

Teaching Method Reform and Practice Based on the OBE Concept: A Case Study of the Remote Sensing Software Application Course

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Abstract

As a multidisciplinary and highly integrated subject, Remote Sensing Software Application is a core course for majors in Remote Sensing Science and Technology as well as Geographic Information Science, characterized by its strong practical orientation. This paper summarizes the issues in traditional teaching, including low student engagement, an incomplete assessment mechanism, and insufficient integration of ideological and political education into the curriculum. To address these challenges, a teaching reform approach based on the OBE (Outcome-Based Education) concept is proposed. The course objectives were optimized and used as a guide to elaborate on reforms in teaching content, teaching methods, assessment methods, evaluation systems, and the integration of ideological and political elements. Additionally, the outcomes of the course reform and the broader impact of these outcomes are analyzed.

Keywords

OBE concept; teaching methodology reform; remote sensing software application.

1. Introduction

The Outcome-Based Education (OBE) concept, also known as results-oriented education, is a student-centered approach that builds course systems through a reverse design process focused on achieving desired outcomes. By integrating flexible and diverse personalized learning requirements, OBE encourages students to meet self-fulfillment challenges during the learning process and uses feedback on outcomes to refine course design and teaching strategies, ensuring continuous improvement in education. Compared with traditional education models, the OBE model emphasizes learning methods, the allocation of study time, and fostering students' interest and motivation in learning. Under the OBE framework, designing appropriate teaching content, methods, assessment approaches, and evaluation systems is critical to ensuring students achieve the expected learning objectives.

Remote Sensing Software Application is an interdisciplinary course encompassing remote sensing science, geography, computer science, and mathematics. It is a required course for majors such as Remote Sensing Science and Technology and Geographic Information Science, characterized by its strong emphasis on practical application. The traditional teaching model for this course mainly involves instructors delivering lectures and students passively receiving knowledge. This monotonous approach reduces student engagement and limits their ability to think independently and solve remote sensing engineering problems. To address these challenges, the OBE education concept has been introduced to transform teaching philosophy, modify teaching methods, and reform assessment practices.

Using the Remote Sensing Software Application course as a case study, this paper identifies key deficiencies in the traditional teaching process. Building on efforts to address these issues, it introduces the OBE education concept to optimize course objectives, guide the improvement of

teaching content, methods, assessment approaches, and evaluation systems, and integrate ideological and political elements into course instruction.

2. Problems in Traditional Teaching of Remote Sensing Software Applications

2.1. Low student initiative in learning

On the one hand, the teaching content is organized according to the software operation process, which lacks a reverse-driven approach rooted in real-world problems. This purely forward-driven design prevents the transformation from 'teacher-led understanding' to 'student-initiated learning and comprehension.' On the other hand, students engage in passive learning, further compounded by assignments and experiments that are disconnected from practical applications. As a result, students concentrate solely on 'solving problems' in a technical sense rather than truly 'understanding and addressing problems,' leading to a lack of learning initiative in both respects.

2.2. Inadequate course assessment mechanisms

The assessment of students' learning effectiveness in the traditional teaching mode consists of two main components: regular grades and final grades. Regular grades are primarily composed of three parts: attendance grades (evaluated based on attendance records), experimental grades (evaluated based on the completion of laboratory reports), and homework grades (evaluated based on the quality of homework submissions). The final grade, on the other hand, is determined by performance on the final exam, which represents a relatively singular assessment method. This approach makes it challenging to accurately reflect students' true mastery of the knowledge.

2.3. Lower integration of the course's Civic Policy

The traditional teaching mode typically begins with the introduction of basic concepts and methods, followed by an in-depth exploration of theoretical content, and concludes with the application of theory to practice. While the teaching content is designed strictly according to the syllabus, this overly standardized approach results in a low level of integration with Civic Politics. Incorporating Civic Politics into the course can enhance the quality of talent cultivation by enabling students to not only master the course content but also develop their ideological and political awareness.

3. Teaching Reform of Remote Sensing Software Applications Based on OBE Concepts

The remote sensing software application course is designed with a problem-solving approach, and the course objectives are defined as follows: through this course, students will develop the ability to construct models for analyzing and solving practical problems, formulate strategies for addressing real-world issues within software systems, operate the software to obtain solutions, and evaluate and analyze the results effectively. The specific details are illustrated in Figure 1.

