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Integrating Technical Skills, Soft Skills, and Digital Technology in Culinary Vocational Education: A Deep Learning Model for Industry 5.0

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Abstract

The emergence of Industry 5.0 requires vocational education to integrate technical competencies with human-centered skills such as creativity, collaboration, and adaptability, supported by digital technology. However, culinary vocational learning remains fragmented, with these components often developed separately. This study aims to develop an integrative conceptual model to address this gap. This research adopts a qualitative conceptual approach supported by a systematic literature-based synthesis. Data were collected from Scopus, Google Scholar, and SINTA using structured keywords. The selected studies were analyzed through content analysis and thematic synthesis to identify key components and relationships for model development. The study proposes the Integrated Culinary Deep Learning Model (ICDLM), which consists of four core dimensions: culinary technical skills, soft skills (creativity and collaboration), digital technology integration, and project-based learning. These components are structured as an interconnected system that enables holistic and meaningful learning. The findings indicate that integrative approaches are more effective than fragmented methods in developing higher-order competencies such as critical thinking, adaptability, and innovation. Theoretically, this study contributes an integrative framework for vocational education. Practically, the ICDLM model provides guidance for designing adaptive and industry-relevant culinary learning. Future research is recommended to empirically validate the model.

Keywords: vocational education, culinary learning, integrated culinary deep learning model, meaningful engagement, meaningful learning

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1. Introduction

The emergence of Industry 5.0 has marked a significant transformation in the paradigm of education, shifting its focus from the mere acquisition of technical competencies toward the integration of technological capabilities with essential human values, including creativity, collaboration, critical thinking, and

innovation. Unlike previous industrial revolutions that emphasized automation and efficiency, Industry 5.0 highlights the importance of human-centric approaches, where technology functions as an enabler to augment human potential rather than replace it. Consequently, vocational education, particularly in the culinary field, is required to produce graduates who are not only

technically proficient but also capable of adapting to dynamic industry demands, engaging in collaborative problem-solving, and leveraging digital technologies effectively (Hartono et al., 2021; Sari & Putra, 2022).

However, empirical conditions indicate that culinary vocational education has not fully aligned with these evolving demands. The current learning practices are predominantly oriented toward the mastery of fundamental technical skills, such as cooking techniques, food preparation, and presentation. While these competencies remain essential, they are often developed in isolation from equally important soft skills, including creativity, teamwork, and communication (Jati et al., 2022). Furthermore, the prevailing instructional approaches tend to be conventional and teacher-centered, limiting opportunities for students to actively participate, explore ideas, and engage in collaborative learning processes (Taqiya et al., 2025). This imbalance results in graduates who may demonstrate technical proficiency but lack the adaptive and innovative capacities required in a rapidly changing industrial landscape.

Several prior studies have attempted to address these limitations through the integration of innovative approaches in culinary education. For instance, the utilization of digital technologies has been shown to enhance accessibility, flexibility, and engagement in the learning process (Andriani et al., 2021). Additionally, the adoption of project-based learning (PBL) has been widely recognized for its effectiveness in fostering creativity, collaboration, and problem-solving skills among students (Hermawan & Santoso, 2022). Despite these advancements, existing research tends to adopt a fragmented perspective, focusing on isolated components such as technology

integration or pedagogical strategies, without offering a comprehensive framework that systematically integrates technical skills, soft skills, and digital competencies within a unified learning model.

Another conceptual issue arises from the ambiguity surrounding the term “deep learning” in educational discourse. The term is frequently associated with two distinct interpretations: first, as a pedagogical approach that emphasizes deep conceptual understanding, critical reflection, and meaningful learning experiences; and second, as a subfield of artificial intelligence involving neural networks and computational models (Sutopo et al., 2021). In the context of this study, deep learning is explicitly defined from a pedagogical perspective. It refers to an approach that encourages learners to engage in higher-order thinking, connect theoretical knowledge with real-world applications, and develop reflective, creative, and collaborative competencies. Clarifying this distinction is crucial to avoid conceptual confusion and to ensure the appropriate application of deep learning principles in educational settings (Handayani et al., 2024).

