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Exploring the Reform of Experimental Teaching in the Context of Engineering Education Professional Accreditation

Xueye Cao[a,*]

School of Civil Engineering, Yan'an University, Yan'an, 716000, China
[a]caoxueye@126.com
[*]Corresponding author

Abstract: *In the context of engineering education professional accreditation, experimental teaching has evolved into a key component that supports the fulfillment of graduation requirements and develops students' capability to solve complex engineering problems. Based on the Outcomes-Based Education (OBE) philosophy, this study explores innovative reform pathways for experimental teaching, taking the Civil Engineering Surveying course as a case study. To address the needs of Emerging Engineering Education and the intelligent transformation of the surveying industry, a student-centered, technology-driven, and "three-integration" reform principle has been established. The systematic reform of experimental teaching is promoted through five dimensions: reconstructing instructional objectives, integrating teaching content, innovating pedagogical methods, implementing a diversified evaluation system, and deepening university-industry collaboration. The teaching reform effectively enhances students' practical engineering skills, thus providing a valuable reference for the improvement of experimental teaching in similar engineering disciplines.*

Keywords: *Engineering Education Professional Accreditation; Experimental Teaching; Engineering Surveying; OBE*

1. Introduction

Engineering Education Professional Accreditation (EEPA) serves as an internationally recognized quality assurance system for higher engineering education programs. The mutual recognition of accreditation outcomes facilitates the integration of China's engineering education into the global standards, enhances the global competitiveness of engineering graduates and elevates the overall quality of engineering education[1]. The essence of engineering education program accreditation focuses on evaluating whether engineering graduates meet industry-recognized standards, forming an outcome-oriented qualification assessment system based on educational objectives and graduate requirements[2]. China launched a pilot program for engineering education accreditation in 2006 and officially joined the Washington Accord in 2016, achieving international mutual recognition of substantial equivalence[3]. By the end of 2023, 2,395 undergraduate engineering programs at 321 regular higher education institutions were certified through EEPA[4]. EEPA has emerged as the central pathway for developing engineering academic programs.

Experimental teaching serves as a core pedagogical practice for cultivating talent in civil engineering, playing an irreplaceable role in fulfilling the graduate attributes of engineering education accreditation, specifically the ability to solve complex engineering problems[5]. Driven by the three principles of accreditation standards (Student-Centered, Outcome-Based Education, and Continuous Quality Improvement), experimental teaching has transformed from a traditional auxiliary means of theory to a key link supporting the achievement of graduation requirements[6].

Civil engineering surveying experimental teaching serves as a critical practical teaching component of the civil engineering surveying course, demonstrating distinct professionalism, practicality, and applicability. With the rapid iteration of intelligent engineering surveying technologies, a significant disconnect has emerged between experimental teaching of civil engineering surveying and industry requirements. This discrepancy is manifested in the following aspects: teaching content updates lag behind technological advancements, teaching methodologies lack diversity, evaluation mechanisms remain insufficiently competency-driven, and school-enterprise collaborative education mechanisms

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are inadequately established.

To address the needs of interdisciplinary integration in Emerging Engineering Education (3E) and the intelligent transformation of the surveying industry, the experimental teaching of civil engineering surveying necessitates comprehensive reforms in teaching content, pedagogical methodologies, and evaluation mechanisms. This requires deepening industry-academia collaboration to establish a new experimental teaching paradigm featuring profound integration of production and education.

2. Analysis of Demand for Engineering Survey Professionals

2.1. Talent Demand Characteristics in the Context of Emerging Engineering Education

With the accelerated evolution of a new round of scientific and technological revolution and industrial transformation, the development of 3E has become a central measure for China to address international competition and serve national strategies[7]. 3E aims to cultivate diversified and innovative high-caliber engineering talents, who possess not only solid professional knowledge and skills but also competencies in interdisciplinary knowledge acquisition and application, engineering practice competencies, innovation and entrepreneurship competencies, and lifelong learning competencies[8]. Simultaneously, it emphasizes fostering students' cultural identity and commitment, global perspective, and social responsibility, enabling them to address challenges in complex engineering practices and contribute actively to technological advancement and societal progress[9].