Based on these teaching objectives, the course undergoes a comprehensive reform encompassing multiple dimensions, including the development of teaching content, the organization of teaching methods, the assessment of learning outcomes, and the evaluation of teaching effectiveness.

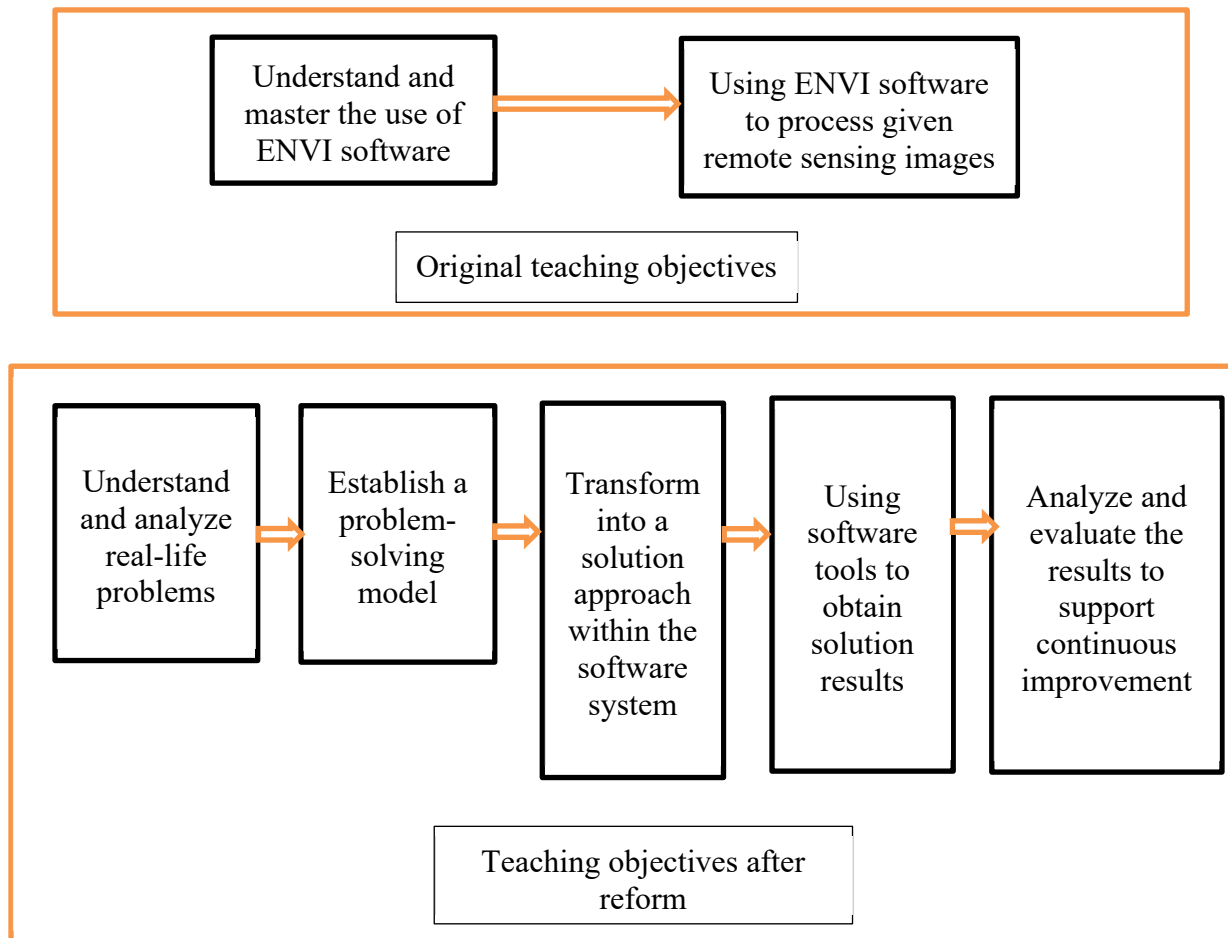


Figure 1. Comparison of teaching objectives between new and old courses

3.1. Construction of teaching content

Firstly, the teaching content is meticulously structured around the course objectives, addressing the primary shortcoming of the original curriculum, which focused solely on software operation. By emphasizing both the 'starting point' (the actual problem) and the 'end point' (the solution), the course integrates eight typical cases sourced from industry frontline units to create a comprehensive case bank. Using these real-world cases as a foundation, the teaching content shifts from merely imparting 'software operation skills' to fostering 'the ability to use software to solve practical remote sensing problems.' This transformation ensures that the teaching approach is problem-oriented and aligned with real-world applications. The details are illustrated in Figure 2.

