Curriculum and Teaching Methodology (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2025.080520
ISSN 2616-2261 Vol. 8 Num. 5

Reflection and Exploration on the Teaching of Brewery Plant Design under the Background of Engineering Education Professional Accreditation

Liu Feixiang*, Pu Shunchang, Fang Songping, Yu Zhengyang, Sang Na

Department of Biology and Food Engineering, Bozhou University, Bozhou, Anhui, China
**Corresponding author: 2017070001@bzuu.edu.cn*

Keywords: Brewery Plant Design, Textbook Development, Curriculum Structure, Faculty Training, Assessment Methods

Abstract: Since its inception, the Brewing Engineering program has become a distinctive major at Bozhou University, focusing on cultivating high-quality brewing talents to serve the Jianghuai region. "Brewery Plant Design" is a compulsory course within the Brewing Engineering curriculum, serving as an interdisciplinary course that bridges theory and practice while enhancing students' comprehensive qualities. Seizing the opportunity presented by our university's current pursuit of Engineering Education Professional Accreditation (EEPA), this paper analyzes and explores prominent issues in the course concerning textbook development, curriculum structure, faculty training, and assessment methods. Feasible solutions aligned with EEPA requirements are proposed to enhance students' practical abilities and engineering competencies.

1. Introduction

Engineering Education Professional Accreditation (EEPA) serves as a quality assurance system for engineering education and is a crucial foundation for international mutual recognition of engineering qualifications and engineer credentials [1]. The Washington Accord is one of the most influential international agreements for mutual recognition of engineering education. China officially joined this accord in June 2016 and received unanimous approval during the closed-door meeting of the Washington Accord at the 2023 International Engineering Alliance meeting, confirming the substantial equivalence of China's EEPA system with other member organizations and maintaining its full member status. Programs accredited under EEPA gain international recognition for the quality of their engineering education. Therefore, pursuing EEPA holds significant importance for the university, its programs, and its students. The core principle of EEPA is student-centeredness, ensuring that graduates meet industry-recognized standards through continuously improved curricula and assessment systems designed to comprehensively enhance students' learning and practical abilities [2].

Currently, only around 20 universities in China offer Brewing Engineering programs, with Guizhou University being the only one accredited nationally for this discipline, thus providing

limited reference points for Brewing Engineering accreditation [3]. As a core compulsory course in Brewing Engineering, "Brewery Plant Design" is a comprehensive subject centered on process design, integrating knowledge from multiple disciplines. It is also a highly practical and application-oriented engineering course [4]. Through this course, students synthesize their acquired knowledge to develop a preliminary capability for designing brewery plants. The course provides fundamental comprehensive training essential for engineers, complementing graduation internships and design projects, thereby fostering students' engineering capabilities and qualities in the field of brewery plant design. Furthermore, it cultivates students' abilities in analysis and problem-solving, enabling them to evaluate the strengths and weaknesses of different plant designs and make scientifically sound decisions to improve brewery process design levels [5]. Aligned with EEPA requirements, this paper analyzes problems encountered since the course's inception concerning textbooks, content, faculty, and student assessment, proposing corresponding improvement measures to establish a sustainable and effective teaching quality enhancement mechanism.

2. Textbook Development

As a specialized program, selecting appropriate textbooks is crucial for Brewing Engineering. However, relevant textbooks specifically tailored for "Brewery Plant Design" are currently limited in China, and their alignment with the Brewing Engineering program is often poor. This manifests in two main aspects. Firstly, existing textbooks target limited disciplines. Textbooks like "Design of Bioprocessing Plants," "Introduction to Bioengineering Plant Design," and "Food Plant Design and Environmental Protection" are primarily written for majors such as Bioengineering and Food Science and Engineering. While related to Brewing Engineering, significant differences exist in teaching emphases and professional requirements. Brewing Engineering possesses unique processes and demands that existing textbooks fail to fully address. Secondly, there is insufficient integration of relevant content. The content arrangement in existing textbooks typically covers general knowledge of plant design, including site selection, overall plant layout, process flows, material balances, and workshop layouts. While somewhat generic for various plant types, this content lacks organic integration with the specifics of breweries, particularly different types like Chinese Baijiu, beer, wine, and rice wine plants. For instance, the principles and content in existing textbooks, mainly focused on liquid fermentation, do not align with the solid-state open fermentation used in Baijiu production. Moreover, breweries have heightened requirements for fire safety and environmental protection, aspects inadequately covered in current textbooks.

