# Exploration and Practice of Cultivating Applied Competencies in Food Majors Driven by Engineering Education Accreditation and Industry-Education Integration

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**Abstract** To address the talent challenges brought by the high-end, intelligent, and green transformation of the food industry, this initiative adopts a dual-driven approach based on engineering education accreditation and industry-education integration. It involves constructing an integrated "competency-curriculum-evaluation" reversedesign system, building a three-dimensional and interconnected authentic training environment of "platform-project-mentor", and improving a three-in-onemulti-valuation system covering "process-outcome-development". These efforts effectively promote the cultivation of students' application competencies and provide a reference for the development of emerging engineering disciplines and collaborative industry-education integration in local universities.

**Key words** Engineering education accreditation; Industry-education integration; Food major; Application competency

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As the food industry accelerates its transformation toward high-end, intelligent, and green development, the demand for talent has evolved from merely mastering professional knowledge to possessing systematic application competencies that enable solving complex engineering problems, driving technological innovation, and adapting to industrial changes[1]. However, compared with the urgent needs of the industry, the talent cultivation system for food majors in many local universities in China still lags behind[2]. The long-standing tendency of emphasizing theory over practice and prioritizing knowledge over skills[3] has resulted in the condition that graduates often exhibits low adaptation, weak transferability, and insufficient innovation when facing real engineering scenarios, complex technical challenges, and dynamic market demands. The root cause lies in the lack of effective alignment between the "output end" of talent cultivation and the "demand end" of the industry, as well as the absence of a systematic mechanism design for cultivating applied competencies.

To overcome this dilemma, it is necessary to go beyond the reform of individual teaching methods and reconstruct the cultivation mechanism of applied competencies at a systemic level. The philosophy of "student-centered, outcome-oriented, and continuous improvement" advocated by engineering education accreditation emphasizes that all teaching activities should be designed and continuously improved based on the measurable abilities that students are expected to achieve upon graduation[4-5]. Meanwhile, deepening the integration of industry and education provides fertile ground and practical arenas for these standardized competency goals, and introduces the latest technologies, real-world projects, and dynamic cases from the industry into the entire cultivation process[6]. The two are deeply complementary and synergistic. Engineering education accreditation ensures the systematic and standardized nature of ability cultivation, while the integration of industry and education endows competency cultivation with practicality and cutting-edge relevance.

The Food Science and Engineering major at Chengdu University, as a nationally recognized first-class major, has taken the lead in Southwest China in obtaining professional accreditation from the China Engineering Education Accreditation. Based on years of exploration and practice, the major has been driven by the dual engines of "professional accreditation" and "industry-education integration" to promote the systematic and progressive cultivation of students' applied competencies.

## Problems in Cultivating Applied Competencies

### Disconnection between ability goals and industry needs

The descriptions of "applied competencies" and "engineering competencies" in the training program are often too broad and vague[7], such as "possessing a certain level of engineering practice ability" or "understanding the production reality of the food industry". These have not been broken down into specific, observable, and assessable competency indicators based on detailed industry research and job analysis. As a result, curriculum design and teaching activities lack clear targets for ability cultivation, creating a disconnect with the dynamically evolving real-world needs of the industry.

### Lack of situation in ability training

The practical teaching components (experiments, course design, internships, graduation projects) are poorly connected, lacking organic integration and progressive difficulty under a top-level design[8]. Experiments in the lower grades are mostly confirmatory

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and weakly linked to the comprehensive design and engineering practice in the upper grades, failing to form a "competency development chain" that runs through the four years with progressive advancement. Moreover, much of the practical training is confined to simplified, idealized laboratory environments, where the equipment, raw materials, processes, and standards used are quite at odds with actual working conditions in modern food factories. Students rarely have the opportunity to handle equipment malfunctions, respond to quality fluctuations, conduct cost accounting, or coordinate cross-team operations on real or highly simulated production lines. This leads to a pronounced disconnect between knowledge and practice.

**Incomplete competency evaluation and improvement mechanisms**

Traditional evaluation methods heavily rely on summative assessments such as final exams and lab reports, focusing primarily on testing knowledge recall and comprehension. These approaches are insufficient for effectively assessing higher-order applied competencies such as design ability, collaboration skills, and innovative thinking[9]. Due to the lack of process-oriented, multi-dimensional evaluation data based on competency indicators, teaching improvement loses its foundation and often relies on teachers' personal experience or subjective feelings. "Continuous improvement" without scientific evaluation feedback is like the blind men trying to size up an elephant. That is to say, it is difficult to form a rigorous closed loop of "setting goals—implementing teaching—evaluating achievement—analyzing feedback—making targeted improvements".

