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A Comparative Study of Sino-U.S. Talent Training Programs Based on ABET Engineering Accreditation: A Case Study of the Sino-Foreign Cooperative Program in Software Engineering at Xi'an Eurasia University

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Abstract: *This comparative study examines software engineering education in China and the United States within the ABET accreditation framework, highlighting disparities and aligning with international standards. Findings reveal differences in teaching methods, assessments, and practical components. Recommendations encompass a blended learning model, diverse assessments, and a focus on project management, team collaboration, and software testing to prepare graduates for global software engineering challenges. This study aims to bridge academia-industry gaps, produce globally competitive professionals, and foster software industry innovation.*

Keywords: *ABET Engineering Accreditation; Personnel training; Software engineering education; Hybrid learning model; Curriculum structure*

1. Introduction

International talent mobility has become the norm as global economic integration continues to deepen. The international recognition of the educational quality of professional talents has the potential to facilitate cross-regional mobility. Assessing the quality of talent development through professional international accreditation offers an objective and impartial means to measure the level and quality of professional talents.

The Accreditation Board for Engineering and Technology (ABET) is a globally recognized organization dedicated to evaluating and accrediting engineering and technology education programs (ABET, 2022). ABET accreditation serves as a benchmark that ensures the quality and effectiveness of these programs. ABET assesses various aspects of educational programs, including curriculum content, faculty qualifications, student learning outcomes, facilities, and continuous improvement processes.

With the rapid advancement of science and technology and the increasing frequency of industrial transformations, new challenges have emerged for students in applying engineering knowledge to solve practical problems. One such challenge is the significant decoupling between engineering practice and science, leading to many graduates needing help to meet the development needs of enterprises (Chen et al., 2023), further exacerbating the shortage of engineering talent.

Software engineering, as an interdisciplinary field involving computer science and engineering (Chen et al., 2019; UCI Department of Informatics, 2023), aims to enhance software development's quality, efficiency, and reliability. It also seeks to cultivate students' software application research and development abilities and comprehensive skills such as teamwork (Song et al., 2020; Zhang H, Zhang Z, and Cheng, 2019). With the continuous development and widespread adoption of information technology, software engineering has gradually become a crucial component across various industries, playing a significant role in socioeconomic development and technological progress. Against this backdrop, many countries increasingly focus on engineering education, highlighting the growing importance of software engineering education.

In summary, conducting a comparative study of talent development programs between China and the United States, within the framework of ABET accreditation, holds significant implications. Through comparative research, it is possible to discern disparities in educational systems between the two nations,

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unearth pedagogical strengths, and foster more profound cultural exchange and international educational collaboration. This paper takes the Sino-foreign cooperative programs between Xi'an Eurasia University and Middle Tennessee State University in the United States as an example, outlining the curriculum based on international engineering accreditation standards. This endeavor promotes the standardization, regularization, and scientification of professional education while safeguarding the internationalization of the institution's professional education and talent development.

2. Comparison between China and the United States

In this chapter, a policy analysis approach is employed to explore the comparative aspects of China and the United States in the field of software engineering education. Specifically, the focus will be on examining national policies, graduation requirements, and degree conferment, as well as curriculum structure and credit allocation. Software engineering, as an engineering discipline guiding the development and maintenance of computer software, holds a prominent position within the framework of talent cultivation, particularly in the realm of data science.

2.1 National policies

Software Engineering is an engineering discipline that guides the development and maintenance of computer software. It serves as a core course in the field of data science and holds a significant position within the framework of talent cultivation (Nie et al., 2023). The curriculum encompasses feasibility analysis, requirement analysis, system design, implementation and maintenance, software project management, and more. The instructional objectives aim to equip students to comprehend the fundamental concepts, operational principles, and software development methodologies in software engineering. This guidance enables students to apply software engineering methodologies in subsequent software development processes, enhancing development efficiency, minimizing system redundancies, and reducing maintenance costs.

In accordance with the requirements of China's engineering education professional accreditation system, the course objectives play a supportive role in shaping the outcomes of graduate requirements. As such, the course objectives are redefined across dimensions of knowledge, skills, and professional attributes (Xu, 2022). The supporting relationship between curriculum objectives, graduation requirements and teaching content is shown in Figure 1.