In the context of 3E, the demand characteristics of measurement professionals are as follows[10]:

(1) Serving national development strategies.

Engineering surveying serves as a critical foundation for national economic development and defense construction. With the advancement of technologies such as digital technologies and smart cities, emerging engineering professionals in surveying must acquire expertise in the new-generation geodetic reference framework and achieve digitalized management of surveying markers. In the belt and road initiative cross-border infrastructure projects, proficiency in international surveying standards and adaptability to complex environments is essential. Additionally, these professionals should be capable of conducting geospatial data acquisition and implementing security management, thereby accelerating the development of 3D Real Scene China and smart cities.

(2) Meeting industrial demands.

To address the demands of traditional engineering upgrades and emerging industry convergence, new engineering surveying professionals must master high-precision deformation monitoring, terrestrial 3D laser scanning (LiDAR), and unmanned aerial vehicle (UAV) technologies. The fields of smart city and smart manufacturing require the integration of building information modeling (BIM) and geographic information system (GIS) technologies. Engineering surveying professionals should also possess capabilities for interdisciplinary technology integration and practical implementation competencies.

(3) Future-oriented.

3E emphasizes dynamic prediction of talent demands, requiring engineering surveying professionals to establish a continuously updated knowledge system . Proficient in AI-driven measuring robots and deep learning data analysis systems, possessing digital twin-enabled multi-source sensor fusion methods, while capable of supporting green low-carbon construction projects.

2.2. Talent Demand Characteristics in the Context of Intelligent Engineering Surveying Technology

Driven by artificial intelligence, big data, the internet of things (IoT), UAV, LiDAR and BIM, the intelligent transformation of engineering surveying technology facilitates a shift from manual to intelligent surveying operations[11], thereby significantly altering the structure of talent demand.

(1) Manual setting-out, data logging, and other fundamental surveying tasks have been replaced by intelligent total stations and measuring robots, leading enterprises to prefer recruiting technicians capable of operating intelligent equipment.

(2) Talent demands demonstrate a trend of softening hard skills and hardening soft skills, with competency requirements for measurement personnel shifting from instrument operation skills to

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capabilities in intelligent data processing and decision-making, engineering scenario understanding, and cross-disciplinary collaboration.

(3) Professionals must master full lifecycle project management, such as coordinating multi-phase data flows (e.g., design, construction, and monitoring) within BIM models, to support emerging engineering paradigms like smart cities and BIM-based lifecycle management.

3. Exploring the Principles of Experimental Teaching Reform

3.1. The reform of teaching objectives should be guided by the student-centered principle

At the heart of EEPA lies the principle of Outcome-Based Education (OBE), which emphasizes that the ultimate goal of education is the attainment of student competencies. This concept inherently necessitates a student-centered approach throughout the entire talent cultivation process.

As a critical component in cultivating engineering students' practical skills, innovative capabilities, and teamwork competencies[12], the design of experimental teaching objectives must be clearly aligned with the specific abilities students should acquire upon graduation, closely integrated with the graduation requirements stipulated by engineering accreditation standards, and reflect the principle of student-centeredness:

(1) The formulation of teaching objectives should be based on students' competency needs and directly support the attainment of graduation requirement indicators specified by accreditation standards.

(2) Teaching objectives should be aligned with the attainment of students' competencies, reflect the cultivation of their abilities—particularly in solving complex engineering problems—and guide their progression from basic operational skills to higher-order capabilities such as analysis and design.

(3) Academic objectives should focus on students' learning outcomes, emphasizing the knowledge, skills, and competencies acquired through experimental activities.