Based on a critical review of the literature, a significant research gap can be identified in the development of culinary vocational learning models. Specifically, there is a lack of integrative models that simultaneously incorporate three key dimensions: (1) technical culinary skills as core competencies, (2) soft skills development, particularly creativity and collaboration, and (3) the effective use of digital technology as an integral component of the learning process. Moreover, existing studies rarely ground their instructional models in a deep learning framework that emphasizes meaningful engagement, critical reflection, and conceptual understanding. In addition, many of the proposed models are not

articulated in a systematic and comprehensive conceptual structure, thereby limiting their applicability and scalability in real educational contexts. This gap represents a critical barrier to the development of vocational education that is responsive to the demands of Industry 5.0.

In response to these challenges, this study proposes the development of an Integrated Culinary Skills-Based Deep Learning Model. This model is designed to holistically integrate technical, cognitive, and technological dimensions within a coherent instructional framework. Technical culinary skills are positioned as the foundational competencies, while soft skills particularly creativity and collaboration are embedded as essential outcomes of the learning process. Simultaneously, digital technologies are utilized not only as instructional tools but also as platforms for innovation, communication, and knowledge construction (Iswari et al., 2025). The implementation of this model is operationalized through a project-based learning approach, which provides authentic learning experiences and encourages active student engagement, reflective thinking, and collaborative problem-solving.

The formulation of this study is guided by several research questions that aim to provide a clear analytical direction. First, what are the characteristics of culinary vocational learning that align with the demands of Industry 5.0? Second, how can technical skills, soft skills, and digital technology be effectively integrated within culinary education? Third, what is the conceptual structure of a deep learning-based model that facilitates this integration? These questions are designed not only to explore existing conditions but also to generate a novel conceptual contribution to the field.

Accordingly, the objectives of this study are threefold: (1) to identify the key

components of culinary vocational learning that are relevant to Industry 5.0, (2) to analyze and synthesize previous research on innovative culinary education practices, and (3) to develop a comprehensive conceptual model based on integrated culinary skills and deep learning principles. By achieving these objectives, this study is expected to contribute both theoretically and practically. Theoretically, it offers a novel integrative framework that enriches the discourse on deep learning in vocational education. Practically, it provides a structured reference for educators, institutions, and policymakers in designing and implementing more adaptive, innovative, and industry-relevant culinary education systems.

Ultimately, this research underscores the importance of reorienting vocational education toward a more holistic, integrative, and future-oriented approach. In doing so, it aligns educational practices with the broader vision of Industry 5.0, where human creativity and technological advancement coexist synergistically to drive sustainable development and innovation.

2. Method

This study employs a qualitative research approach with a conceptual framework development design, supported by a structured and systematic literature review. This approach is selected to enable the integration, analysis, and synthesis of various theoretical and empirical findings in order to construct a comprehensive conceptual model of integrated culinary skills-based deep learning in vocational education. Unlike a strict Systematic Literature Review (SLR), this study does not aim to produce statistical generalizations, but rather to develop a conceptual understanding and model grounded in existing knowledge.

The literature review process was conducted systematically to ensure the credibility, relevance, and comprehensiveness of the sources. Data were collected from several reputable academic databases, including Scopus, Google Scholar, and SINTA. The search strategy utilized a combination of carefully selected keywords, such as “deep learning in vocational education,” “culinary skills learning model,” “integrated culinary skills,” “project-based learning in culinary education,” and “vocational education and Industry 5.0.” These keywords were combined using Boolean operators (AND, OR) to refine the search process and ensure that the retrieved literature was aligned with the research focus.

To ensure the quality of the selected literature, this study applied explicit inclusion and exclusion criteria. The inclusion criteria were: (1) articles published in peer-reviewed and indexed journals, (2) publications within the period of 2019–2024 to maintain relevance with recent developments, (3) studies related to vocational education, culinary learning, soft skills development, or educational technology, and (4) research that discusses innovative or integrative learning approaches. The exclusion criteria included: (1) non-scientific publications, (2) articles not relevant to the research objectives, and (3) studies with incomplete or inaccessible data.

The selected literature was analyzed using qualitative content analysis and thematic synthesis. In the content analysis stage, each article was examined to identify key concepts, variables, and theoretical perspectives relevant to the research focus. The analysis focused on several main components, including culinary technical skills, creativity, collaboration, digital technology integration, and learning models. Relevant data from each study were

systematically coded and organized into meaningful categories.