Course objectives	Graduation requirements indicator points	Main teaching content
Objective 1: To be able to apply advanced mathematical foundations, engineering technology foundations, social science foundations and software engineering knowledge to solve complex engineering problems in software engineering and applications	1. 3 Master the theoretical knowledge of computer software, and be able to design appropriate software models for the solution of complex software engineering problems	Overview of Software Engineering; Feasibility study
Objective 2: To be able to design solutions to complex engineering problems in the field of software engineering, to develop software systems that meet specific needs, and to be able to reflect a sense of innovation in the design process, taking into account social, health, safety, legal, cultural and environmental factors	3.1 Be able to determine software design tasks under external constraints such as law, safety, and environment, and conduct reasonable demand analysis	Requirements analysis; Outline design; Detailed design
Goal 3: Strong sense of teamwork and collaboration, able to assume the roles of individual, team member and leader in a team in the context of software engineering and related interdisciplinary contexts, and have the ability to respond to emergencies	9.2 Clarify roles in the system development process, take responsibility, and have the ability to independently take charge of the development of some modules	Coding and testing; Software maintenance
Objective 4: Understand and master software engineering project management principles and economic decision-making methods, and apply them in an interdisciplinary context of software engineering and applications	11. 2 Master technical and economic analysis, economic benefit and social benefit analysis ability and certain economic management knowledge, understand the relevant regional culture, business environment and laws and regulations	Software project management

Figure 1: Supporting relationship among Course objectives, Graduation requirements, and Teaching content

As per the stipulations within the American ABET accreditation framework concerning educational outcomes, it is mandated that the program establishes and disseminates program educational objectives congruent with the institutional mission, the program's diverse stakeholders, and the specified criteria. An explicit, methodically employed, and impactful procedure involving representatives from the program's stakeholders must be in place for the periodic assessment of these programs' educational objectives. This assessment process ensures the enduring alignment of said objectives with the institution's mission, the requirements of the program's constituents, and the designated criteria (ABET,

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2022).

2.2 Graduation requirements and degree conferment

2.2.1 Current conditions at Xi'an Eurasia University

The academic program at Xi'an Eurasia University spans four years and culminates in the conferment of a Bachelor of Engineering degree upon graduation, The specific requirements for software engineering degree awarding and graduation from Xi 'an Eurasia University are shown in Figure 2. To earn this degree, students are required to fulfil several conditions, including demonstrating commendable ideological and political morality, completing a total of 177 credits as outlined in the designated talent development plan, attaining a physical fitness score of 50 or above, and meeting one of the following criteria: participating in at least one academic competition by extracurricular competition recognition standards, or obtaining at least one qualification certificate relevant to the field as stipulated by pertinent criteria. The degree will be granted to those students who, within the prescribed timeframe, satisfy the requirements outlined in the Implementation Regulations for bachelor's degree Conferment at Xi'an Eurasia University. This program's approach prioritizes a balanced development of academic knowledge, ethical values, physical fitness, and practical skills, ultimately leading to a Bachelor of Engineering degree award.

Duration	4 years
Degree	Bachelor of Engineering
Graduation Requirements	(1) Qualified in ideological and political moral character; (2) Complete a total of 177 credits according to the talent training program requirements; (3) Physical fitness test score >= 50 points; (4) Meet one of the following conditions: a. Academic competition: Participate in academic competitions >= 1 time (in accordance with the recognition criteria of extracurricular competition); b. Qualification certificate: Obtain >= 1 professional-related qualification certificate (in accordance with relevant recognition criteria)
Degree Conferral Requirements	Students who meet the relevant requirements stipulated in the *"Implementation Rules for the Conferral of Bachelor's Degrees at Xi'an Eurasia University"* within the prescribed time frame will be awarded the Bachelor of Engineering degree

Figure 2: Software Engineering Degree Conferral and Graduation Requirements of Xi'an Eurasia University

2.2.2 Current Conditions at Middle Tennessee State University

The Computer Science Department at MTSU provides a Bachelor of Science degree with two tracks: the professional concentration program, accredited by the Computing Accreditation Commission of ABET, and the business applications concentration (not accredited). The Computer Science major equips students for careers in computing across sectors such as business, government, education, and industry, and also serves as a foundation for graduate studies. (MTSU, 2022)

2.3 Curriculum structure and Credit Distribution

2.3.1 Current situation at Xi'an Eurasia University

The curriculum of the Software Engineering program at Xi'an Eurasia University is structured into three components: General Basic Platform Courses, Discipline-specific Basic Platform Courses, and Elective Courses. The General Basic Platform Courses encompass Political Theory and General Education, totalling nineteen and forty-five credits, respectively. The Discipline-specific Basic Platform Courses consist of Discipline Fundamentals and Professional Fundamentals, amounting to fifteen and forty-five credits. Elective Courses encompass Professional Electives, General Electives, and Concentrated Practical Modules, totalling three credits, twenty credits, and sixteen credits. The specific credit distribution of software engineering courses in Xi 'an Eurasia University is shown in Figure 3.