3.2. Organization of teaching methods

Based on the characteristics of the course, which integrates both theoretical and experimental components, a comprehensive teaching approach has been developed. This approach builds upon the traditional 'one lesson, one practice' method and is guided by the principles of Outcome-Based Education (OBE). It is structured around Problem-Based Learning (PBL), employs the flipped classroom as a key method, emphasizes ability cultivation as the central theme, and fosters a collaborative team dynamic between teachers and students. The specific details are illustrated in Figure 3.

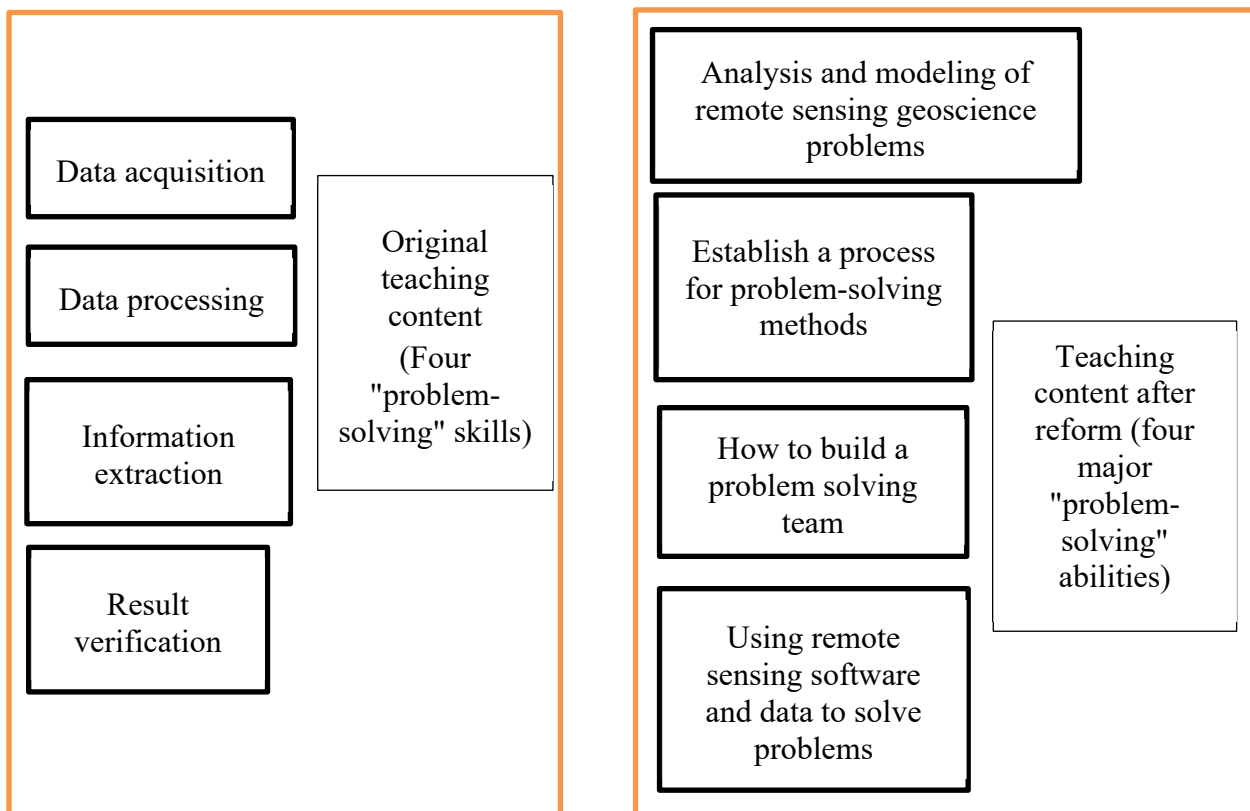


Figure 2. Comparison of new and old teaching content

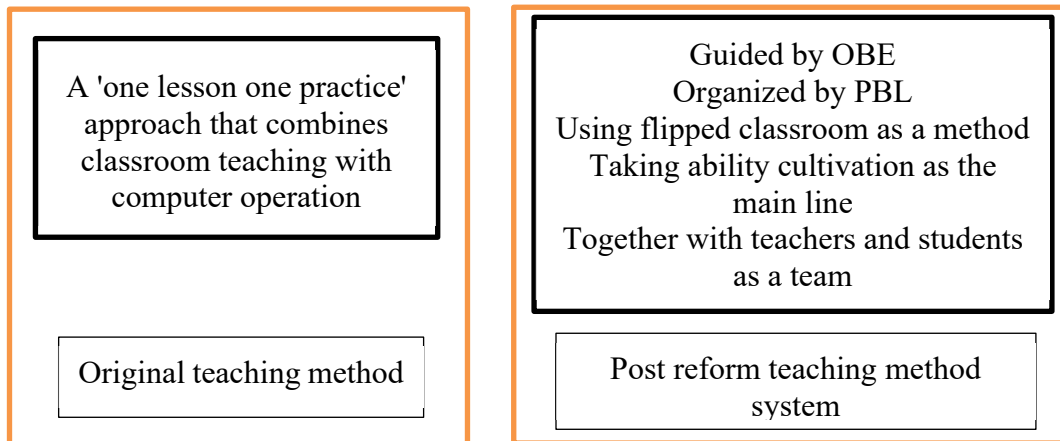


Figure 3. Comparison of new and old teaching methods

3.3. Assessment of learning effects

The course assessment has been transformed from the traditional method, which allocated 30% and 70% weights to regular grades and final paper grades, respectively, into a comprehensive evaluation of the entire learning process. This