## Reform and Practice in Cultivating Applied Competencies

### Using professional accreditation as a guide to establish an integrated "competency-course-evaluation" backward design system

**Precisely defining and decomposing "competency elements"** A team of experts was formed, comprising core faculty members, industry and enterprise specialists, human resources managers, and graduate representatives. Aligning with the general graduation requirements outlined in the *Standards for Engineering Education Accreditation*, and taking into account the characteristics of the food industry and regional development needs, the team collaboratively deliberated and established 12 graduation requirements that support the major's educational objectives. Each graduation requirement was further broken down into 2 to 4 observable, measurable, and assessable secondary competency indicators, resulting in a total of 38 indicators. This process formed a clear "competency profile" for graduates.

**Constructing a fully-covered "course-competency" support matrix** Based on the 38 competency indicators, the curriculum system has been reconstructed through backward design. The syllabus for each course was revised to clearly specify: which specific competency indicators the course supports, the level of support for each indicator (designated as H: high support, M: medium support, and L: low support), and through which teaching activities and assessment methods this support is achieved. Through a matrix diagram, the support relationships of all courses to the competency system can be visualized, ensuring that each key ability is systematically cultivated by corresponding course groups.

**Implementing a data-driven "evaluation-improvement" closed-loop management** A normalized evaluation mechanism for the achievement of course objectives and graduation requirements has been established. At the end of each course, an analysis of the achievement levels of the competency indicators supported by the course is conducted based on assessment data. At the major level, an *Annual Evaluation Report on the Achievement of Graduation Requirements* is compiled each year, integrating data from course achievement reports, student surveys, and employer feedback. This report serves as the basis for revising the training plan, adjusting course content, and reforming teaching methods.

### Empowering practice through industry-education integration: building a three-dimensional "platform-project-mentor" competency training system

**Jointly establishing a "virtual-physical complementary, internal-external linked" competency incubation platform** A three-level competency training platform has been established, integrating on-campus provincial-level experimental teaching demonstration centers and virtual simulation centers with 25 deeply collaborative off-campus practice bases, to form a progressive pathway: on-campus basic training, virtual simulation exercises, and off-campus practical enhancement. The on-campus basic training platform is utilized to strengthen students' fundamental experimental skills and unit operation abilities. The virtual simulation experimental teaching centers address the challenges of understanding high-risk and high-cost processes. The practice bases support a range of activities including internships, course design, comprehensive training, graduation projects, and faculty engineering ability development. From virtual to real and from on-campus to off-campus, this system provides a smooth transitional and seamlessly connected practical environment for the enhancement of students' competencies.

**Implementing an "industry-originated, whole-process" project-based learning framework** Real-world technical challenges, research and development projects, and technological transformation needs from enterprises are transformed into topics for course design, comprehensive experiments, and graduation projects (theses), forming a progressive project chain: from cognitive projects in the lower grades, to design-oriented projects in the middle grades, and comprehensive innovative projects in the upper grades. For example, the real-world project "Optimization of Low-Salt Processing Technology and Quality Control for Sichuan-Style Cured Meat" was integrated into multiple courses, including *Animal Product Processing* (with Lab), *Food Machinery and Equipment*, *Food Factory Design* and *Environment*, *and Production Internship*. This allowed students to experience the entire process, from laboratory-scale experiments and pilot-scale simulations to factory investigations.

**Building a "university-industry mixed, whole-process accompanied" mentor community** A dual-mentor system, comprising academic supervisors from the university and industry mentors from enterprises, has been fully implemented. Technical experts from partner companies are appointed as industry mentors to actively participate in the entire talent cultivation process. The dual mentors jointly guide students in internships, course projects, and graduation projects (theses), ensuring that the topics are derived from real-world problems, the research process receives authentic guidance, and the outcomes produced have genuine value. Meanwhile, a two-way faculty exchange mechanism has been established. Specifically, university faculty regularly participate in engineering practice, technical consulting, or collaborative research and development at enterprises to update their industry knowledge and enrich their teaching. Meanwhile, enterprise experts are regularly invited to the university to engage in teaching seminars, deliver lectures, and take on partial teaching responsibilities, while also receiving pedagogical training to enhance their educational capabilities.

**Using multi-dimensional evaluation as a feedback engine to improve the "process-outcome-development" three-in-one competency evaluation system**

**Strengthening process-oriented competency evaluation** In project-based learning, internships, and training sessions, the weight of process-oriented assessment has been significantly increased. A variety of assessment formats are employed, including records of experimental operations, engineering logs, phased design reports, project review meetings, evaluations of teamwork performance, and oral defenses. These methods enable real-time evaluation and feedback on students' competencies in engineering practice, teamwork, communication, and tool usage. This formative assessment approach focuses not only on the final outcome, but also on students' thinking processes, choice of methods, and competency development during problem-solving, enabling teachers to provide timely intervention and guidance.