Following this, thematic synthesis was conducted to identify patterns, relationships, and overarching themes across the literature. The identified themes were grouped into several core dimensions, namely: (1) technical competency development, (2) soft skills enhancement (creativity and collaboration), (3) integration of digital technology in learning, and (4) implementation of project-based learning approaches. These dimensions were then used as the foundational structure for developing the proposed conceptual model.

To enhance the validity and trustworthiness of the findings, this study employed triangulation techniques. Source triangulation was conducted by comparing findings from multiple studies across different journals. Methodological triangulation was achieved through the integration of content analysis and thematic synthesis, ensuring analytical depth and consistency. In addition, theoretical triangulation was applied by incorporating perspectives from vocational education theory, learning theory, and educational innovation.

Finally, the development of the conceptual model was carried out through an iterative synthesis process, in which the identified themes and components were integrated into a coherent framework. This process involved abstraction, comparison, and conceptual refinement to ensure that the resulting model is both theoretically grounded and practically applicable. The final model is expected to provide a comprehensive reference for the development of innovative culinary vocational learning that aligns with the demands of Industry 5.0.

3. Results and Discussion

The findings of this study can be summarized into three main points. First, this study successfully develops a novel conceptual model, namely the Integrated Culinary Deep Learning Model (ICDLM), which integrates previously fragmented approaches into a coherent framework. Second, the model is structured based on four interrelated core components: culinary technical skills, soft skills (creativity and collaboration), digital technology integration, and project-based learning as the main integrative mechanism (Faradiyah Nurul et al., 2022). Third, the study reveals that effective vocational learning in the Industry 5.0 era requires a holistic integration of these components, as partial approaches are insufficient to address the complexity of modern industrial demands.

a. Development of the Integrated Culinary Deep Learning Model

The primary finding of this study is the successful development of a conceptual framework referred to as the *Integrated Culinary Deep Learning Model (ICDLM)*. This model emerges as a response to a critical gap identified in the literature, namely the fragmented nature of culinary vocational education, where technical skills, soft skills, and digital technology integration are often treated as separate and independent components. The synthesis of existing studies

indicates that while numerous innovations have been introduced such as the integration of digital technologies (Andriani et al., 2021), the application of project-based learning (Hermawan & Santoso, 2022), and the emphasis on creativity and collaboration (Pratama, 2020) these approaches tend to operate in isolation and lack a unified conceptual structure.

The ICDLM is therefore proposed as an integrative conceptual model that systematically connects these previously fragmented dimensions into a coherent pedagogical framework. Unlike conventional models that emphasize procedural mastery, ICDLM positions learning as a multidimensional process that integrates cognitive, technical, social, and technological aspects (Sholihatinnisa et al., 2021). This integrative perspective is essential in addressing the demands of Industry 5.0, which requires vocational graduates to possess not only technical proficiency but also adaptive thinking, creativity, and the ability to collaborate in technologically enriched environments (Sari & Putra, 2022).

To further clarify the conceptual contribution of this study, Table 1 presents a synthesis of selected literature that highlights the dominant focus and limitations of previous research in culinary vocational education.

Table 1. Synthesis of Previous Studies in Culinary Vocational Learning

Author	Focus of Study	Key Findings	Limitations
Andriani et al. (2021)	Digital technology in learning	Improved access and flexibility	Lacks integration with soft skills
Hermawan & Santoso (2022)	Project-based learning	Enhances creativity and collaboration	Not integrated with digital technology
Pratama (2020)	Soft skills development	Improves creativity and teamwork	Limited connection to technical skills
Setiawan et al. (2021)	Technology-enhanced learning	Increases engagement and motivation	Does not address holistic competency
Kusuma & Setiawan (2023)	Vocational competency	Strengthens technical skills	Neglects soft skills and technology

Table 1 demonstrates a clear pattern across previous studies, namely the tendency to focus on specific aspects of culinary vocational learning without integrating them into a comprehensive framework. For instance, studies emphasizing digital technology (Andriani et al., 2021; Setiawan et al., 2021) highlight improvements in accessibility, engagement, and flexibility. However, these studies often overlook the importance of aligning technological tools with pedagogical strategies that foster deeper learning and skill integration. Similarly, research on project-based learning (Hermawan & Santoso, 2022) successfully illustrates its effectiveness in enhancing creativity and collaboration, yet it does not sufficiently incorporate digital technology as a core component of the learning process.