new assessment approach incorporates diverse components, including classroom performance, online engagement, quizzes, online assignments, discussions, and other forms of evaluation. These elements aim to provide a holistic assessment of students' regular performance while reinforcing their learning outcomes. The specific details are illustrated in Figure 4.

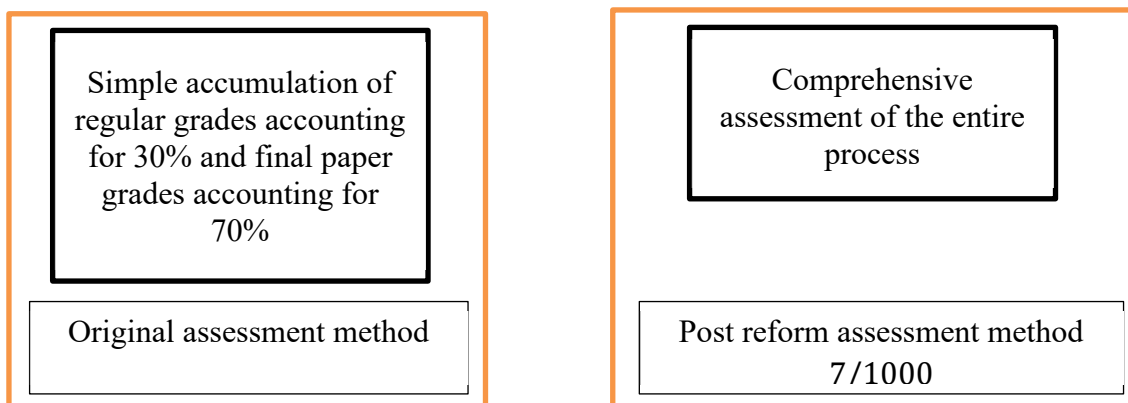


Figure 4. Comparison of new and old assessment methods

3.4. Evaluation of teaching effectiveness

Building on the original evaluation framework, which included student evaluation, supervisory evaluation, and peer evaluation, additional components have been incorporated to enhance the comprehensiveness of the course evaluation. These include attainment evaluation, which reflects the achievement of course objectives, and feedback evaluation from employers regarding students' performance in their subsequent employment. This integrated approach aims to evaluate the quality of the course throughout its entire life cycle. The specific details are illustrated in Figure 5.