3.2. The reform of teaching modes should be prioritized towards a "technology-oriented" approach

The restructuring of content and selection of methodologies in civil engineering surveying experimental teaching should be closely aligned with the forefront of modern surveying technology and industry demands. This ensures that students acquire knowledge of cutting-edge technologies such as UAV and LiDAR, thereby bridging the gap between theoretical learning and practical application. The curriculum content should be continuously updated to broaden students' perspectives in emerging fields, such as intelligent construction and smart cities. In terms of teaching methodology, comprehensive experimental projects were designed to enhance students' holistic competencies in understanding and addressing complex engineering problems, while a task-driven exploratory approach was implemented to stimulate their interest in active learning. Meanwhile, universities and colleges need to forge closer partnerships with surveying equipment manufacturers, large engineering firms, and other industry players to develop hands-on training programs. By incorporating real-world engineering cases and the latest technical standards, these initiatives aim to equip students with the ability to address complex engineering challenges.

The reform of experimental teaching in civil engineering surveying should be guided by the “technology-oriented” principle. Through updating teaching content, enhancing hands-on training, facilitating interdisciplinary integration, and advancing industry-university-research collaboration, it seeks to develop high-quality engineering and technical talents that satisfy the criteria of engineering education accreditation.

3.3. The reform of experimental teaching should be guided by the principle of "Three Integration"

Under the framework of EEPA, the reform of experimental teaching should be guided by the principle of “Three Integration”: the integration of theory and practice, traditional and modern technology, domestic and international aspects[13].

The integration of theory and practice is central to the reform of experimental teaching. Civil engineering surveying is highly practical, requiring experimental instruction to translate theoretical knowledge into practical capabilities. In designing experimental content, clear connections with theoretical courses should be established, with timely arrangements for corresponding instrument operation, data acquisition, and processing exercises. Such hands-on practices deepen the understanding of theoretical concepts. Meanwhile, challenges encountered during experiments can be revisited in theoretical courses for further discussion, forming a virtuous cycle of “theory-practice-theory” reinforcement.

The integration of traditional and modern technologies is essential to meet the evolving demands of the industry. In experimental teaching, it is crucial to retain training on traditional instruments such as levels and total stations to strengthen students' foundational surveying skills. Simultaneously, modern measurement technologies, including UAV and GNSS, should be actively introduced. This integrated approach not only equips students with both fundamental knowledge and practical skills but also enables them to apply these technologies in real-world contexts, thereby enhancing their innovative thinking and practical capabilities.

The integration of domestic and international perspectives is essential for enhancing the quality of talent cultivation. In experimental teaching, it is crucial to not only ground the instruction in domestic engineering project requirements, in aligning with China's engineering construction standards and regulations, but also to draw upon internationally advanced educational philosophies and methods. This can be achieved by introducing global engineering measurement cases and high-quality overseas teaching resources, thereby fostering students' global perspectives and cross-cultural communication skills.

4. The Investigation of Reform Measures in Experimental Education

In the context of EEPA, the reform of experimental teaching necessitates systematic top-level design and model innovation, aiming to construct a student-centered, OBE, and continuously improving practical teaching system. This section explores specific measures and practical pathways for reforming experimental teaching from five perspectives: instructional objectives, teaching content and methodologies, evaluation system, and university-industry collaboration.

4.1. Reconstructing experimental teaching objectives

The core objective of EEPA is to ensure the attainment of student competencies. This process mandates that course objectives directly support the graduation requirement indicators specified in the accreditation standards. Traditional course objectives are predominantly formulated based on curriculum standards, syllabi, and textbook content, which often leads to an insufficiently explicit correspondence with specific graduation requirement indicators and consequently fails to provide adequate support for the attainment of student competencies. To comply with accreditation requirements, the teaching objectives of the civil engineering surveying course must be reconstructed to explicitly and directly support the specific graduation requirement indicators. In alignment with the revised course objectives, the restructured experimental teaching objectives are defined as follows:

Teaching objective 1: To demonstrate proficiency in operating modern surveying instruments such as total stations, levels, and GNSS receivers, enabling students to perform fieldwork-including leveling, angular measurement, distance measurement, and coordinate surveying-as well as conduct corresponding computations, while also recognizing the limitations of these techniques.