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Course Categories		Credit
General Foundation Courses	Political Theory Courses	19
	General Cultural Courses	45
Discipline and Professional Foundation Courses	Discipline Foundation Courses	15
	Professional Foundation Courses	45
Electives	Professional Elective Courses	3
	General Elective Courses	20
	Concentrated Practical Components	16
	TOTAL	163

Figure 3: Credit Allocation for Software Engineering Courses at Xi'an Eurasia University

This curriculum configuration in credit allocation reflects the comprehensive nature of the Software Engineering discipline. The emphasis on Political Theory and General Education in the General Basic Platform Courses nurtures students' sense of social responsibility and humanistic literacy. Discipline-specific Basic Platform Courses focus on disciplinary knowledge and foundational skills, establishing a robust academic groundwork for students. Elective Courses provide diverse learning options, with Professional Electives and General Electives enabling students to explore personal interests and developmental directions. The Concentrated Practical Modules underscore the cultivation of practical operational skills.

2.3.2 Current situation at Middle Tennessee State University

After completing the above analysis, the credit distribution of software engineering courses at Middle Tennessee State University is analyzed, as shown in Figure 4.

Course Categories		Credit
General Education		41
Major Requirements	Computer Science Core	26
	Professional Computer Science Concentration	18
Supporting Courses		29
Electives		6-16
	TOTAL	120

Figure 4: Credit Allocation for Software Engineering Courses at Middle Tennessee State University

The curriculum structure of the Software Engineering program at Middle Tennessee State University comprises four primary components: General Education, Major Requirements, Supporting Courses, and Electives. Specifically, General Education Courses encompass 41 credits, while Major Requirements encompass both Computer Science Core and Professional Computer Science Concentration, accounting for 26 credits and 18 credits, respectively. Electives provide a flexible range of study options from 6 to 16 credits. Additionally, Supporting Courses contribute 29 credits to the total of 120 credits required for the program. Notably, compliance with Middle Tennessee State University's credit requirements for courses in Natural Sciences and Humanities (8+6 credits) is mandatory.

3. Findings

3.1 Teaching Context and Level of Professional Knowledge

In China, the curriculum instruction of software engineering tends towards isolation and a pronounced level of abstraction in its imparted knowledge. In Chinese software engineering courses, the instructional content predominantly centers around textbooks, encompassing numerous conceptual knowledge points with extensive textual volume (Chen et al., 2023). Moreover, due to limited class hours, the teaching process is constrained to primarily describing concepts and phenomena (Chen et al., 2019). This aspect misaligns with the "goal-oriented" concept emphasized in engineering education accreditation, as it lacks the theoretical-practical linkage necessary for expanding students' learning interests and capabilities.

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Additionally, even courses with similar names to their content still exhibit lower difficulty levels in the Chinese context compared to their American counterparts, simultaneously resulting in a significantly higher proportion of theoretical courses over practical ones. Exploring how to establish coherent sequencing and interrelation among courses within the curriculum cluster to achieve knowledge integration and mutual application becomes a key optimization direction inspired by professional accreditation.

3.2 Evaluation and Assessment Methods

Evaluation and assessment methods within Chinese software engineering courses demonstrate a certain degree of uniformity and simplicity. The assessment and evaluation methods within Chinese software engineering courses tend to emphasize "knowledge over skills." These methods predominantly rely on routine assignments, attendance, and final exams, with a notable weightage attributed to the final exam. Such an approach contradicts the educational model advocated by engineering education accreditation, underscoring an industry-oriented emphasis on cultivating and training abilities (Frenk et al., 2022). The diversification of assessment formats and an increased emphasis on continuous evaluation represent areas that require improvement under the guidance of professional accreditation.

3.3 Practical Components

Practical components in Chinese software engineering education must be more robust, potentially leading to a disconnection between theoretical learning and practical application in real-world production contexts. The teaching model of the software engineering discipline leans towards theoretical exposition and knowledge dissemination, with a relatively limited emphasis on practical engineering training. Throughout the four-year study period, students have limited exposure to interactions with enterprises, resulting in a challenge for graduates to comprehend authentic industry needs and competency requirements. Despite the supplementary participation opportunities in competitions such as "Internet+" and university-level innovation and entrepreneurship contests, students' engagement motivation is not particularly strong. This shortfall impedes adequate knowledge and skill development training, potentially leading to a disconnection between academic training and practical application. Consequently, graduates might face challenges in employability and the potential outcome of being unemployed shortly after graduation ("graduate unemployment") (Lambert & Ashwin, 2022).

4. Suggestion

4.1 Design and Implement Blended Learning Model in Alignment with ABET Criteria

Drawing inspiration from both domestic and international talent development programs in data science, and guided by the foundational principles of engineering education accreditation, particularly as set forth by the Accreditation Board for Engineering and Technology (ABET), a proposal is put forth to implement a blended learning approach.

