Exploration of Interest-Driven Innovative Practical Activities

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Abstract. Practical activities are a crucial means to cultivate students' innovative and engineering practice abilities, and they are a realistic requirement for enhancing students' comprehensive qualities at the higher education level. Based on the actual learning conditions of civil engineering students at Tibet Agriculture and Animal Husbandry University, and considering students' interests, preferences, and areas of focus, this paper integrates professional courses across different academic years, the OBE (Outcome-Based Education) philosophy, and student needs. It constructs interest-driven innovative practical activities and comprehensive practice projects. The study explores the combination of professional knowledge and students' interests, offering valuable insights for innovative educational practices in higher education in Tibet and contributing to the improvement of students' overall competencies.

Keywords: Student Interest, Innovative Practice, Civil Engineering Majors, Educational Reform, OBE Teaching Philosophy.

1 Introduction

With the changing demands of the times, civil engineering majors face new opportunities and challenges in the context of the rapid development of new engineering education. Significant changes have occurred in the mode, content, and methods of professional teaching. Compared to the update of teaching content, changes in teaching models should receive more attention [1]. Traditional teaching methods, which primarily involve teacher-led lectures and textbook-based learning, have given way to the integration of engineering practice education as a vital link between theoretical learning and practical application in engineering. It serves as a key approach to cultivating students' engineering abilities and innovative capabilities [2]. Innovation-driven practical activities, guided by teachers and centered on students, involve completing comprehensive practical tasks with characteristics such as autonomous participation, a broad range of knowledge, and strong integrative components. These activities are an essential

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platform for implementing practice-based education [3]. Many prestigious central universities have made significant achievements in the form [4], content [5], and application mechanisms [6] of practical activities, sparking a trend of imitation in local universities. In the exploration of practical activity teaching, scholars have found that most students have a positive attitude toward social practice activities, believing they enhance cooperation, leadership, and innovation skills. However, issues such as limited practice formats, time constraints, lack of guidance, and insufficient school support were also identified.

Outcome-Based Education (OBE) focuses on student learning outcomes and practical abilities. It designs the knowledge, skills, and competencies students should acquire based on their future learning results. Many scholars have analyzed factors like professional characteristics, student conditions, and employment direction, and proposed innovations in practice activities, including models for school-industry integration and specialized innovation.However, considering the differences in educational orientations and the disparities in student quality and capabilities between central and local universities[7-8], such imitative approaches often face challenges in implementation and limited effectiveness [9]. The root cause lies in the lack of objective research on the teaching subjects, i.e., the students [10]. In this context, the civil engineering undergraduate education at Tibet Agriculture and Animal Husbandry University, based on students' learning conditions and interest characteristics, combines subject knowledge, shifts teaching concepts, innovates the types of practical activities, and enriches the forms and content of practice. This exploration aims to create practical activities that are better suited to students' learning conditions.

2 Significance of Interest-Driven Innovative Practical Activities

Tibet Agriculture and Animal Husbandry University is the first university in the Tibet Autonomous Region to offer engineering disciplines. It is also at the forefront of efforts to maintain stability, promote development, and implement ethnic regional autonomy. The university has focused on integrating Marxist viewpoints with the cultivation of scientific spirit in both practical and classroom teaching, effectively enhancing students' abilities to correctly recognize, analyze, and solve problems. It has made significant and effective attempts in improving internship and classroom teaching process management, as well as incorporating ideological and political education into the curriculum.

During the teaching process, it was observed that civil engineering students in their first and second years, facing the broad scope and high difficulty of professional courses, often lose confidence and adopt a passive attitude toward learning. Some attempt to compensate for their lack of knowledge by cramming. Surveys and discussions revealed several issues in practical teaching: first, language barriers prevent some students from communicating effectively in Mandarin, leading to low self-confidence and diminished interest; second, in traditional practical activities, low participation and distraction were common, with some students relying on others to complete tasks; third, students struggled with comprehensive abilities, autonomous learning, and integrating knowledge. As the difficulty increases, understanding deeper knowledge becomes more challenging, leading to frustration and a loss of interest in learning.Therefore, to improve students' innovative abilities, independent thinking, and comprehensive competencies, teaching innovation must be tailored to students' learning characteristics. By analyzing students' learning interests, we can design interest-driven practical activities that engage students, encourage them to actively participate, and connect theoretical knowledge with real-world situations. Through these activities, students can identify and solve problems, enhance their critical thinking, develop scientific skepticism, embrace challenges, and foster innovation .

