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A Preliminary Study on the Teaching Reform of Food Microbiology Featuring Grain and Oil Disciplines Under the OBE Philosophy

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Abstract: Against the backdrop of emerging engineering construction and professional accreditation for engineering education, the conventional teaching paradigm of Food Microbiology fails to satisfy the demand for interdisciplinary, versatile talents. Rooted in the Outcome-Based Education (OBE) philosophy, this paper conducts a comprehensive exploration into the instructional reform of Food Microbiology with distinctive grain and oil disciplinary characteristics. To start with, this paper sorts out a three-dimensional curriculum objective system covering knowledge mastery, practical competence and all-round literacy in light of corporate operational demands and disciplinary development requirements. Secondly, it systematically dismantles the whole curriculum framework and embeds curriculum-based ideological and political elements into every teaching segment. Thirdly, a hybrid online-offline teaching framework is established, supplemented by diversified instructional tactics including virtual simulation and case-based learning. Finally, an assessment mechanism integrating formative evaluation and summative evaluation is constructed, forming a closed-loop system for the continuous optimization of teaching quality. Practical outcomes demonstrate that the aforesaid teaching framework can boost students' initiative in autonomous learning, deepen their comprehension of disciplinary knowledge, upgrade their hands-on operational capacity and optimize the overall curriculum evaluation effect, thereby offering an instructional scheme for cultivating high-caliber talents adaptive to the rapid evolution of the food industry.

Keywords: Outcome-Based Education (OBE); Food microbiology; Instructional reform; Grain and oil disciplinary features

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1. Introduction

Outcome-Based Education (OBE) represents an educational philosophy compatible with the developmental trend of contemporary disciplines. It adheres to reverse instructional design logic, takes social development requirements, occupational standards and undergraduate graduation criteria as the starting point, and reversely constructs curriculum frameworks, defines teaching objectives and arranges instructional contents.

Meanwhile, it coordinates all links of teaching implementation and academic assessment, and ultimately forms a self-improving closed-loop teaching quality system consisting of evaluation, feedback and optimization. As a core major course for Food Science and Engineering as well as Food Quality and Safety majors, Food Microbiology acts as a vital connecting bridge between fundamental microbial theories and industrial applications in the food sector [1]. Taking universities with long-standing disciplinary foundations in grain and oil research as research objects, this paper explores the feasible approaches of integrating the OBE philosophy into the instructional reform of Food Microbiology, aiming to comprehensively elevate undergraduates' core professional capabilities and comprehensive literacy, and cultivate outstanding applied talents for the rapid, high-quality development of China's grain and oil food industry [2,3].

2. Analysis of the current deficiencies in food microbiology instruction

For a long time, the delivery of Food Microbiology courses in domestic universities has been plagued by numerous unresolved drawbacks. Conventional teaching models are predominantly teacher-centered, adopting cramming instruction that forces students to receive knowledge passively, which results in low learning motivation and insufficient autonomous awareness. Furthermore, curriculum contents are disjointed from the fast-evolving industrial practices. Especially for characteristic sectors such as grain and oil storage and processing, the cases and theoretical knowledge contained in traditional textbooks lag behind industrial updates, and cannot cope with emerging technologies and industrial challenges [4]. In experimental teaching, confirmatory experiments account for the overwhelming majority, while comprehensive and design-oriented experimental arrangements are insufficient. Consequently, the phenomenon of students attaining high exam scores yet lacking practical proficiency prevails, and their innovative awareness and hands-on capabilities cannot be fully nurtured.

3. Reform concepts and targeted objectives

3.1. Core reform concepts

In accordance with the core microbial-related demands within the grain and oil food industry, this paper breaks the discipline-oriented logical framework of traditional curricula, and implements the end-oriented thinking of OBE throughout the entire instructional process. Based on the microbial proficiency required for various posts in the grain and oil sector, the expected learning outcomes of the curriculum are deduced backward, ensuring precise alignment between teaching contents and industrial realities [5]. The complete reform framework is structured as follows: pinpoint industrial pain points to set outcome-based core goals; incorporate grain and oil disciplinary features to restructure curriculum modules; innovate instructional paradigms to reinforce competence cultivation channels; optimize evaluation mechanisms to build a closed feedback loop.

3.2. Three-dimensional reform objectives

Guided by the OBE philosophy, the instructional reform of Food Microbiology targets the cultivation of interdisciplinary microbial application talents adaptive to the development of the grain and oil industry, which covers three hierarchical objectives:

(1) Knowledge Objective: Master the core theoretical system of Food Microbiology and establish precise correlation with grain and oil disciplinary scenarios.