Furthermore, studies focusing on soft skills (Pratama, 2020) provide valuable insights into the importance of creativity and teamwork but lack a strong connection to technical competency development. On the other hand, research emphasizing technical skills (Kusuma & Setiawan, 2023) tends to neglect the broader competencies required in modern vocational education, particularly those related to innovation and adaptability.

This fragmentation indicates that existing approaches are inherently partial and insufficient to address the complex demands of Industry 5.0. The lack of integration across these dimensions results in learning models that are limited in scope and effectiveness (Fauzi et al., 2023). Therefore, the ICDLM model addresses this limitation by synthesizing these diverse perspectives into a unified conceptual framework, ensuring that technical skills, soft skills, and digital technology are developed simultaneously and coherently.

Building upon this synthesis, the ICDLM model is conceptualized as a holistic learning framework that integrates four key dimensions into a single system. However, unlike previous models that merely combine multiple elements, ICDLM emphasizes the interdependence and interaction between these components. This integrative structure ensures that learning is not only comprehensive but also meaningful and contextually relevant.

To illustrate the comparative positioning of the ICDLM model against previous approaches, Table 2 presents a conceptual comparison between fragmented learning models and the integrative ICDLM framework.

Table 2. Comparison between Conventional Approaches and ICDLM

Aspect	Conventional Models	ICDLM Model
Structure	Fragmented, partial	Integrated and holistic
Skill Development	Focus on one dimension	Multi-dimensional (technical, soft skills, technology)
Role of Technology	Supporting tool	Integral pedagogical component
Learning Approach	Teacher-centered / procedural	Student-centered / deep learning
Outcome	Technical proficiency	Adaptive, creative, collaborative competence

Table 2 highlights the fundamental differences between conventional learning approaches and the proposed ICDLM model. Conventional models are typically characterized by fragmented structures, where

different learning components are addressed separately (Puspita Dewi et al., 2024). This fragmentation limits the ability of students to develop a comprehensive skill set, as learning experiences are not interconnected. In

contrast, the ICDLM model adopts a holistic structure that integrates multiple dimensions of learning into a unified framework.

One of the most significant distinctions lies in the approach to skill development. Conventional models tend to prioritize technical skills as the primary learning outcome, often neglecting the importance of soft skills and technological competencies. However, ICDLM emphasizes a multi-dimensional approach, where technical skills are developed alongside creativity, collaboration, and digital literacy. This aligns with the demands of Industry 5.0, which requires a balance between human capabilities and technological integration (Sari & Putra, 2022).

Additionally, the role of technology in conventional models is often limited to that of a supporting tool, whereas in ICDLM, technology is positioned as an integral pedagogical component that enhances learning experiences and enables innovation. This shift reflects a deeper understanding of technology as a driver of learning transformation rather than merely an auxiliary resource.

Moreover, the learning approach in ICDLM is inherently student-centered and grounded in deep learning principles. Students are actively engaged in the learning process through exploration, reflection, and collaboration, which contrasts with the more passive, teacher-centered approaches commonly found in traditional models. As a result, the learning outcomes produced by ICDLM are not limited to technical proficiency but extend to the development of adaptive, creative, and collaborative competencies.

In summary, the ICDLM model represents a significant advancement in culinary vocational education by addressing the limitations of previous approaches and

providing a comprehensive, integrative framework. This model not only bridges the gap between fragmented learning dimensions but also aligns educational practices with the evolving demands of Industry 5.0, thereby offering both theoretical and practical contributions to the field.

b. Core Dimensions of the Integrated Culinary Deep Learning Model (ICDLM)

A key finding of this study is the identification and formulation of four core dimensions that constitute the structural foundation of the Integrated Culinary Deep Learning Model (ICDLM). These dimensions—culinary technical skills, soft skills (creativity and collaboration), digital technology integration, and project-based learning—are derived from a systematic synthesis of the literature and represent the essential components required to achieve holistic vocational learning in the context of Industry 5.0. Unlike conventional approaches that treat these elements as separate domains, the ICDLM model conceptualizes them as interdependent and mutually reinforcing components within a unified learning system (Kusumaningrum & Nuryana, 2022).