ABET's core emphasis within the framework of engineering education accreditation pertains to the development of multifaceted engineering competencies. In accordance with these principles, the proposed blended learning model is designed to harmonize online and offline pedagogical modalities. Conventional lecture-based instruction undergoes a transformation into a blended paradigm, encompassing self-directed study, the integration of massive open online courses (MOOCs), participative group discussions, inquiry-based learning, and instructor-guided face-to-face sessions. Moreover, in order to meet the requirements, set forth by ABET, which place particular emphasis on the student's mastery of fundamental engineering principles, a culture of pre-class self-study, profound classroom dialogues with both peers and instructors, and post-class online exercises is fostered. This educational approach is characterized by its adaptability, aligning with ABET's criteria for outcome-focused education, thereby enabling students to tailor their learning experiences according to their individual paces and requirements, ultimately facilitating a profound grasp of the subject matter.

4.2 Emphasize Assessment Feedback and Continuous Iterative Improvement in Accordance with ABET Standards

In adherence to ABET standards, it becomes essential to undertake a comprehensive reform of assessment methods for specialized courses, thus disassembling the dominance of monolithic evaluation

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based solely on standardized examinations and numerical scores. The underlying shift emphasizes a holistic evaluation strategy.

ABET's accreditation criteria underscore the paramount importance of outcomes assessment. In accordance with this perspective, the present approach integrates assessments originating from an array of sources, encompassing assignments, empirical investigations, classroom deliberations, course reports, practical professional experiences, and standardized examinations. This diversified evaluation framework aligns with ABET's particular focus on fostering a culture of ongoing enhancement. This all-encompassing evaluation and continuous improvement structure harmonizes both internal and external evaluations, thereby ensuring strict conformance with the distinctive facets of software engineering education as defined by ABET.

4.3 Prioritize Project Management and Team Collaboration in Alignment with ABET Accreditation Criteria

ABET's accreditation standards underscore the imperative nature of project management and teamwork skills. These attributes are essential within the contemporary landscape of software development, characterized by multifaceted projects executed by teams of specialized practitioners. Consequently, software engineering education should accord precedence to the cultivation of these competencies, aligning with the criteria delineated by ABET.

In accordance with ABET's focus on practical applications of engineering principles, the educational model integrates structured coursework and experiential learning. This holistic approach imparts students with insights into project planning, progress monitoring, resource allocation, and related facets that are essential for efficient coordination and management of intricate software projects, as stipulated by ABET's criteria. Simulated collaborative environments and interdisciplinary teamwork experiences grant students opportunities for active engagement in diverse teams, thereby honing their cross-cultural and cross-disciplinary communication and collaboration skills. This focus on project management and team collaboration serves to enhance students' readiness to meet the demands of professional development, aligning with ABET's aspirations for preparing students for diverse and globally oriented professional settings.

4.4 Enhance Software Testing and Quality Assurance Education in Accordance with ABET Requirements

ABET accreditation standards place substantial emphasis on the practical application of engineering principles. Within the realm of software engineering, this places a particular focus on software testing and quality assurance, as articulated by ABET.

In compliance with ABET requirements, the present approach augments the training in software testing and quality assurance skills, thereby inculcating in students a profound understanding of the significance of testing within the software development lifecycle. Students are exposed to the design of effective testing strategies through dedicated coursework and practical projects, adhering to ABET's stipulations regarding the application of engineering principles to practical problems. This approach aligns with ABET's emphasis on the development of analytical and problem-solving skills. Practical experiences derived from real-world case studies and simulated projects serve to equip students with the ability to address complex software systems, thus harmonizing with ABET's accreditation standards.

5. Conclusion

In conclusion, this comparative study of software engineering education in China and the United States within the ABET accreditation framework highlights the significance of aligning educational programs with international standards. The research underscores the importance of integrating practical experiences, outcome-focused education, and continuous improvement into software engineering curricula to meet the demands of a dynamic and evolving field. It identifies areas for improvement, including assessment diversity, practical exposure, and knowledge integration, and provides concrete recommendations for enhancing software engineering education.

By drawing insights from both countries and emphasizing alignment with ABET criteria, this study seeks to facilitate a comprehensive and global approach to software engineering education. The proposed reforms aim to bridge the gap between academia and industry, equipping graduates with the skills,

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competencies, and adaptability needed for success in the software industry. Ultimately, the goal is to produce software engineering professionals who not only meet international accreditation standards but also thrive in an ever-competitive and fast-evolving global landscape, contributing to the continued growth and innovation of the software industry.

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