(2) Competence Objective: Possess hands-on proficiency in microbial isolation, strain identification, analytical detection and pollution source tracing within grain and oil food matrices.
(3) Literacy Objective: Consolidate the awareness of industrial service, proactively respond to the evolving demands of the grain and oil industry, and foster a mindset oriented toward applying technical expertise to industrial development [6].

4. Detailed reform implementation measures

Guided by the OBE philosophy, the curriculum undergoes a full-scale structural redesign. Through in-depth field research on the competency requirements of graduates employed by food enterprises (especially grain and oil manufacturers), combined with an analysis of the graduation standards specified in engineering education accreditation criteria for Food Science and Engineering majors, five measurable, attainable overall curriculum objectives are formulated to integrate knowledge acquisition, practical competence and comprehensive literacy organically [7]. The specific reform measures are elaborated as follows:

4.1. Modular restructuring of curriculum contents highlighting grain and oil disciplinary traits

The original instructional contents are systematically reorganized into modular units, abandoning the traditional chapter classification based on disciplinary theoretical frameworks, and adopting a problem- and application-centered module design logic. The core restructuring principle lies in streamlining foundational contents, amplifying applied segments, and highlighting grain- and oil-featured knowledge. The theoretical curriculum is divided into three interrelated modules:

(1) Module 1: Fundamental Theories of Food Microbiology, which mainly elaborates the succession laws of microbial communities within grain storage ecological systems.
(2) Module 2: Microbial Application and Risk Control in the Food Industry, which analyzes high-profile food safety incidents such as aflatoxin contamination cases to enhance the practical pertinence of curriculum delivery.
(3) Module 3: Grain and Oil-Oriented Food Microbiology, featuring frequently updated content closely linked to industrial frontlines, which effectively stimulates undergraduates' learning enthusiasm.

4.2. Diversified innovative instructional paradigms

Hybrid online-offline teaching assigns knowledge transmission tasks to online resources, including pre-recorded lecture videos, electronic teaching plans and expanded resource repositories covering academic papers, industrial research reports and popular science documentaries. In offline theoretical classes, quick quizzes, case seminars and group debates are deployed to shift classroom time toward interactive discussion and problem-solving [8]. A virtual simulation experimental platform for food microbial inspection is deployed, which enables repeated simulation of microbial isolation, cultivation, identification and enumeration operations within a virtual environment, facilitating exploratory experiments that are infeasible or hazardous in physical laboratories. The organic integration of curriculum-based ideological and political education represents a mandatory requirement for higher education in the new era. Instructors shall fully excavate abundant ideological and political connotations embedded within Food Microbiology, and integrate such elements naturally into every instructional segment to realize the unification of knowledge imparting and value

guidance.

4.3. Student-centered diversified evaluation framework

Formative evaluation adopts multiple assessment forms, including online preview performance, classroom participation, online assignments and quizzes, experimental reports and operational assessments, group research projects and proposal drafting, as well as final comprehensive examinations. The core tenet of formative evaluation lies in timely feedback and iterative improvement; assessment indicators are embedded into the whole learning cycle to deliver real-time updates on students' learning progress to both instructors and learners [9]. Continuous Improvement constitutes the core soul of the OBE framework. The teaching quality supervision system built on assessment, feedback and iterative optimization ensures that instructional contents and philosophies keep pace with corporate developmental trends, and fosters innovative talents that meet the demands of society and industrial entities.

4.4. Construction of competent teaching staff

The integration of the OBE philosophy and diversified instructional paradigms imposes higher competency requirements on course instructors. The role of faculty transforms from pure knowledge transmitters to learning facilitators, competence developers and outcome evaluators [10]. In terms of faculty training, regular seminars focusing on emerging engineering philosophies and specialized food microbiology techniques are organized, and industrial technical specialists are invited to deliver hands-on operational guidance. Instructors are encouraged to participate in various academic conferences and engage in horizontal research projects collaborating with enterprises, so as to establish a normalized practice training system for teaching staff. From the perspective of teaching team development, multi-disciplinary expert resource pools are integrated to build school-enterprise joint teaching and research teams, promoting all-round disciplinary advancement.

5. Practical effects of the curriculum reform

5.1. Improvement of students' learning performance

Diversified instructional approaches and enriched curriculum contents boost students' classroom engagement, generating prominent positive feedback in terms of comprehensive literacy and learning experience. Undergraduates' academic achievements and hands-on capabilities witness substantial improvement; their experimental operation procedures become standardized, and the logical rigor and feasibility of experimental reports are greatly enhanced [11]. Students' willingness to participate in academic competitions related to food microbiology rises markedly, effectively cultivating their innovative thinking capacity.