The first dimension, culinary technical skills, serves as the foundational layer of the model. Vocational education fundamentally aims to equip learners with practical competencies that are directly applicable in professional settings (Ismiyanto et al., 2026). In culinary education, these competencies include mastery of cooking techniques, understanding of ingredients, adherence to hygiene and safety standards, efficiency in workflow, and the ability to produce high-quality culinary products (Maulida et al., 2026). However, the findings of this study indicate that technical skills should not be confined to procedural execution alone. Instead, they must be developed in

conjunction with reflective and analytical thinking, enabling students to adapt, innovate, and respond to varying culinary contexts (Rahmawati & Wulandari, 2023; Kusuma & Setiawan, 2023).

To further elaborate on the structure of these dimensions, Table 3 presents a detailed breakdown of each core component and its corresponding indicators within the ICDLM framework.

Table 3. Core Dimensions and Indicators of the ICDLM Model

Dimension	Key Indicators	Learning Focus
Technical Skills	Cooking techniques, food safety, presentation, efficiency	Procedural and applied competence
Creativity	Innovation, idea generation, menu development	Creative thinking and problem-solving
Collaboration	Teamwork, communication, coordination	Social and interpersonal competence
Digital Technology	E-learning platforms, media, simulations, digital tools	Technological literacy and adaptability
Project-Based Learning	Real-world projects, reflection, evaluation	Experiential and integrative learning

Table 3 illustrates that each dimension of the ICDLM model is operationalized through specific indicators that guide the implementation of learning activities. The dimension of technical skills is associated with procedural and applied competencies, ensuring that students acquire the foundational abilities required in the culinary profession. However, the inclusion of creativity and collaboration as distinct yet interconnected dimensions highlights a significant shift from traditional vocational learning paradigms. Creativity is not merely an optional skill but a critical competency that enables students to innovate and respond to changing market demands. Similarly, collaboration is essential in culinary settings where teamwork and coordination are integral to operational success (Rasid & Buang, 2019).

The integration of digital technology further expands the scope of learning by providing access to diverse resources, enabling interactive learning experiences, and supporting flexible learning environments (Andriani et al., 2021). Digital tools, such as virtual simulations and online platforms,

facilitate experiential learning and allow students to engage with content beyond the physical classroom.

Project-based learning (PBL), as reflected in the table, serves as the integrative mechanism that connects all dimensions. Through real-world projects, students are required to simultaneously apply technical skills, think creatively, collaborate with peers, and utilize digital tools. This holistic approach ensures that learning is not fragmented but rather interconnected and meaningful (Maghfiroh et al., 2025). Therefore, Table 3 reinforces the argument that the effectiveness of the ICDLM model lies in the integration of these dimensions into a cohesive learning framework.

Beyond identifying the dimensions, this study also reveals that the strength of the ICDLM model lies in the interrelationships among these components. The interaction between dimensions is not linear but dynamic, where each element influences and reinforces the others (Zaki & Imaduddin, 2026). For instance, the application of digital technology enhances creativity by providing access to diverse culinary inspirations, while

collaboration strengthens the implementation of project-based learning through teamwork and shared problem-solving.

To illustrate these relationships, Table 4 presents the interaction patterns among the core dimensions within the ICDLM model.

Table 4. Interaction between Core Dimensions in ICDLM

Dimension Interaction	Description
Technical Skills ↔ Creativity	Enables innovation in culinary products
Technical Skills ↔ Collaboration	Enhances team-based food production
Technology ↔ Creativity	Expands idea generation and innovation
Technology ↔ PBL	Supports project implementation and evaluation
Collaboration ↔ PBL	Strengthens teamwork in project execution

Table 4 highlights the dynamic interactions between the core dimensions of the ICDLM model, emphasizing that learning effectiveness is achieved through the synergy of these components rather than their isolated application. The interaction between technical skills and creativity, for example, enables students to move beyond routine execution and engage in innovative culinary practices (Leng & Buang, 2019). This aligns with the findings of Pratama (2020), which emphasize the importance of creativity in enhancing vocational competencies.

Similarly, the relationship between technical skills and collaboration reflects the collaborative nature of culinary work environments, where tasks are often distributed among team members. Effective coordination and communication are therefore essential for achieving high-quality outcomes (Indriani & Wibowo, 2023). The integration of digital technology further strengthens these interactions by providing tools that facilitate communication, access to information, and the execution of complex projects.