The poor fit of existing textbooks for Brewing Engineering causes significant inconvenience during teaching. Firstly, it increases the burden on instructors. To compensate for textbook deficiencies, teachers must invest considerable time and effort in collecting, organizing, and filtering teaching materials suitable for Brewing Engineering. This not only increases their preparation workload but can also lead to unsystematic and disjointed teaching content, negatively impacting teaching effectiveness and quality. Secondly, it adversely affects student learning outcomes. Using mismatched textbooks makes it difficult for students to grasp the core knowledge and skills specific to Brewing Engineering. Students may find the textbook content confusing and struggle to connect the learned knowledge to the practical design of breweries. This hinders the formation of a complete professional knowledge system and dampens student interest and enthusiasm for the major.

To address the lack of suitable textbooks, a project to develop an institutional textbook for "Brewery Plant Design" has been initiated. This specialized textbook will better meet the teaching needs of the Brewing Engineering program. It will emphasize the characteristics of designing different types of breweries (e.g., Baijiu, beer, wine, rice wine), enabling students to gain a deeper

understanding of their specific requirements. This textbook will fill a gap in Brewing Engineering literature, providing students with more professional and practical learning materials and offering teachers more systematic and comprehensive teaching resources. Its use will help students understand fundamental theories and methods of general plant design while mastering the unique aspects of brewery design, thereby enhancing both their professional competence and practical skills. The development of this textbook will also promote teaching reform and development within the Brewing Engineering program, elevating the overall level of program construction.

3. Curriculum Structure

"Brewery Plant Design" is offered in the seventh semester (senior year) at our university. By this time, students have completed core compulsory courses such as Baijiu Technology, Beer Technology, and Rice Wine Technology, providing them with a systematic grasp of brewing process theory. This course is vital for Brewing Engineering students as it integrates theoretical knowledge with practical production, offering a platform to apply learned concepts. Through this course, students learn the principles, methods, and procedures of brewery plant design, acquiring fundamental design skills essential for future careers in the brewing industry.

However, students generally lack sufficient production experience and have limited subjective impressions of actual breweries. This makes it difficult for them to connect theoretical knowledge with practical production scenarios during learning, impacting effectiveness. To address this, multimedia presentations showcasing plant layouts, equipment selection, workshop arrangements, etc., are integrated into theoretical teaching. This provides students with an intuitive understanding of real breweries, enhancing sensory perception and stimulating learning motivation [6]. For example, videos filmed on-site at breweries can illustrate different plant areas, equipment operation, and production flows; detailed explanations of design key points, supported by images and diagrams, help students better comprehend and grasp relevant knowledge. As a theoretical course, the teaching methods for "Brewery Plant Design" tend to be singular, often resulting in low student engagement. Traditional classroom teaching may not meet diverse learning needs or effectively spark interest. To increase engagement, our university has introduced a one-week practical course, "Brewery Plant Design Project," in the seventh semester. This hands-on experience allows students to engage directly in the design process, fostering practical and innovative skills. Using modern computer software like CAD and 3DMAX, students can complete workshop layouts and equipment selection tasks. The practical course also cultivates teamwork and communication skills as students collaborate on design tasks.

Course content overlaps with previously studied subjects like "Principles of Chemical Engineering," "Brewing Equipment," and "Engineering Drawing." To avoid redundancy and improve teaching efficiency, overlapping content should be streamlined to ensure cohesion with prior courses. For instance, chemical engineering principles relevant to plant design can be condensed, focusing on aspects pertinent to brewery design to avoid repetition with the "Principles of Chemical Engineering" course. Content already covered in "Brewing Equipment" and "Engineering Drawing" can be reviewed and reinforced within "Brewery Plant Design" rather than retaught. Reducing redundant content makes teaching more concise and logical, preventing student boredom. It also helps students better understand the connections between courses, reinforcing the systematic nature of their professional knowledge [7].