5.2. Elevation of overall teaching quality

The curriculum reform yields three landmark breakthroughs in teaching quality:

From the perspective of process control: the matching degree between curriculum contents and grain and oil occupational requirements, as well as the coverage of industrial-oriented teaching resources, is elevated; the standardization rate of on-campus experimental operations and the pass rate of off-campus internships both register growth.

From the perspective of competency attainment: students' mastery of core theories and familiarity with industrial regulatory standards are strengthened; corporate recognition of comprehensive project proposals

rises, enabling undergraduates to put forward targeted suggestions on industrial technical optimization.

From the perspective of industrial adaptability: corporate evaluation of graduates' post competency improves, and enterprises express higher satisfaction with students' hands-on proficiency and problem-solving capabilities. A quantifiable, controllable quality supervision framework is established to realize precise matching between talent cultivation and the demands of the grain and oil industry.

5.3. Enhanced industrial and social recognition

After constructing a full-cycle management system of "process supervision – outcome assessment – continuous optimization", landmark reform achievements are accomplished. Guided by industrial demands, the reform realizes precise docking between curriculum contents and grain and oil occupational requirements, breaking the disciplinary-oriented barriers of traditional teaching and shaping an innovative curriculum form characterized by prominent grain and oil features and practical orientation. The integrated application of school-enterprise cooperation, project-based learning and digital instructional tools significantly stimulates students' learning initiative, accomplishing a fundamental transformation from knowledge indoctrination to competency cultivation [12]. The establishment of quality control and multi-dimensional evaluation mechanisms standardizes the entire instructional cycle and guarantees the realization of training objectives, cultivating interdisciplinary talents equipped with solid theoretical foundations and robust practical skills. The reform creates a win-win ecological cycle among higher education, industrial entities and undergraduates, and provides a replicable, promotable practical paradigm for grain and oil featured professional courses, embodying the practical value of the OBE philosophy in cultivating applied talents and offering valuable references for homologous curriculum reforms.

6 Conclusions and prospects

6.1. Core conclusions

The instructional reform of grain and oil featured Food Microbiology rooted in the OBE philosophy constitutes a systematic, student-centered educational innovation initiative. The iteratively optimized instructional framework reshapes curriculum objectives and contents, establishes a hybrid teaching paradigm, and constructs a multi-dimensional formative evaluation system [13]. Practical reform outcomes indicate that the aforementioned framework comprehensively cultivates undergraduates' core professional proficiency, engineering practical capabilities, innovative thinking and all-round literacy to better accommodate the developmental demands of the food industry, despite minor fluctuations in students' exam scores and classroom satisfaction levels.

6.2. Existing deficiencies and limitations

Although the OBE-oriented instructional reform achieves preliminary outcomes, several unresolved challenges remain. Firstly, the new teaching framework demands intensive time and energy investment from students, and learners with weak autonomous learning capacity struggle to keep up with the learning schedule. Secondly, the paradigm imposes heavy lesson-preparation burdens on instructors, accompanied by a surge in supporting teaching resource construction workload [14]. Lastly, multi-dimensional evaluation generates far heavier administrative workload than conventional assessment modes, and strict measures must be implemented to guarantee the impartiality and effectiveness of all evaluation links.

6.3. Future development prospects

On the basis of existing reform outcomes, further optimization will be carried out to adapt to new talent cultivation requirements brought by the new round of technological and industrial revolutions:

(1) In-depth integration of digital and intelligent technologies: further explore the application of artificial intelligence and big data analytics in Food Microbiology instructional delivery;

(2) Construction of integrated industry-university-research collaborative education platforms: deepen cooperative ties with grain and oil food enterprises, co-establish internship bases, and fully integrate corporate production cases and industrial demands into classroom teaching;

(3) Development of interdisciplinary curriculum clusters centered on this course: drive the reform of correlative courses such as Food Chemistry and Food Technology, and build an interdisciplinary curriculum group capable of solving complex grain and oil engineering problems [15].

7. Concluding remarks

Starting from the developmental demands of the grain and oil food industry and guided by the OBE philosophy, this paper conducts all-round reform on Food Microbiology covering objective positioning, content restructuring, instructional paradigm innovation and multi-dimensional evaluation mechanisms, aiming to improve students' capacity to resolve practical microbial-related issues within grain and oil industrial scenarios. Subsequent reform work will further conduct in-depth research on the integration of artificial intelligence, school-enterprise collaborative education and curriculum-based ideological and political education. The curriculum quality evaluation system will be continuously refined to advance the connotative development of the course, and cultivate interdisciplinary, innovative talents specialized in the grain and oil food sector.

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