The interaction between technology and project-based learning is particularly significant, as digital tools enable more

efficient project management, documentation, and presentation. This not only enhances the learning experience but also prepares students for technology-driven work environments (Andriyani et al., 2025). Additionally, collaboration plays a critical role in project-based learning by fostering teamwork and shared responsibility, which are essential for successful project outcomes.

Overall, Table 4 demonstrates that the ICDLM model operates as an interconnected system in which each dimension contributes to and enhances the others. This systemic perspective is crucial in addressing the complexity of vocational learning in the Industry 5.0 era.

Furthermore, this study identifies that the integration of these dimensions leads to the development of higher-order competencies that extend beyond technical proficiency. These competencies include adaptive thinking, problem-solving, innovation, and the ability to work effectively in diverse and dynamic environments.

To capture the outcomes of this integration, Table 5 presents the learning outcomes associated with the implementation of the ICDLM model.

Table 5. Learning Outcomes of the ICDLM Model

Dimension	Expected Outcomes
Technical Skills	High-quality culinary production
Creativity	Innovative menu and product development
Collaboration	Effective teamwork and communication
Digital Technology	Technological adaptability and literacy
Integrated Learning	Critical thinking, adaptability, innovation

Table 5 outlines the expected learning outcomes resulting from the implementation of the ICDLM model, demonstrating its impact on both specific and holistic competencies. At the individual level, each dimension contributes to distinct learning outcomes. Technical skills lead to the ability to produce high-quality culinary products, while creativity enables students to develop innovative menus and adapt to emerging trends in the culinary industry. Collaboration enhances interpersonal skills, including communication, teamwork, and coordination, which are essential in professional settings.

The integration of digital technology equips students with the ability to navigate and utilize technological tools effectively, thereby increasing their adaptability in technology-driven environments (Setiawan et al., 2021; Arifin & Suryadi, 2023). These outcomes are particularly relevant in the context of Industry 5.0, where digital literacy is a fundamental requirement.

More importantly, the integration of all dimensions leads to higher-order outcomes, such as critical thinking, adaptability, and innovation. These competencies reflect the essence of deep learning, where students not only acquire knowledge but also develop the ability to apply, analyze, and extend that knowledge in various contexts. This aligns with the principles of constructivist and experiential learning theories, which emphasize active engagement and meaningful learning experiences (Mulyani et al., 2023).

In summary, Table 5 confirms that the ICDLM model facilitates the development of

comprehensive competencies that are aligned with the demands of modern vocational education. By integrating multiple dimensions into a cohesive framework, the model ensures that learning outcomes are not only technically oriented but also cognitively, socially, and technologically enriched (Mahardhika et al., 2025).

Overall, the identification of these four core dimensions and their interactions provides a robust conceptual foundation for the ICDLM model. This finding reinforces the importance of adopting an integrative approach in vocational education, where multiple competencies are developed simultaneously to prepare students for the complex challenges of Industry 5.0.

c. Integrative Learning Effectiveness of ICDLM in the Context of Industry 5.0

The third major finding of this study highlights that the effectiveness of vocational learning in the Industry 5.0 era is fundamentally determined by the degree of integration among multiple learning dimensions rather than the application of isolated instructional approaches. The synthesis of the literature reveals that fragmented learning strategies such as the exclusive use of digital technology, standalone project-based learning, or isolated soft skills training are insufficient to address the complexity of modern vocational education. Instead, an integrative learning model, such as the Integrated Culinary Deep Learning Model (ICDLM), is required to

simultaneously develop technical, cognitive, social, and technological competencies.

This finding is supported by multiple studies indicating that partial approaches tend to produce limited outcomes. For instance, the integration of digital technology alone may enhance accessibility and engagement but does not necessarily improve higher-order thinking skills or collaborative competencies (Andriani et al., 2021; Setiawan et al., 2021). Similarly, project-based learning has been shown to foster creativity and problem-

solving skills, yet its effectiveness is significantly reduced when not supported by technological tools or structured competency frameworks (Hermawan & Santoso, 2022). These limitations underscore the need for a holistic approach that integrates multiple dimensions of learning into a unified system.

To illustrate the comparative effectiveness of fragmented versus integrative approaches, Table 6 presents a synthesis of learning outcomes across different instructional strategies.