3 Innovative Education Reform Measures

3.1 Exploration of Practical Activities Based on Freshmen's Learning Conditions

Civil engineering majors are highly practical and comprehensive, requiring extensive calculations and a solid foundation in mathematics and physics, as well as spatial visualization skills. As a university in Tibet, our civil engineering students generally have a better foundation compared to other disciplines at the university, but some students still face significant gaps in meeting the professional requirements. Through various methods such as surveys and personal interviews, we gained insights into students' learning dynamics and discovered the following characteristics of their academic conditions: First, students' understanding of the civil engineering discipline is largely influenced by their family background, and many students have a limited understanding of their major and lack the foundational skills necessary for learning professional knowledge. Second, some students tend to rely heavily on rote memorization, which leads to weak comprehensive abilities, poor autonomous learning skills, and limited spatial imagination. As the complexity of the courses increases, students struggle to make connections between knowledge points, resulting in difficulty understanding more advanced content and a growing sense of frustration and loss of interest. Third, students have a strong desire to improve their learning abilities and enhance their overall competencies.

In response to students' learning characteristics and areas of interest, we found that students, compared to traditional PPT-based teaching, are more engaged with tangible objects and traditional culture. To address this, the university has incorporated these interests into teaching by inviting senior engineers with extensive experience working in Tibet to lead students in field trips to visit traditional Tibetan architecture, such as Tibetan fortresses and Tibetan cultural buildings in the Lulang area of Nyingchi, for a cognitive internship. This allows students to experience the structure, formation characteristics, and load-bearing forms of Tibetan architecture, gaining a better understanding of the regional characteristics.

In civil engineering courses, students need to understand concepts such as force transmission, rigid and flexible bodies, which are abstract topics. However, due to their weaker academic foundation, students find it difficult to grasp these abstract concepts, and their understanding of physics, which forms the basis of civil engineering, is limited. To improve their understanding of force transmission, traditional practical activities such as structural competitions or bridge-building contests typically require knowledge of Structural Mechanics, which first-year students have not yet studied. Therefore, for first-year students at our university, practical activities need to be simplified, and alternative activity types should be explored. To engage students' interests, we have introduced simple activities like building and dismantling competitions using building blocks. Students work in groups and compete to build structures in a set time, with the opposing group dismantling the structure. To win, students must consider how to design their structures so they are easily built but difficult to dismantle. Through this playful activity, students naturally learn basic mechanical principles.

Engineering Graphics is a key foundational course for civil engineering majors, laying the groundwork for students' ability to read blueprints and fostering their spatial imagination. However, our students have relatively weak spatial visualization skills. While PPT presentations can demonstrate graphic views through animations, students tend to prefer hands-on observations of real objects. To cater to this preference, we incorporated traditional mortise and tenon models, allowing students to observe these structures in real life. Additionally, for the three-view drawing topic, we used traditional shadow puppet models to help students build simple shadow puppets and learn about projection using light, integrating their interest in traditional culture and tangible objects into their learning process. By engaging students in these interactive activities, they learn while having fun, which strengthens their attention, enhances their focus, and improves their comprehensive abilities.

These practical activities are relatively simple compared to those at central universities, where students may have participated in similar activities before higher education. However, our students in Tibet lack such experiences prior to university. These activities provide an opportunity to attract students' interest and enhance their learning focus, helping them build a stronger foundation for their future academic success.

3.2 Comprehensive Practice Innovation Based on the OBE Concept

After one year of university study, sophomore and junior students have developed a deeper understanding of their major compared to freshmen. Their focus has shifted significantly, and they have developed a greater interest in future employment directions. Civil engineering majors, with their strong practical nature, are well-suited for an open teaching model that tends to yield better teaching results [11-12]. Outcome-Based Education (OBE), also known as goal-oriented education, focuses on student learning outcomes and practical work abilities. It starts by analyzing the knowledge, skills, and competencies students should acquire based on their future learning results. For example, Wang Xiufang and others, using the OBE philosophy, proposed a "moral education, interdisciplinary integration, and demand-oriented" talent cultivation model to meet the needs of the petroleum and petrochemical industries. They developed a "cross-disciplinary integration, demand-driven" curriculum system composed of foundational, interdisciplinary, and industry-specific courses. Outcome-Based Education (OBE), currently a mainstream educational philosophy in developed countries such as the UK, the US, and Canada, focuses on the learning outcomes and the maximum capabilities that students acquire through education. It involves setting clear goals, building systems, designing processes, and evaluating outcomes, ultimately using a backward design approach for talent cultivation and professional teaching systems [13].

Based on students' learning conditions and interests, and incorporating the OBE philosophy, we developed comprehensive and innovative practical activities. Using the "Water Treatment Experimental Technology" course for the Water Supply and Drainage program as an example, we aimed to enhance engineering practice and research skills. Applying the student-centered, outcome-oriented, and continuous improvement principles of OBE, we defined the course goals and direction, addressing both internal and external needs. We conducted surveys targeting teachers, employers, and students to assess their demands for practical and research skills. The surveys, using a stratified approach, covered areas such as employment prospects, professional knowledge, practical abilities, and the practical teaching system, ensuring a thorough understanding of the course's practical teaching goals and methods.

