Exploring the Development of Competencies and Curriculum Reform for Culinary Majors in the Context of the Catering Industry's Digital-Intelligent Transformation

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Abstract: Against the backdrop of the deepening digital-intelligent transformation of the catering industry, new competency requirements have emerged for culinary professionals. Traditional teaching models, which focus primarily on skill-based training, are increasingly inadequate to meet the practical demands of intelligent kitchens, digitalized operations, and standardized production. Based on the development trends of the catering industry and the practical application of smart catering technologies, this study systematically analyzes the evolving competency requirements for culinary professionals. In response, an optimized curriculum framework is proposed, emphasizing modular progression, industry-education integration, and intelligence-driven instruction. This research aims to provide both theoretical support and practical guidance for aligning culinary education with the talent demands of the smart catering era.

1. Introduction

Digital intelligence builds upon the foundation of digitalization by integrating intelligent technologies, representing a technological and industrial evolution that drives a new transformation of productivity and production relations. With the advent of the digital-intelligent era, higher vocational education is undergoing a corresponding transformation, presenting unprecedented opportunities and challenges for educators and practitioners in this field.

China attaches great importance to the digital-intelligent transformation of the education sector. As early as 2017, the State Council issued the New Generation Artificial Intelligence Development Plan[1], highlighting the use of intelligent technologies to accelerate reforms in talent cultivation models and teaching methods, establish learner-centered educational environments, and provide customized daily and lifelong education. In 2023, the Chinese Academy of Education Sciences published the China Blue Book of Smart Education (2022)[2], defining "smart education" as a new educational paradigm aimed at delivering appropriate, high-quality, and time- and space-transcending learning opportunities to every learner. In August 2025, the State Council issued the

Opinions on Deepening the Implementation of the 'AI+' Action[3], emphasizing that artificial intelligence technologies benefit public welfare and will promote intelligent and flexible educational models, as well as resource-rich autonomous learning.

Culinary higher vocational education is a crucial component of the broader higher vocational education system, tasked with cultivating highly skilled professionals and supporting the sustainable development of the catering industry. In the context of the digital-intelligent transformation of the catering sector, reforming culinary higher vocational education has become imperative. This study analyzes the changes within the catering industry driven by digital-intelligent technologies and, based on the evolving demands for culinary professionals, proposes a restructured approach to talent cultivation and curriculum design in culinary higher vocational education.

2. Emerging Changes in the Catering Industry Driven by Digital-Intelligent Transformation

The digital-intelligent transformation is profoundly reshaping the operational models, customer interactions, supply chains, and labor structures of the catering industry. In recent years, technologies such as the Internet of Things, artificial intelligence, and big data have been driving significant changes, including the integration of front- and back-of-house processes, personalized services, and automated food production. Concepts such as smart restaurants and intelligent kitchens have already emerged as key trends in the current development of the catering sector[4].

2.1. The Diversification of Consumer Touchpoints and Engagement Channels in the Catering Industry

Driven by digital channels such as food delivery platforms, mini-program ordering systems, and online membership programs, catering enterprises are shifting from a single in-store service model to a hybrid, omnichannel business model. Customers can not only dine on-site but also place orders online for in-store pickup or home delivery, resulting in diversified consumer touchpoints. This trend requires catering businesses to ensure both the timeliness of service and the consistency of product quality across multiple channels[5]. Consequently, restaurant operations are gradually transitioning from experience-based management to data-driven management.

2.2. The Intelligent Transformation of Central Kitchens and Back-of-House Operations in the Catering Industry

In parallel with the diversification of consumer touchpoints and the shift toward omnichannel business models, catering enterprises are increasingly adopting intelligent technologies in their central kitchens and in-store back-of-house operations. Automated cooking machines, smart steam ovens, food preparation robots, and intelligent vegetable washers are gradually replacing manual labor for highly repetitive and labor-intensive food production tasks. The integration of these intelligent devices not only enhances process standardization and reduces human error but also optimizes energy consumption and operational efficiency[6]. As such, the intelligent transformation of kitchen operations has become a key trend in the digital-intelligent evolution of the catering industry, complementing changes in consumer engagement and overall business models.

2.3. Enhancing Supply Chain Efficiency and Food Safety Transparency in the Catering Industry

The adoption of Internet of Things and blockchain technologies is transforming supply chain management in the catering industry. These technologies enable comprehensive traceability of food

ingredients, covering their sourcing, transportation, and storage conditions, thereby ensuring full transparency throughout the supply chain. Such transparency not only mitigates supply chain risks but also enhances the effectiveness of food safety supervision in back-of-house operations[7]. In addition, the immutable nature of blockchain guarantees the accuracy and reliability of recorded data, effectively preventing potential food safety hazards during food production.

2.4. Enhancing the Precision and Efficiency of Restaurant Operations

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2.5. Enhancing the Personalization of Customer Dining Experiences

With the rapid advancement of artificial intelligence (AI) technologies, AI has become a key driver in enabling personalized services in restaurants. Some catering enterprises are already leveraging user profiling, machine learning, and natural language processing to analyze consumer preferences, dietary restrictions, and past ordering behavior[8]. These analyses allow for accurate predictions of customers' dish preferences and dining habits, resulting in higher customer satisfaction. Moreover, AI technologies lower the production barriers for personalized food products, enabling restaurant operators to offer customized meals to on-site customers at low cost and effectively meet their personalized service demands.