Table 6. Comparison of Learning Outcomes: Fragmented vs Integrative Approaches

Approach	Strengths	Limitations	Overall Impact
Technology-based learning	Enhances access and flexibility	Limited impact on soft skills	Moderate
Project-based learning	Improves creativity and problem-solving	Lack of technological integration	Moderate
Soft skills training	Enhances collaboration and communication	Weak connection to technical skills	Moderate
ICDLM (Integrative model)	Holistic skill development	Requires structured implementation	High

Table 6 clearly demonstrates that while individual instructional approaches provide certain advantages, their overall impact remains limited when implemented in isolation. Technology-based learning, for example, significantly improves accessibility and flexibility, enabling students to access diverse learning resources and engage with content beyond traditional classroom settings (Andriani et al., 2021). However, without integration with pedagogical strategies that promote interaction and reflection, its contribution to deeper learning remains constrained.

Similarly, project-based learning enhances creativity and problem-solving abilities by engaging students in real-world tasks (Hermawan & Santoso, 2022). Nevertheless, its effectiveness is often limited by the absence of technological support and structured competency integration. Soft skills training, while essential for developing

communication and teamwork, does not automatically translate into improved technical performance unless it is embedded within practical learning contexts.

In contrast, the ICDLM model demonstrates a significantly higher overall impact due to its integrative nature. By combining technical skills, soft skills, digital technology, and project-based learning into a cohesive framework, ICDLM addresses the limitations of fragmented approaches. This integration enables the simultaneous development of multiple competencies, resulting in more comprehensive and meaningful learning outcomes (Utomo et al., 2025). Therefore, Table 6 reinforces the argument that integrative models are essential for achieving effective vocational learning in the Industry 5.0 era.

Beyond comparative effectiveness, this study also identifies that integrative learning models contribute to the development of

higher-order competencies that are critical in modern industry contexts. These competencies include critical thinking, adaptability, innovation, and problem-solving, which are central to the concept of deep learning.

To further elaborate on these outcomes, Table 7 presents the key competencies developed through the implementation of the ICDLM model.

Table 7. Higher-Order Competencies Developed through ICDLM

Competency	Description	Supporting Literature
Critical Thinking	Ability to analyze and evaluate culinary processes	Mulyani et al. (2023)
Creativity	Innovation in menu and product development	Pratama (2020)
Collaboration	Effective teamwork and communication	Indriani & Wibowo (2023)
Adaptability	Ability to respond to changing industry demands	Sari & Putra (2022)
Problem-solving	Addressing real-world culinary challenges	Hermawan & Santoso (2022)

Table 7 highlights the emergence of higher-order competencies as a direct outcome of integrative learning within the ICDLM framework. These competencies extend beyond basic technical proficiency and reflect the core characteristics of deep learning. Critical thinking, for instance, enables students to analyze culinary processes, evaluate outcomes, and make informed decisions, thereby enhancing the quality of their work (Mulyani et al., 2023).

Creativity plays a crucial role in enabling students to innovate and develop unique culinary products that align with market trends (Pratama, 2020). Meanwhile, collaboration ensures that students can effectively work in teams, communicate ideas, and coordinate tasks, which are essential skills in professional culinary environments (Indriani & Wibowo, 2023). Adaptability is particularly important in the context of Industry 5.0, where rapid technological advancements and changing consumer preferences require continuous learning and adjustment (Sari & Putra, 2022).

Problem-solving, as another key competency, is developed through exposure to real-world challenges in project-based learning environments. Students learn to identify problems, generate solutions, and implement strategies effectively (Hermawan & Santoso, 2022). Collectively, these competencies demonstrate that the ICDLM model not only enhances technical abilities but also fosters cognitive and interpersonal skills necessary for success in modern industries.

Furthermore, this study reveals that the effectiveness of integrative learning is closely linked to its alignment with Industry 5.0 principles, which emphasize the synergy between human capabilities and technological advancements. In this context, learning is no longer limited to skill acquisition but extends to the development of human-centered competencies supported by digital technologies.

To illustrate this alignment, Table 8 presents the relationship between ICDLM components and Industry 5.0 principles.