**Emphasizing outcome-based competency evaluation** The graduation project (thesis) serves as a "touchstone" for assessing students' comprehensive applied competencies. The 100% university-enterprise dual-mentor system and the authenticity review of project sources are strictly implemented. Evaluation criteria have shifted from traditional thesis formatting and workload to dimensions such as the innovativeness in solving engineering problems, the rationality of the design, the technical and economic feasibility, and the applicability of the outcomes. Furthermore, a multi-channel recognition mechanism for competency outcomes has been established. Achievements such as awards in high-level academic competitions including the "Internet +" and "Challenge Cup" as well as publicly disclosed invention patents are recognized as course credits or accepted as substitutes for relevant practical components according to established standards, thereby encouraging students to engage in innovative practice.

**Tracking developmental competency evaluation** A mechanism for tracking the career development of graduates and collecting social feedback has been established. Through methods such as questionnaire surveys, alumni interviews, and return visits to enterprises, regular feedback is collected on employers' evaluations of graduates' professional competence, job performance, and development potential, as well as reflections from alumni approximately five years after graduation on the alignment between their knowledge and skill structures and career development needs. The results of this tracking serve as important evidence for evaluating the long-term quality of professional talent cultivation, revising educational objectives, and optimizing the list of competency elements.

## Outcomes of the Reform Practice

### Student growth and development

Over the past five years, the average annual graduation rate exceeded 96%, with a degree conferral rate above 92%. More than 60% of graduates have pursued further studies at renowned universities or secured employment in leading food enterprises both domestically and internationally. Employers have generally reported that graduates demonstrate "strong engineering awareness", "quick adaptability", "exceptional problem-solving skills", and "good teamwork and communication abilities". Students have also achieved significant improvements in the quantity and level of awards received in various national and provincial academic competitions.

### Discipline and major development

The Food Science and Engineering major successfully passed the engineering education accreditation in both 2017 and 2024. In 2021, it was selected as a national first-class undergraduate major, and in 2024, it was designated as a provincial applied brand major. The major has established one provincial off-campus practice education base for college students, developed eight provincial applied brand courses or first-class courses, and was selected as one provincial modern industry college. The effectiveness of the teaching reform was recognized with a second prize in provincial teaching achievements.

## Conclusions

In response to the urgent demand for high-quality applied talents driven by the transformation and upgrading of the food industry, local universities with food majors must fundamentally restructure their talent cultivation systems. The reform practice of the Food Science and Engineering major at Chengdu University demonstrates that using engineering education accreditation as a "yardstick" to systematically standardize the goals and pathways of competency cultivation, while leveraging deep industry-education integration as a "furnace" to provide authentic contexts and continuous empowerment for competency development, forms a "dual-engine" model of synergistic drive. This model effectively bridges the gap between talent cultivation and industry needs. Through the construction of a closed loop involving "backward design—practical empowerment—multi-dimensional evaluation", the major has not only achieved the progressive and systematic cultivation of

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understanding of industry trends, enterprise operation and management, and market changes. They must be able to accurately identify industry hot topics, select appropriate teaching cases, and demonstrate strong project guidance skills to help students carry out their inquiries systematically and solve problems encountered during the research process. The application of this teaching model also encourages instructors to continuously learn, broaden their knowledge boundaries, and proactively enhance their professional competence and teaching guidance skills, thereby achieving a positive outcome of "teaching benefits teachers as well as students".

Of course, there are still some limitations and areas for improvement in the application of the PBL teaching model in this study. Currently, the evaluation of PBL teaching effectiveness is mainly based on qualitative methods such as classroom observation, student feedback, and outcome presentations. There is a lack of standardized and systematic data support, and no detailed, long-term tracking analysis or quantitative research has been conducted on students' learning outcomes or competence enhancement. Furthermore, the influence of different project types and team sizes on the teaching effect has not been fully explored.

In future teaching research and practical application, the teaching team will address the existing shortcomings by further optimizing the PBL teaching model, improving the project design framework, and selecting teaching cases that are more aligned with students' professional characteristics and industry needs. Meanwhile, a scientific and systematic evaluation system for teaching effectiveness will be established, with enhanced long-term tracking of students' learning processes and competence improvement. Through a combination of quantitative analysis and qualitative assessment, the application effects of the PBL teaching model will be comprehensively and objectively evaluated. Furthermore, cooperation with food enterprises will be strengthened to introduce more real-world corporate projects and industry resources, making PBL teaching more closely aligned with the actual needs of enterprises. Continuously exploring teaching pathways suitable for graduate students in Food Processing and Safety and fully leveraging the advantages of the PBL teaching model will provide strong support for cultivating more high-quality professionals for the food industry.

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students' applied competencies, but also continuously promoted the connotation of professional development. In the future, this model still requires further exploration in areas such as digital empowerment, interdisciplinary integration, and the cultivation of sustainable development capabilities, in order to continuously adapt to and even lead industrial transformation in food engineering education and provide a more solid talent foundation for the modernization of the food industry system.

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