3. New Trends in the Competency Development of Culinary Students in the Digital-Intelligent Era

The digital-intelligent transformation of the catering industry has not only improved operational efficiency and service quality but also reshaped labor structures and talent demands[5]. Traditional positions such as servers and chefs are gradually declining, and the competency requirements for culinary professionals are shifting from purely service-oriented or cooking skills to multi-skilled technical talents with capabilities in information technology, data analysis, and innovation. Consequently, the digital-intelligent transformation imposes new requirements on competency development for higher vocational culinary students. Modern culinary students are expected to possess not only culinary skills but also digital literacy, data analysis proficiency, the ability to operate and maintain intelligent equipment, innovative thinking and practical creativity, interdisciplinary collaboration and communication skills, as well as critical thinking and lifelong learning abilities.

3.1. Developing Digital Literacy and Data Analysis Competencies in Culinary Students

Under the digital-intelligent transformation of the catering industry, menu systems, ordering systems, inventory management systems, and kitchen equipment are increasingly interconnected, generating large volumes of data. For culinary students, in addition to mastering cooking skills, it is essential to develop fundamental digital literacy. This includes the ability to interpret insights derived from big data, such as sales reports, order fluctuations, and evaluations of new dishes, and

to apply this understanding in tasks such as menu optimization, cost control, and operational decision-making.

3.2. Developing Competencies in Operating and Maintaining Intelligent Kitchen Equipment in Culinary Students

AI-driven intelligent cooking devices, such as automated cooking robots and smart steam ovens, introduce new technical requirements for culinary professionals. In the future culinary industry, students who are proficient in operating and calibrating these intelligent devices will gain a significant competitive advantage in roles related to restaurant management and menu development. Therefore, the training of culinary students should include an understanding of the basic principles of intelligent cooking equipment, routine calibration and maintenance techniques, and safe operational practices, with the goal of developing students' competencies in effectively using and maintaining such equipment.

3.3. Developing Innovative Thinking and Practical Innovation Competencies in Culinary Students

Future culinary products are expected to evolve toward greater diversity and personalization, placing higher demands on the innovative capabilities of culinary professionals. Culinary students should be able to design digital recipes that are compatible with intelligent cooking systems, translating traditional flavors into standardized procedures and thereby demonstrating value in standardized food production. In addition, students should possess the ability to incorporate creativity into dish preparation using AI or simulation technologies. Therefore, cultivating innovative thinking and practical innovation competencies in culinary students is of critical importance.

3.4. Developing Interdisciplinary Collaboration and Communication Competencies in Culinary Students

In the future catering industry, collaboration between culinary professionals and engineers, data analysts, and supply chain managers will become increasingly frequent, placing new demands on the interdisciplinary collaboration and communication competencies of culinary students. Students should possess the ability to communicate across disciplines, including understanding the basic technical language related to sensors, data flows, and application programming, as well as translating their culinary expertise into information that can be effectively understood by technical teams.

3.5. Developing Critical Thinking and Lifelong Learning Competencies in Culinary Students

While the development of artificial intelligence presents significant opportunities for the culinary industry, it also introduces new challenges. Faced with intelligent production systems, culinary students need to develop critical thinking skills to make informed decisions and trade-offs. Moreover, given the rapid pace of technological advancement and the frequent iteration of intelligent cooking equipment, students must not only master existing digital-intelligent technologies but also cultivate a mindset and capability for lifelong learning to adapt to the rapidly evolving industry.

4. Emerging Strategies for Optimizing the Curriculum Framework in Culinary Education

As discussed above, the competency requirements for culinary professionals have shifted in the context of the digital-intelligent transformation of the catering industry. To enhance the industry relevance of talent cultivated in higher vocational culinary education, the training objectives of higher vocational culinary programs must also evolve accordingly. Aligning with these updated training objectives, the curriculum system for higher vocational culinary programs is expected to undergo comprehensive optimization and upgrading. The following section uses the Culinary Technology and Nutrition program as an example to illustrate the construction of a new curriculum framework for culinary-related disciplines.

4.1. Building a New Curriculum Framework through Modular Progression

The culinary curriculum is structured into three progressively arranged modules: foundational, core, and advanced modules. Based on the talent cultivation patterns of higher vocational culinary programs and the evolving competency requirements driven by the digital-intelligent transformation of the catering industry, outdated courses are removed and emerging digital-intelligent-related courses are introduced. The professional courses within the three modules are systematically optimized and adjusted to construct a new curriculum framework for higher vocational culinary programs that aligns with the development of digital-intelligent catering. This approach aims to enhance both the quality of talent cultivation and the industry relevance of graduates.