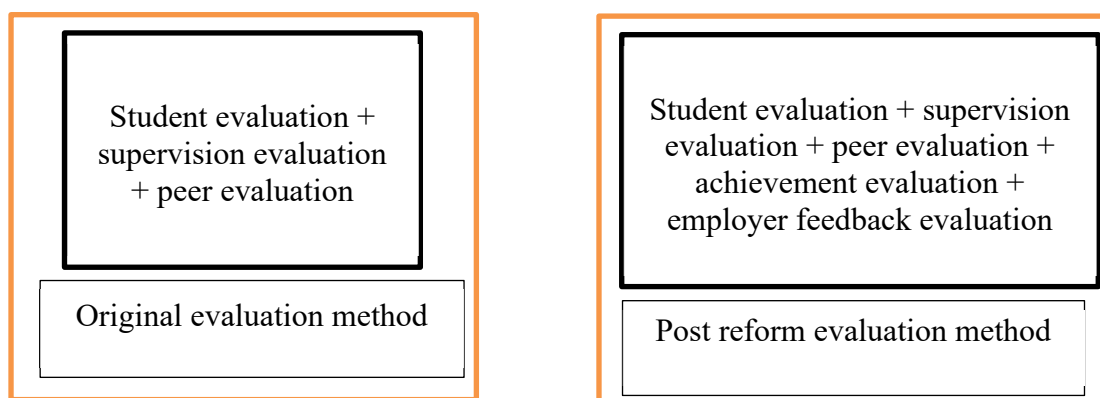


Figure 5. Comparison of old and new evaluation systems

3.5. Integration of the Civics of the Curriculum

Focusing on the effective integration of ideological and political education within the course, this approach avoids superficial preaching and achieves the subtle and profound impact of fostering values through practical learning. Based on the course's characteristics, ideological and political elements are seamlessly embedded into the curriculum. For instance, the development of remote sensing in China, particularly the satellite remote sensing industry, originated under the personal care and guidance of Chairman Mao Zedong and Premier Zhou Enlai, and is closely tied to the foundation of national strategic security. The integration of ideological and political education in this course emphasizes the theme of science and technology serving the nation. It draws on the patriotic spirit of the "Two Bombs, One Satellite" initiative, where the founding fathers of the Republic "dedicated themselves to advancing the nation," and connects this spirit with the contemporary responsibilities of college students. By highlighting the significant role of remote sensing technology in addressing real-world issues such as environmental protection, economic development, and human well-being, the course

instills in students a deep sense of responsibility and pride. Additionally, during the teaching of software applications, the pressing need to address bottleneck technologies such as chips and software is incorporated as a teaching entry point. This motivates students to study diligently, fostering a commitment to applying their knowledge in service of the nation's development. The specific details are illustrated in Figure 6.

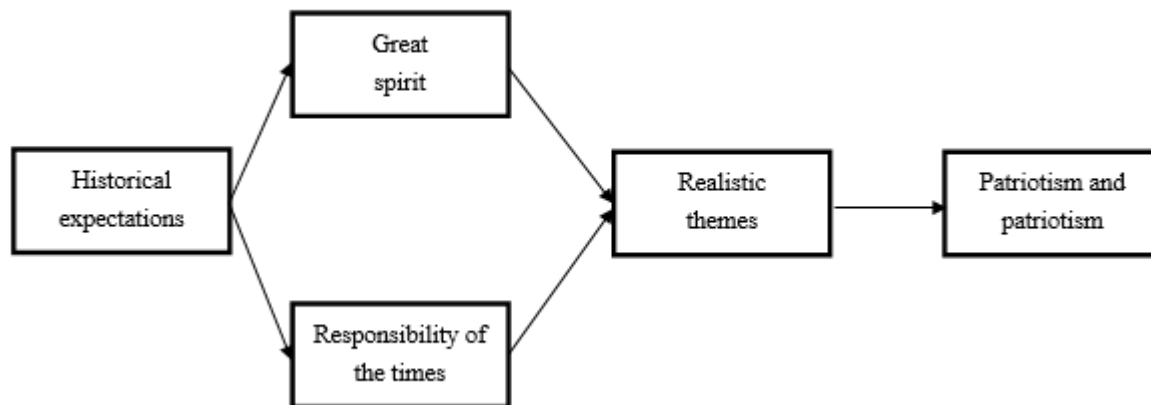


Figure 6. Ideological and political system diagram of the course 《Remote Sensing Software Applications》