Teaching objective 2: Enable students to select appropriate measuring instruments for specific tasks, design measurement experiments, collect and process data, and perform scientific analysis of complex engineering problems.

Teaching objective 3: To communicate effectively with team members, clarify individual responsibilities, and collaborate to accomplish the experimental tasks and reports.

As specified in the accreditation criteria for civil engineering programs, teaching objective 1 addresses graduation requirement indicator 5 (ability to use modern tools), teaching objective 2 corresponds to graduation requirement indicator 4 (research capability), and teaching objective 3 aligns with graduation requirement indicator 9 (individual and teamwork skills). Starting from these teaching objectives, the instructional content and teaching methods were designed using a backward design approach to ensure the attainment of students' competencies.

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4.2. Integrating Experimental Teaching Content

The obsolescence of experimental teaching content in engineering surveying has restricted students' hands-on practice to conventional methods[5], thereby limiting their ability to tackle real-world engineering problems with acquired knowledge. Based on the reconstructed experimental teaching objectives, the integrated teaching contents are as follows:

Table 1: The integrated experimental teaching system for engineering surveying.

Experimental project	Experimental content	Teaching objective
Understanding and operation of leveling instruments	1.To familiarize students with the basic configuration of the DS_3 tilting level and the operational roles of its individual components. 2.Develop the ability to perform the operational procedures of a leveling instrument, which encompass setting up, rough leveling, aiming, fine leveling, and reading. 3.To familiarize students with the field observation methods and data processing procedures for ordinary leveling surveys.	Teaching objective 1 Teaching objective 3
Ordinary leveling surveys	1.Students will be able to master the operational procedures and technical requirements for third- and fourth-order leveling, and understand the specification limits for misclosure tolerance. 2.Develop proficiency in the operation of electronic levels and master the station observation procedures and data verification protocols. 3.Enabled students to data processing from closed or connected leveling routes, thereby validating the measurement accuracy.	Teaching objective 1 Teaching objective 3
Understanding and operation of total station instruments	1.To comprehend the key components, fundamental functions, and operational interface of a total station. 2.Master the operational procedures of a total station, including centering and leveling, prism parameter setup, and data recording. 3.To master the technique of horizontal angle measurement using the method of observation sets with a total station, encompassing both field operations and data processing.	Teaching objective 1 Teaching objective 3
Observation of horizontal and vertical angles	1.Enable students to correctly and efficiently perform the observation procedures and subsequent computational analysis of horizontal angles via the method of direction observation in rounds. 2.To acquire practical skills in observing vertical angles, including mastering the proper procedures, calculating the index error, and adhering to the specified tolerance requirements. 3.To verify the principle of eliminating instrumental errors through combined face-left and face-right observations.	Teaching objective 1 Teaching objective 3
Distance measurement	1.Enable students to master the fundamental principles and operational techniques of distance measurement using steel tapes and total stations. 2.To develop an understanding of the operational principles, applicable scenarios, and inherent error sources of various measurement tools. 3.To develop collaborative competence, proficiency in standardized protocols, and data handling abilities.	Teaching objective 1 Teaching objective 3
Total station operations: coordinate measurement and layout	1.Enable students to develop the ability to perform coordinate measurement and setting-out using a total station based on its fundamental principles, and to comprehend the mathematical model for 3D coordinate computation. 2.Proficient in the operational procedures of a total station and can independently perform station setup, backsight orientation, coordinate acquisition, and stakeout point positioning.	Teaching objective 1 Teaching objective 3