(1) Enhancing the Foundational Module of the Culinary Curriculum

In the foundational module, traditional courses such as Basic Culinary Skills Training and Food and Nutrition are retained, while new courses focusing on the fundamentals of digital-intelligent catering, such as Introduction to Catering Big Data and Fundamentals of Intelligent Cooking, are introduced. This approach allows students to consolidate their basic culinary skills while gaining preliminary knowledge and understanding of digital-intelligent catering and intelligent cooking, laying a solid foundation for more advanced learning. At the same time, courses such as Introduction to Culinary Arts, which are largely theoretical and less relevant to the development of modern digital-intelligent catering, are removed.

(2) Enhancing the Core Module of the Culinary Curriculum

In the core module, the focus is on reinforcing both key digital-intelligent catering technologies and advanced culinary skills. Traditional courses such as Regional Cuisine Techniques and Techniques of the Eight Major Chinese Cuisines are retained, while new courses including Digital Recipe Design and Culinary Ingredients and Supply Chain Management are introduced. Digital Recipe Design enables students to learn methods for designing digital recipes compatible with intelligent cooking devices, allowing them to control the operation of these devices and achieve precise cooking outcomes. Culinary Ingredients and Supply Chain Management equips students with knowledge of culinary ingredients while also teaching fundamental principles and methods of supply chain management, covering key aspects from ingredient procurement, transportation, and storage to usage in culinary operations.

(3) Enhancing the Advanced Module of the Culinary Curriculum

In the advanced (expansion) module, the curriculum is designed to broaden students' perspectives and knowledge base while enhancing their innovative practice abilities and overall professional competence. Interdisciplinary courses such as Catering and Artificial Intelligence, Dish Innovation and Development, and Intelligent Kitchen Management are introduced. These courses enable students to understand the integration of the catering industry with cutting-edge technologies, cultivate innovative thinking and interdisciplinary collaboration skills, and ensure that the curriculum framework aligns with the trends of digital-intelligent transformation in the catering

sector.

4.2. Integrating Industry and Education to Design New Curriculum Content for Culinary Programs

In response to the new requirements posed by the digital-intelligent transformation of the catering industry, schools collaborate closely with catering enterprises to jointly develop professional curriculum content that aligns with practical needs. Course development teams, composed of school instructors and technical experts from the industry, update course content in a timely manner based on emerging challenges and requirements encountered during the digital-intelligent transformation of catering. Furthermore, real-world industry cases can be integrated into culinary classroom teaching. By incorporating both successful practices and lessons learned from failures in the industry's digital-intelligent transformation, students can acquire practical strategies and problem-solving methods from authentic scenarios.

4.3. Leveraging Intelligent Technologies to Innovate Teaching Models in Culinary Education

With the advancement of artificial intelligence (AI) technologies, AI is poised to become a novel and critical support in the curriculum of higher vocational culinary programs, assisting instructors in creating student-centered, intelligent, autonomous, and customized teaching models. In this new teaching paradigm, students, guided by instructors, actively engage in self-directed exploration of course content using AI technologies. While completing professional learning tasks, they simultaneously enhance their digital-intelligent literacy.

5. Conclusions

In summary, under the backdrop of the digital-intelligent era, the catering industry is undergoing unprecedented and profound transformations. From front-of-house to back-of-house operations, from supply chains to customer services, and from operational management to production organization, all aspects are accelerating toward intelligence, automation, precision, and personalization. This restructuring of the industry ecosystem has directly driven changes in the competency requirements for culinary professionals, thereby imposing higher standards on higher vocational culinary education. Modern culinary talents must not only possess solid culinary skills but also develop a range of integrated competencies, including digital literacy, data analysis abilities, proficiency in operating and maintaining intelligent equipment, interdisciplinary collaboration skills, and practical innovation capabilities, to meet the evolving demands of the industry. Traditional training models, which rely primarily on experiential learning and skill practice, are increasingly inadequate for adapting to the digital-intelligent transformation of the catering sector, underscoring the urgent need for reform in higher vocational culinary education.

Looking ahead, the digital-intelligent reform of culinary education needs to be continuously deepened. On one hand, educators should actively engage with industry transformation trends by collaborating with catering enterprises, intelligent equipment manufacturers, and research institutions to further optimize curriculum structures, share data resources, and update course content. On the other hand, schools should strengthen the development of "dual-qualified" faculty, guiding instructors to master cutting-edge industry technologies and update their pedagogical approaches, thereby enabling the synchronized iteration of curriculum design, classroom teaching, and technology application. Furthermore, as technologies such as artificial intelligence, the Internet of Things, and blockchain continue to permeate the catering industry, culinary education must also explore more comprehensive evaluation systems and practical training models to provide students

with sustainable pathways for competency development.

The optimization of the culinary curriculum framework is not merely a reactive adjustment to industry demands; it also serves as a key driver for upgrading the catering industry and fostering the growth of culinary talent. As the culinary education system, the catering industry ecosystem, and innovations in digital-intelligent technologies continue to interact, future culinary education is poised to be revitalized amid the digital-intelligent wave, delivering highly skilled professionals with enhanced competitiveness, creativity, and adaptability to the catering sector.

Acknowledgements

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