly offered in the third or fourth semester. 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 [3]. These mathematical theories and knowledge are widely applied in subsequent professional courses such as Signal and Systems, Principles of Automatic Control,

Digital Signal Processing, Mathematical Physics Equations, and Fundamentals of Circuit Analysis. However, scientific integration system of science and engineering has not been formed. The specific reasons are as follows:

2.1 Less Communication between Departments. At present, the curriculum is undertaken by teachers from the Mathematics Department of the freshmen's college, and the subsequent application of the curriculum is mainly in other engineering departments. Although there is a need and desire for communication, due to various reasons, there is very little communication between teachers and professional teachers of subsequent courses, communication is lacking, information asymmetry, and research on the integration of science and engineering between departments remains at a lower level.

2.2 Low Interest of Students to the Integration of Science and Engineering. The course starts early in the third or fourth semester, and students have insufficient knowledge reserves and insufficient awareness of the importance of course application; Some students do not have solid basic knowledge of advanced mathematics and are not taking postgraduate entrance exams, so they do not want to spend more time; There is not enough case resources for the integration of science and engineering, and the comprehensive knowledge of cases in the integration of science and engineering is relatively difficult. Students have a fear of difficulties, so overall, students have low interest in learning the practice of science and engineering integration and are lack of motivation.

2.3 Limited Practical Ability of Teachers. The teachers of this course have been mainly engaged in basic mathematics teaching for many years, with little background in related engineering majors. They also rarely engage in inter departmental communication and cooperation, and are lack of sufficient exploration and reserve of engineering background and cutting-edge applications related to knowledge points. There is not sufficient integration of science and engineering in the curriculum. Their ability to connect theory with engineering practice needs to be improved.

2.4 No Assessment and Evaluation on the Integration of Science and Engineering. Exams are to some extent a test of students' mastery of knowledge [4], and in principle, important teaching links should be assessed. However, due to the influence of traditional habits and the lack of quantitative indicators for practical assessment of the integration of science and engineering [5], the assessment and evaluation system does not reflect the practical part of the integration of science and engineering teaching, which seriously affects students' enthusiasm for exploring the integration of science and engineering.

3. Construction of a Curriculum Integration System of Science and Engineering

The construction of a scientific curriculum system is the key to the success of the curriculum. This study closely focuses on the cultivation requirements of "innovative and applied composite talents" in the context of "new engineering", shapes students from the aspects of knowledge, ability, and quality, solidly implements the teaching concept of integrating theory with practice [6], and starts with teaching content, teaching resources, teaching methods, subject competitions, teaching teams, and assessment methods, Construct a scientific curriculum system for the integration of science and engineering.

3.1 Restructuring Teaching Content. After all, the key to attracting students and stimulating their learning motivation for a course is still the teaching content [7]. Under the new teaching objectives, the teaching content should not only be based on knowledge from books, but also on prcacice. It should be closely related to professional, industry, and social developments, integrate theory with practice, and reflect the integration characteristics of science and engineering in the curriculum. Therefore, it is necessary to reconstruct the teaching content.

3.2 Enriching Teaching Resources. The information age has provided various convenient conditions for resource sharing. Micro courses, university MOOCs, academic website databases, high-quality course construction from various universities, forums, etc. have provided many valuable electronic resources for curriculum reform [8]; Various teaching reform conferences,

experience exchange and sharing meetings can also provide new offline resources for teaching reform, learning platforms, and other practical resources for the integration of science and engineering. Record micro lessons on knowledge points; Build a case library for the integration of science and engineering based on knowledge point background, knowledge point analysis, and knowledge point application (case analysis, etc.) mode; and add professional lecture videos for the course.

3.3 Innovating Teaching Methods. Traditional teaching mainly focuses on offline teaching of pure course theory. The requirement for the integration of science and engineering has led to an increase in course content. The knowledge points involved in the integration of science and engineering are highly comprehensive and complex. Comprehensively utilizing various teaching methods such as analogy, transformation, and integrating theory with practice, fully utilizing online and offline links, and integrating courses well before and after class. For certain problems, practical teaching can be carried out, such as in the mapping section, computer software (engineering) such as MATLAB can be used to integrate science and engineering to achieve image correspondence of the mapping, which can enable students to understand the meaning of the mapping very intuitively.

3.4 Relying on Subject Competitions. Subject competitions can make students use their knowledge to solve practical problems. During the competition, it can enhance their hands-on and innovative abilities, broaden their horizons, and achieve better professional growth [9]. So encourage students to actively participate in college mathematics competitions, college mathematics modeling competitions, and professional competitions at all levels. And in order to encourage students to participate more in course practice, the college actively calls on teachers to carry out "one lesson, one competition" for this course, which show that the school is working together to assist in the engineering practice of the course.