4. Faculty Development

Faculty competence is a critical evaluation metric in educational assessment. Teachers directly influence student learning outcomes and development as organizers and implementers of teaching

activities. Therefore, continuous improvement of faculty quality is essential [8]. In recent years, the recruitment of high-caliber talent (e.g., PhDs, professors) has strengthened the university's faculty both quantitatively and qualitatively, bringing new vitality and opportunities to teaching and research. However, most current teachers entered teaching directly after graduation. While possessing solid academic foundations, they generally lack substantial practical experience. EEPA standards explicitly require course instructors to have at least six months of relevant engineering practice. This requirement ensures teachers can integrate real-world engineering experience into teaching, enabling students to better grasp professional knowledge and skills, thereby enhancing practical and innovative abilities. Consequently, the university must prioritize addressing this gap in faculty practical experience through effective measures.

To enhance faculty practical experience and improve teaching quality and professionalism, the university can implement the following specific measures. Firstly, utilize faculty secondment programs such as those established by the Anhui Provincial Education Working Committee and university-level secondment initiatives to support faculty placements in brewery settings. Breweries are crucial sites for practical teaching in Brewing Engineering [9]. Through brewery secondments involving frontline production rotations, teachers gain in-depth understanding of actual brewing processes and needs. During secondments, teachers develop comprehensive practical knowledge of both specific areas and the overall brewery operation. They experience various stages like raw material procurement, brewing processes, quality control, and equipment maintenance. Interaction and collaboration with enterprise staff allow teachers to understand management models, corporate culture, and learn advanced technologies and practices. This secondment experience enables teachers to incorporate real engineering cases into teaching, enriching content and enhancing its relevance and practicality. It also fosters university-industry collaboration, creating better conditions for student internships and employment. Secondly, dispatch teachers with practical production experience to collaborate with design institutes on brewery plant design projects. Design institutes are specialized agencies for brewery design. By engaging in design work at such institutes, teachers become familiar with and adept at standardized brewery design processes, software applications, and relevant legal/regulatory knowledge. Collaborating with professional designers on actual projects allows teachers to learn advanced design concepts and methods and master the latest design software and technologies. They also gain awareness of legal requirements impacting brewery design. This design practice experience enables teachers to integrate practical design knowledge into teaching, cultivating students' design thinking and innovation capabilities. It also promotes collaboration between the university and design institutes, providing a better platform for research and social service.

5. Assessment Methods and Process

In education, an outcome-based education (OBE) approach is paramount. This means the goal of teaching is not merely knowledge transmission but, more importantly, focusing on the abilities and achievements students gain through learning. Establishing a reasonable and scientific course evaluation system is the prerequisite for assessing course attainment, as it accurately measures learning outcomes and provides a basis for teaching improvement [10]. For the "Brewery Plant Design" course, building an OBE-oriented evaluation system is especially critical. The course aims to develop practical abilities, innovation skills, and teamwork spirit. Comprehensively assessing student learning outcomes determines whether course objectives are met and whether students possess the required professional competencies in brewery plant design.

Assessment is conducted through group design projects, formative guidance, and a final defence. This approach comprehensively evaluates teamwork, practical operational skills, and knowledge

mastery. Group design fosters collaboration on brewery design tasks; formative guidance allows timely identification and targeted resolution of problems during the design process; the final defence provides a platform for students to showcase their work while honing presentation and communication skills. However, compared to disciplines like Bioengineering, Chemical Engineering, or Food Science, the range of potential design topics for breweries is narrower. This leads to issues of topic repetition and similarity among student groups, somewhat compromising the fairness and effectiveness of the assessment. To address this, topic selection needs careful vetting early in the course. Teachers should organize topic selection workshops, guiding students from different perspectives and encouraging innovative thinking to avoid duplication.