Analysis of the survey results revealed the following reflections from previous practical activities:

1. Employers strongly prefer candidates with practical professional skills and have a keen interest in participating in talent cultivation. They are also aware of the importance of developing transferable skills such as learning abilities and understanding of systematic knowledge (including process flows).
2. Teachers are aware of the need for professional and practical abilities but are limited by teaching conditions. They have made extensive efforts to adapt to the demands of enterprises and students' development while maintaining a focus on fundamental theoretical teaching and emphasizing students' learning and practical skills.
3. Students are aware of the societal demand for talent and express dissatisfaction with the current professional practice teaching, particularly in terms of meeting the practical skills and learning capabilities required by enterprises. They show significant anxiety and high expectations.

Therefore, based on the current teaching conditions, enterprise needs, and students' developmental goals, it is necessary to adopt the OBE philosophy to guide practical objectives in water treatment experimental technology. An anonymous online questionnaire was used to gather opinions from students, teachers, and employers. The core questions of each group's questionnaire are shown in Tables 1–3:

Table 1. Survey Questionnaire for Students.

Question No.	Question
1	What is your major?
2	What is your attitude towards the practical activities?
3	Do you believe that the practical activities have helped improve your learning?

Table 2. Survey Questionnaire for Teachers.

Question No.	Question
1	What is your teaching role?
2	What is your opinion on the integration of OBE philosophy into teaching?
3	Do you think OBE can help improve students' practical and learning abilities?

Table 3. Survey Questionnaire for Employers.

Question No.	Question
1	What is your perception of the students' performance?
2	How do you rate the students' professional skills?
3	Do you think the students are well-prepared for their jobs after graduation?

Reflecting on the survey results, we established the following course goals based on the OBE philosophy, which focuses on student-centered, outcome-oriented teaching with continuous improvement:

1. To cultivate students' comprehensive qualities, ensuring they master the basic experimental methods and technologies, the use of water treatment experimental instruments and equipment, and the basic methods for measuring, analyzing, and processing experimental data. This will help students develop research and practical abilities.
2. To deepen students' understanding of the basic principles of water treatment technology, and to cultivate their foundational, skill-based, and innovative practical abilities. Students will learn the general skills required for water treatment experiments and the use of experimental instruments and equipment. By observing experimental phenomena and analyzing results, students will gradually develop their scientific research skills.
3. To develop students' ability to design and organize water treatment experiments, encouraging individual interest in experimental design and fostering teamwork. This will stimulate students' passion for their major, enhance their interest, strengthen their participation, and improve their engineering adaptability, hands-on abilities, scientific thinking, and systems thinking.

By adopting a progressive and integrated teaching model that combines engineering practice with academic learning, we restructured the teaching system to include foundational, skills-based, and innovative experiments. The foundational experiments consist of three key experiments, the skills-based experiments of two, and the innovative experiments of one.

Student participation significantly increased during the project, especially in the innovative experiments. Students not only recalled process flow content from the Water

Quality Engineering course but also revisited knowledge from foundational and skills-based experiments, leading to deeper engagement with the practical content and a stronger sense of ownership. The interaction between selecting processes and operational conditions enhanced student engagement, while the diversification of teaching methods greatly boosted interest and attention.

Through these practical activities, students' hands-on abilities improved significantly. Heuristic teaching on wastewater treatment in Tibet was also conducted, fostering students' scientific thinking.

After the project implementation, a follow-up survey was conducted among the student group. The students expressed strong expectations for practical teaching, but the recognition of previous practical teaching activities was not high (50%). Issues included the proportion of credits allocated to practical teaching (41.67%), the update of practical teaching content (58.33%), whether the instruments, equipment, and materials in experiments met teaching requirements (66.67%), and the proportion of experiment classes in total class hours (50%), all of which were less than ideal. However, there was strong interest in the self-designed experimental plans based on the OBE philosophy (83.33%) and in the experimental operation skills training and competitions (91.67%). Through the innovation of practical activities, students' practical abilities, innovation skills, and analytical abilities were significantly improved, and their learning achievements generally increased by 2-5 points.

Using literature review methods, we built a progressive, segmented, and engineering-integrated practical teaching model that fully mobilized student initiative and met practical ability improvement requirements. The results are significant: students were better able to link theory with practice, especially in operation management, showing notable improvement. Additionally, students' work ethics, adaptability, enthusiasm for labor, and professional qualities were greatly enhanced. These teaching practices have strong potential for broader application and significance, contributing to resource integration in Tibet's higher education institutions and promoting educational reform to accumulate teaching outcomes at the university.

4 Conclusion

In In the practical teaching of civil engineering at local universities, innovations should be based on students' actual learning conditions. Tibet Agriculture and Animal Husbandry University, the first in Tibet to offer engineering programs, serves students with diverse academic backgrounds. Practical activity innovations are tailored to students' academic levels and interests. For freshmen, activities like shadow puppetry and traditional architecture, aligned with their interest in culture, are introduced to enhance focus. For sophomores and juniors, comprehensive activities based on the OBE philosophy are designed, considering both student and employer needs, allowing students to integrate their knowledge. These innovations in practical activities have improved students' overall qualities, greatly benefiting their learning experience.

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