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	3.To enhance team collaboration capabilities and establish standardized protocols for data recording, calculation, and results verification.	
Real-Time Kinematic (RTK) surveying operations: measurement and layout	1.Enable students to understand the fundamental principles of RTK technology and the operational mechanism of differential positioning between reference and rover stations. 2.To acquire proficiency in the operational techniques of RTK surveying and layout. 3.To develop students' collaborative skills and data competency, with a focus on standardizing data recording, verification, and presentation of findings.	Teaching objective 1 Teaching objective 3
Open-inquiry experimentation	1.Design and implementation of deformation monitoring for campus buildings. 2.Three-dimensional modeling of campus buildings based on RTK and BIM integration. 3.Design and implementation of a surveying experiment to enhance hands-on learning.	Teaching objective 2 Teaching objective 3

In this reform of experimental teaching, the traditional theodolite-based experiments were eliminated and new experiments involving total stations and RTK technology were introduced. By emphasizing the engineering context of the experiments, the redesign aims to stimulate students' interest, enhance the effectiveness of experimental teaching, and better satisfy the competency requirements for students under the framework of engineering education accreditation. Additionally, by leveraging collaborations with surveying and mapping equipment manufacturers and large engineering companies, to incorporated industry expert lectures and hands-on practices into the curriculum. These added lectures and field practices help students stay abreast of cutting-edge technologies and real-world engineering demands, thereby significantly broadening their professional perspectives and practical skills.

4.3. Innovative Methodology in Experimental Teaching

Engineering surveying is a highly practice-oriented discipline, and students must participate in experiment instruction to master the operation of surveying instruments. To address the varying levels of experimental teaching content, differentiated instructional approaches are proposed to improve the effectiveness of experiment education.

For fundamental experiments (e.g., ordinary leveling surveys), instructors can leverage blended learning platforms such as Chaoxing Learning to deliver experimental animation videos, lecture slides, and other instructional resources before class. By implementing quizzes or discussion activities, teachers can promptly assess students' comprehension of the theoretical concepts and identify any existing issues. During the class, live demonstrations can be employed to teach instrument operation, providing immediate feedback to correct procedural deviations. This approach effectively cultivates students' practical skills in instrumentation, experimental techniques, and teamwork capabilities. Following the class, students are guided to complete their experimental reports, with an emphasis on in-depth analysis of error sources and their underlying causes. Furthermore, the laboratory remains accessible for students to conduct self-directed consolidation and extended practice, encouraging them to explore more efficient and accurate experimental methods.

For comprehensive professional experiments (such as total station coordinate staking) that are closely integrated with real world engineering practice, Project Based Learning or Case Based Instruction can be employed to enhance students' engineering practice competencies. In practice, students can be provided with authentic engineering or project case studies prior to the experiment, guiding them to independently complete the calculation of setting-out data, engage in the discussion of experimental schemes, and formulate experimental plans. Moreover, students are encouraged to participate in on site engineering layout, where they can learn to assess and analyze precision within a real engineering environment, thereby cultivating their comprehensive ability to solve complex engineering problems.

For innovative experimental research, each group may select different projects according to its members' interests and preferences. By leveraging AI tools, intelligent learning companions, and other smart platforms, and integrating the professional knowledge of engineering surveying, the groups should judiciously choose appropriate experimental instruments and independently carry out the entire experimental workflow-including experimental design, method selection, and data acquisition. Such experiments reinforce students' innovative thinking and practical abilities, and cultivate their comprehensive competence in proactively identifying, analyzing, and solving problems throughout the experimental process.

In summary, employing a diversified instructional approaches-such as blended learning, Project Based Learning, and inquiry driven learning-tailored to the specific characteristics of each experiment effectively stimulates students' intrinsic motivation and interest, while simultaneously enhancing their proficiency in instrument operation, engineering practice, and the resolution of complex problems.