3.5 Building a Teaching Team. A good teaching team is a prerequisite for conducting good teaching, and the integration of course science and engineering requires teachers to be as familiar as possible with the engineering application of the course. However, most of the team teachers are engaged in basic theory teaching and have insufficient engineering background. Therefore, it is necessary to start from multiple aspects and build a good teaching team to improve this situation. For example, to motivate teachers to continuously engage in professional learning, regularly send teachers to participate in relevant teaching reform meetings, the team regularly holds course construction seminars, maintains active contact with relevant department course leaders, and utilizes "virtual teaching and research rooms" to connect different teachers in the team with different departments[10]. Maintain the healthy development of the team from multiple perspectives, ensuring that the integration of science and engineering is implemented effectively and deeply.

3.6 Reforming Assessment Methods. The integration system of complex function and integral transformation courses in science and engineering has brought changes in course content and teaching methods. The assessment methods should be reflected accordingly, and this is also a measure taken in response to the requirements of the Ministry of Education for process assessment. In addition to the traditional closed book section, practical sections should also be added to each teaching section in the course of process assessment. For example, it can be a paper related to course application, a research report, software implementation, or subject competition. To motivate students in these aspects, reasonable grading rules should be set up in all these aspects, and the grading rules and quantitative methods for each assessment indicator should be scientifically and reasonably set.

4. The Effect of Teaching Reform based on the Integration of Science and Engineering

Since its establishment, the curriculum system of integrating science and engineering has received good feedback through one semester of practice in the Excellence Class, as well as through discussions or private letters.

4.1 A Positive Change in Students' Learning Attitude. Previously, students often felt bored with the theories they learned and confused about their specific applications. By setting up science and engineering integration cases in the curriculum, students understood the usefulness of the course and realized its importance. For example, although the course was not a postgraduate entrance examination course, it did provide a theoretical foundation for some of the courses, resulting in a more proactive and proactive learning attitude.

4.2 A Significant Improvement in Students' Learning Outcomes. Through the integration of science and engineering in the course teaching process, students have a more thorough understanding of theoretical knowledge, and their average exam scores have increased. At the same time, their innovation ability has also been improved. The results of university mathematics competitions, mathematical modeling competitions, and professional competitions are higher than those of previous parallel classes. Comparing the results of the pilot class (30 people) with those of the parallel class, statistical analysis was conducted on their results.

4.3 A Great Enhancement in Satisfaction. In order to better understand the impact of integrated science and engineering teaching on students and provide better feedback on teaching, a survey questionnaire was distributed to a pilot class of 30 people after the course was completed. 30 people anonymously filled it out. Through data analysis, as shown in Fig. 1, the satisfaction survey statistical chart of integrated science and engineering showed that 90% of people supported the assessment of integrated science and engineering. From Fig. 2, it can be seen that 70% of supporters of the integration of science and engineering choose a theoretical background (knowledge and theoretical background and humanistic history), 83% choose course experiments (computer program implementation), 93% choose application cases (mostly from subsequent courses), and 77% choose subject competitions (willingness to participate).

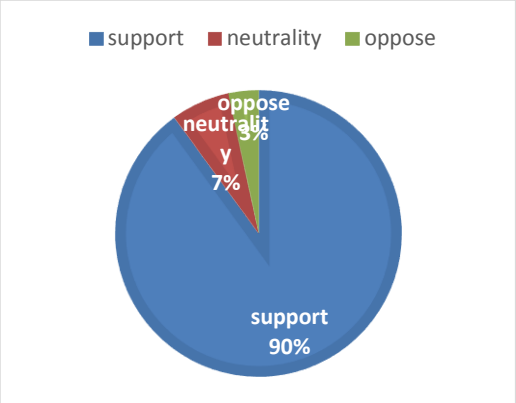

Figure 1. Satisfaction Survey Statistical Chart

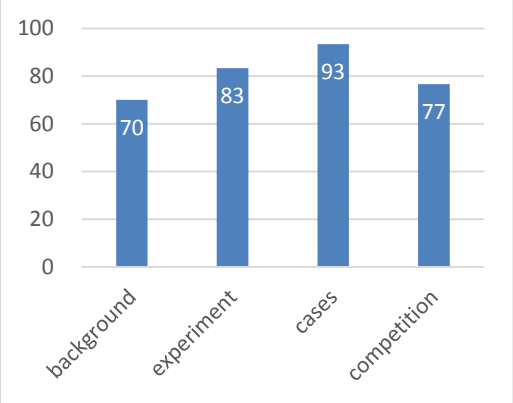

Figure 2. Statistical Chart of Reform Supporters [%]

5. Conclusion

The integration of science and engineering is a new concept in the teaching of engineering majors under the background of new engineering, which is in line with the talent cultivation goals of universities. This article explores from various perspectives of teachers, students, schools, and society, and develops a teaching system for the integration of complex function and integral transformation courses, which is in line with the actual situation of our school. It has been tried and run in the excellent class. Practice has proven that the integration of science and engineering has stimulated students' learning interest, improved their innovation and application abilities, Improving learning effectiveness is a great exploration. In the later stage, this teaching reform can be implemented in more teaching classes, in order to cultivate more high-quality composite talents.

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