Table 8. Alignment between ICDLM and Industry 5.0 Principles

ICDLM Component	Industry 5.0 Principle	Learning Implication
Technical Skills	Human-centered production	Skill mastery with adaptability
Creativity	Innovation-driven processes	Development of new ideas
Collaboration	Human-machine synergy	Team-based problem solving
Digital Technology	Smart technology integration	Technology-enhanced learning
Project-based Learning	Real-world application	Contextual and experiential learning

Table 8 demonstrates that the ICDLM model is closely aligned with the core principles of Industry 5.0, particularly the emphasis on human-centered and technology-driven innovation. Technical skills, for instance, are not only focused on production efficiency but also on adaptability and responsiveness to changing industrial needs. This reflects the shift from purely mechanistic approaches to more human-centric models of production.

Creativity is positioned as a driver of innovation, enabling students to contribute to the development of new products and services. Collaboration reflects the importance of human interaction and teamwork in achieving optimal outcomes, particularly in environments where human and technological systems coexist (Prihantoro et al., 2025). The integration of digital technology further supports this synergy by providing tools that enhance learning and productivity.

Project-based learning serves as a bridge between theoretical knowledge and practical application, ensuring that students can apply their skills in real-world contexts. This experiential approach aligns with the Industry 5.0 emphasis on contextual and meaningful learning experiences (Hidayani et al., 2025). Overall, Table 8 confirms that the ICDLM model is not only pedagogically sound but also highly relevant to contemporary industrial demands. Its alignment with Industry 5.0 principles underscores its potential as a transformative framework for vocational education.

In conclusion, this study demonstrates that integrative learning models such as ICDLM offer a more effective approach to vocational education by addressing the limitations of fragmented instructional strategies. Through the integration of multiple learning dimensions, the model facilitates the development of comprehensive competencies that are essential for success in the Industry 5.0 era.

4. Conclusion

This study aims to develop a conceptual model of culinary vocational learning that is aligned with the demands of Industry 5.0 through a qualitative conceptual approach supported by a systematic literature-based synthesis. Based on the analysis and synthesis of relevant literature, this study successfully formulates the Integrated Culinary Deep Learning Model (ICDLM) as a comprehensive and integrative framework for vocational education.

The findings indicate that the primary challenge in culinary vocational education lies in the fragmented implementation of learning components, where technical skills, soft skills, and digital technology are often developed separately. Such fragmentation limits the effectiveness of learning in preparing students to meet the complex and dynamic demands of modern industry. In response to this issue, the ICDLM model integrates four core dimensions culinary technical skills, soft skills (creativity and collaboration), digital technology integration,

and project-based learning into a unified and interdependent system.

Furthermore, this study reveals that effective vocational learning in the Industry 5.0 era cannot rely on partial or isolated instructional approaches. Instead, it requires a holistic integration of multiple learning dimensions that simultaneously develop technical, cognitive, social, and technological competencies. The ICDLM model demonstrates that project-based learning serves as a central mechanism that enables the integration of these components through experiential, contextual, and reflective learning processes. As a result, students are not only equipped with technical proficiency but also develop higher-order competencies such as critical thinking, creativity, collaboration, adaptability, and problem-solving.

From a theoretical perspective, this study contributes to the advancement of vocational education literature by providing an integrative conceptual framework grounded in constructivist, experiential, and collaborative learning theories, as well as aligned with the principles of Industry 5.0. The ICDLM model extends the concept of deep learning beyond cognitive understanding by incorporating practical, social, and technological dimensions into a cohesive learning system.

From a practical perspective, the proposed model offers a strategic reference for educators, curriculum developers, and policymakers in designing and implementing innovative culinary learning practices. The integration of technical skills, soft skills, and digital technology within a project-based learning framework enables the creation of more adaptive, relevant, and industry-oriented learning environments.

However, this study has certain limitations, as it is based on literature

synthesis and has not been empirically validated in real educational settings. Therefore, future research is recommended to empirically test the effectiveness of the ICDLM model using both quantitative and qualitative approaches. Further studies may also explore contextual factors such as institutional readiness, teacher competencies, and technological infrastructure to enhance the applicability of the model.

In conclusion, the ICDLM model provides a robust and relevant framework for transforming culinary vocational education in the era of Industry 5.0. By promoting integrative, reflective, and technology-enhanced learning, this model has the potential to produce graduates who are not only technically competent but also creative, collaborative, and adaptive in facing the challenges of an increasingly complex and dynamic industrial landscape.

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