4.4. Establishment of a Multi-dimensional and Diversified Evaluation System

EEPA emphasizes the principle of “continuous improvement”, for which scientifically robust and systematic teaching evaluation serves as a critical foundation. Conventional assessment methods in experimental instruction tend to focus predominantly on outcome-based measures, thus failing to comprehensively reflect the holistic competencies and professional qualities demonstrated by students throughout experimental processes.

The implementation of process-oriented evaluation facilitates a comprehensive assessment of students' learning outcomes[14]. This evaluation framework extends beyond merely gauging experimental participation and operational proficiency, it also integrates the assessment of collaborative teamwork and problem-solving competencies. By employing a diverse array of evaluative methods-such as structured discussions, standardized testing, peer evaluations, laboratory report analyses, and experimental design assessments-the approach ensures a holistic reflection of students' overall capabilities. Consequently, it significantly enhances both the scientific rigor and equity of the evaluation process. Tailoring assessment methods and weighting criteria for diverse experimental content enhances the specificity and adaptability of the evaluation system, thereby supporting the attainment of instructional objectives and facilitating continuous improvement in teaching quality.

For fundamental experiments, the primary objective is to assess students' proficiency in operating experimental apparatuses and their competency in data analysis. The evaluation framework is structured as follows: Pre-lab preparation (20%), Hands-on experimental execution (40%), and Laboratory report composition (40%). In the pre-lab phase, blended learning platforms such as Chaoxing learning platform are employed to assess students' mastery of foundational knowledge through online quizzes or topic-based discussions. The experimental operation adopted a triple-source assessment (instructor, peer, and self-evaluation) to comprehensively assess students' instrument operation proficiency, procedural adherence, and collaborative dynamics during laboratory sessions. Experimental reports are evaluated primarily based on the quality of completion, focusing on students' abilities in data organization, analysis, and processing, as well as the accuracy and logical coherence of their written expression.

Professional comprehensive experiments are designed to evaluate students' ability to apply specialized knowledge to practical engineering problems. The assessment consists of three weighted components: Design proposal (40%), Experimental execution (20%), and Final report (40%). During the project design phase, students are guided to calculate setting-out data and develop experimental plans based on engineering case studies. Instructors then assess these submitted materials to evaluate students' analytical capabilities in addressing real engineering problems. Experimental execution was assessed through a combination of peer evaluation and self-assessment. This dual approach focused on evaluating students' proficiency in instrument operation, their responsiveness to real challenges encountered during the experiment, and the degree of collaborative consciousness exhibited within the team. The experimental report is used to evaluate students' competence in the accuracy evaluation and analysis of complex engineering problems, as well as examines the logical coherence, normative compliance, and precise use of professional terminology in their experimental reports.

For the research-oriented innovative experiments, which are primarily designed to evaluate students' innovative thinking and practical ability, the assessment criteria consist of three weighted components: Experimental design (40%), Implementation process (40%), and Final outcomes (20%). The experimental design proposals, submitted by student groups, form the basis for evaluation. Instructors assess the feasibility of the selected topic, the logical coherence, and the technical soundness of each proposal. This process emphasizes the evaluation of students' abilities to identify,

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analyze, and resolve problems. The experimental implementation process employed a multi-faceted assessment approach, integrating instructor evaluation, inter-group peer review, and intra-group peer review. This comprehensive evaluation framework was designed to assess students' proficiency in instrument operation, adherence to standardized data acquisition and processing protocols, as well as their collaborative capabilities and individual contributions within team roles. Evaluation of the experimental results is based on the final submitted report, with emphasis placed on logical soundness, rigor in data analysis, and normative presentation.

In summary, an evaluation framework tailored to the specific instructional objectives and competency requirements of various experiment types has been meticulously constructed. This framework differentiates assessment items and their corresponding weights based on the nature of each experiment. By integrating both formative and summative evaluation methods, it yields a comprehensive, multi-faceted assessment structure. This framework not only provides a comprehensive and objective assessment of student learning outcomes, but also offers a scientific basis for the continuous improvement of experimental teaching. Thereby, it effectively facilitates the cultivation and enhancement of professional competencies in the context of engineering education.