4. Results and Radiation After The Teaching Reform of Remote Sensing Software Application Course

4.1. Results of the reforms

(1) Truly achieve 100% attainment of teaching objectives. Using the achievement assessment system established by the teaching reform, the degree of attainment of the course's teaching objectives has reached 100%. This achievement has been reflected in the graduation projects over the past three years, where all projects completed using the knowledge and skills taught in this course have achieved excellent results. Students have been able to effectively solve, analyze, and answer course-related problems during their graduation projects and defenses, receiving unanimous praise from both employers and defense committee experts.

(2) Achievements in disciplinary competitions and innovation contests. Through this course, students have significantly enhanced the key teaching goal of "problem-solving ability development." Using the knowledge and skills gained in the course, students have participated in various academic competitions and innovation contests, earning numerous awards.

(3) High evaluation by institutions of further education. Graduates who continue their studies have received high praise from their graduate school supervisors, especially for their ability to progress from "solving problems" to "analyzing problems" and from "using software" to "understanding software." This transformation has been particularly evident. For example, one student participated in the United Nations Habitat Project during their master's degree at the University of Alberta, Canada, while another student published four SCI papers in this course's field during their master's degree at Shandong University of Science and Technology.

(4) High evaluation by employers. Graduates who have participated in the innovative training provided by this course have received high praise from their employers. For instance, one student joined Wuhan Dasi Technology Co., Ltd. after graduation, and within one year, was promoted to General Manager of the Shandong branch due to excellent performance. Five female students from this course joined the Jinan Survey and Mapping Research Institute,

forming a well-known entrepreneurial team. They were recognized with the “Youth Civilization” award in Jinan.

(5) Teachers have been practiced and improved. Throughout the teaching reform process of this course, four members of the teaching team have significantly advanced in their professional development. They won first and second prizes in the National Undergraduate Young Teachers' Lecture Competition, were recognized as excellent instructors for three consecutive years in national disciplinary competitions, and one of the instructors was directly promoted to associate professor.

4.2. Dissemination of results

(1) This course serves as a foundational subject in remote sensing principles and an introductory course in spatial analysis. It plays a crucial role in bridging the two, laying a strong foundation for subsequent courses. The teaching reforms implemented in this course are significant not only for deepening the content of introductory courses but also for advancing advanced courses in the curriculum. Additionally, the outcomes of this course's reform serve as a model for the overall development of students majoring in remote sensing science and technology. These reforms not only enhance students' professional skills but also contribute to their professional recognition, learning confidence, and overall development. The success of this course's reform positively influences the academic performance and attitudes of the entire cohort of remote sensing students.

(2) With the rapid advancement of information technology, the application of software across disciplines such as remote sensing science and technology, surveying and mapping engineering, geographic information science, and civil engineering has become increasingly widespread. The teaching methods established through the reform of this course serve as a model for software application courses in these fields, promoting improved teaching outcomes across related disciplines.

(3) The success of the course reform and development has significantly boosted the teaching team's confidence. Drawing on the insights and achievements from this reform, the team members have published numerous teaching research papers, submitted several teaching research projects, and guided students in participating in national disciplinary competitions. The team has also helped students present papers at international academic conferences. These contributions have played a pivotal role in promoting the construction and visibility of the remote sensing program.

5. Conclusion

This paper takes the remote sensing software application course as a case study and proposes a reform of teaching methods under the OBE (Outcome-Based Education) framework. By analyzing the issues in the traditional teaching model of remote sensing software application—such as students' lack of learning initiative, an imperfect course assessment mechanism, and the insufficient integration of ideological and political elements—this paper suggests a new teaching approach. This method, based on clearly defined teaching objectives, involves comprehensive reform across multiple dimensions, including the course content, teaching structure, organization of teaching methods, assessment of learning outcomes, and evaluation of teaching effectiveness. Additionally, with the continuous advancement of society, new technologies and methodologies are emerging. The integration of these new tools and approaches into the teaching of remote sensing software applications will be the focus of future research.

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