Furthermore, despite having systematically studied foundational courses like "Engineering Drawing," "Principles of Chemical Engineering," and "Brewing Equipment," students often feel lost when tackling practical brewery design examples. This indicates a gap in applying theoretical knowledge to practice. Therefore, during formative guidance, emphasis should be placed on demonstrating practical applications like material balancing, equipment selection, and CAD drawing through concrete examples. Teachers can use case studies to explain methods for material balances, principles for equipment selection, and CAD drawing techniques, helping students better master practical operational skills.

During the final defence, students present their brewery design using PowerPoint (PPT) and submit a design report. Observations indicate that a significant portion of students exhibit low participation, and effective collaboration within groups is often lacking. This may stem from assessment methods failing to adequately motivate individual accountability and effort. To solve this, the assessment process should include greater individualization. Besides evaluating the overall group project quality, the assessment weighting for individual contributions within the group should be increased to boost participation motivation. For example, specific metrics for individual contribution and performance within the team can be established and assessed separately.

6. Conclusions

"Brewery Plant Design" is a core compulsory course within the Brewing Engineering program. While enhancing and expanding students' professional theoretical knowledge, it places greater emphasis on practical operation, directly preparing students for real-world factory production and fostering the integration of theory and practice. Aligning with EEPA standards and adopting a student-centered approach, continuous reflection on problems encountered in teaching "Brewery Plant Design" and timely implementation of corresponding teaching reforms are essential for sustained improvement in teaching quality. In summary, the reflection and exploration of "Brewery Plant Design" teaching will further consolidate teaching objectives, enhance students' engineering practical abilities, enabling them to undertake various brewery-related course designs and graduation projects. Ultimately, graduates will possess the capability to conduct overall planning, production process design, and technological renovations for breweries.

Acknowledgements

This work was supported by Anhui Provincial Teaching Quality Project: Fermentation Engineering Experimental Training Center (NO. 2024sysx032); Bozhou University Teaching Quality Project: Institutional Characteristic Textbook "Brewery Plant Design" (NO. 2023XJXM025).

References

[1] Edmond P Byrne. (2023) The evolving engineer; professional accreditation sustainability criteria and societal imperatives and norms. Education for Chemical Engineers, 4323-4330.
[2] John W Prados, George D Peterson, Lisa R Lattuca. (2005) Quality assurance of engineering education through accreditation: The impact of Engineering Criteria 2000 and its global influence. Journal of engineering education, 94(1): 165-184.
[3] Fang Chunyu, He Yiguo, Zhu Ronggui. (2023) Laboratory Construction of Liquor-Making Engineering Based on Engineering Certification. Liquor-Making Science & Technology, (2): 140-144.
[4] Li Li, Zong Xuyan, Li Yixuan, Ye Guangbin, Wang Tao. (2019) Constru1ction of Practical Teaching System of"Teaching Factory" in Brewery Engineering Specialty. Agricultural Engineering, 9(5): 109-111.
[5] Niu Chengtuo, Zheng Feiyun, Liu Chunfeng, Wang Jinjing, Xu Xin, Li Qi. (2022) Reform and application of Comprehensive Design in Brewing Factorycourse based on the Emerging Engineering Education background. Food and Fermentation Industries, 48(115): 351-356.
[6] CHEN Hui, WU Chongde, LI Bo, ZHANG Jinwei. (2022) Analysis on the Teaching Mode of Light Industry Undergraduate Engineering Design under the Background of Engineering Education Certification. Leather Science and Engineering, 32(6): 96-99.
[7] Liu Yifan Peng Jinming, Duan Dengle. (2022) Exploration on Teaching Reform of Food Factory Design Fundamentals Course under the Background of Engineering Education Accreditation. Farm Products Processing, (4): 116-120.
[8] Wang Xinhong. (2010) The Faculty Training Strategies in American Engineering Education Accreditation Reform. Research in Higher Education of Engineering, (4): 64-67.
[9] Zhang Kaizheng. Zou Wei, Bian Minghong, Luo Huibo. (2016) Construction of Multi-level Practical Teaching System of Liquor-making Engineering Major. Liquor-Making Science & Technology, (1): 125-127.
[10] Guo Ruili, Zhang Jianshu. (2016) Application of Target Decomposition Method in the Chemical Technology Teaching. Higher Education Forum, (6): 72-74.