4.5. Deepening University-Industry Collaboration

In the context of intelligent construction and digital transformation, deepening university-industry collaboration is pivotal to addressing the theory-practice gap in civil engineering surveying laboratory instruction, thereby cultivating students' practical engineering competencies. University-industry collaboration effectively integrates theoretical knowledge with engineering practice, thereby enhancing students' ability to solve complex engineering problems. Moreover, such collaboration enables students to gain a comprehensive understanding of industrial development trends and cutting-edge technologies in surveying and mapping, thereby laying a solid foundation for their future careers.

To ensure that university-industry collaboration drives in-depth and sustainable reform in civil engineering surveying curriculum and talent cultivation, a systematic long-term cooperation mechanism must be established. The following approaches are proposed to facilitate its implementation:

(1) Co-development of curriculum content:

Guided by the competency requirements for surveying positions in civil engineering, core knowledge and skill points of the course were systematically identified. The latest industry technical standards, advanced equipment operation protocols, and typical engineering cases were integrated into the curriculum system, while content outdated by industry advancements was eliminated. This ensures precise alignment with industry needs and professional standards, enhancing both the practicality and cutting-edge relevance of the teaching content.

(2) Strengthening faculty development:

A dual-qualified teaching team should be established by normalizing faculty engagement in engineering survey practice and technical research and development at partner enterprises, thereby accumulating firsthand engineering experience. Additionally, senior survey technicians from industry should be actively recruited as adjunct faculty or practice mentors to deeply participate in curriculum delivery and practical instruction, enhancing the engineering relevance and cutting-edge nature of teaching content.

(3) Developing practical training bases

By integrating corporate engineering resources with university teaching expertise, practical training bases are co-constructed through two complementary approaches. First, advanced surveying equipment from enterprises-including total stations, GNSS survey vehicles, and UAV mapping platforms-is systematically incorporated to develop simulated “smart construction site” scenarios that reflect current industry trends. Second, on-site internship bases are established at actual corporate projects, enabling students to immerse themselves in real construction environments. Through participating in full-process surveying operations, students directly observe the application of engineering surveying in practice, thereby strengthening the connection between theoretical knowledge and practical implementation.

(4) Implementing collaborative engineering survey projects

This approach engages student groups in full-process tasks of authentic industry projects, including survey planning, field data collection, office data processing, and deliverable acceptance. Throughout the project, enterprise technicians and university faculty provide co-guidance to resolve technical challenges promptly. Such project-based practice not only enhances students' practical competencies and teamwork but also involves them in industrial innovation and technology transfer, fostering innovative thinking and research literacy.

5. Conclusions

Within the framework of Engineering Education Professional Accreditation, reforming the civil engineering surveying experimental teaching is an essential measure to align with the New Engineering initiatives, respond to the industry's intelligent transformation, and enhance the overall caliber of talent development. Based on accreditation standards and talent demand characteristics, this study proposes a student-centered, technology-driven, and "three-integration" reform. The systematic reform has been promoted through five dimensions: instructional objectives, teaching content and methodologies, evaluation system, and university-industry collaboration. This study proposes a novel paradigm for experimental teaching reform through the following integrated measures: (1) restructuring teaching objectives to align with certification standards; (2) introducing experimental projects on intelligent measurement technologies, such as total stations and RTK; (3) implementing diversified pedagogical methods including blended and project-based learning; (4) establishing a differentiated and process-oriented assessment system; and (5) leveraging university-industry collaborative training bases and real-world engineering projects to deepen industry-education integration. These reform measures effectively enhance students' capabilities in engineering practice, innovation, and teamwork, thereby closely aligning experimental teaching with both the requirements of engineering education accreditation and the demands of industry development. This offers a practical and transferable pathway for experimental teaching reform in analogous engineering disciplines.

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