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Digital Transformation and Green Demands: Rethinking Culinary Curricula for a Sustainable Industry

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Abstract – *The culinary industry is undergoing a significant transformation, driven by digital transformation and escalating sustainability demands. This study explores how Indonesian vocational culinary education institution are responding to these dual pressures, focusing on the integration of digital and sustainability competencies into Level 5 curricula. Using a qualitative case study approach informed by Merriam's interpretive framework, data were collected through semi-structured interviews and curriculum document analysis across two vocational institutions. Thematic analysis revealed three core findings; 1) awareness of the need for digital fluency and sustainability literacy, especially for emerging roles like influencer chefs and green professionals/entrepreneurs; 2) a gap between awareness and practice due to outdated national standards, weak industry feedback, and limited faculty training; and 3) bottom-up innovations such as digital marketing modules and sustainability projects led by proactive educators. The study presents a conceptual framework (Figure 4.1) maps the interplay between external industry drivers, institutional constraints, and enabling strategies for curriculum reform. Effective transformation requires not only pedagogical innovation but also alignment with national policy (e.g., green economy goals), updated competency models, and strengthened industry-academia collaboration. This research highlights the urgency for adaptive, sector-specific curriculum strategies that equip culinary graduates with the competencies required for a sustainable, digitally integrated future.*

Keywords - *Vocational education, culinary curriculum, culinary competencies, digital competencies, sustainability, curriculum reform.*

I. INTRODUCTION

The culinary industry stands at a pivotal crossroads, shaped by the dual forces of technological innovation and sustainability imperatives. The rise of ICT has profoundly altered how food is produced, presented, marketed, and consumed. Emerging technologies—such as artificial intelligence (AI), cloud-based operations, social media platforms, and data analytics—have redefined professional success in the culinary arts [2, 6, 14, 34]. Chefs today are expected not only to master technical cooking skills but also to be proficient in digital storytelling, branding, and e-commerce engagement. Platforms like Instagram, YouTube, and TikTok have become indispensable tools for culinary professionals, enabling them to reach global audiences and build culinary identities through visual content [8, 22, 25, 33]. Simultaneously, the industry faces increasing pressure to adopt environmentally responsible practices. The sustainability imperative calls for chefs and restaurateurs to address food waste, reduce carbon footprints, source ingredients ethically, and embrace circular food systems [13, 16, 23, 27, 28, 35]. This shift has led to the emergence of new culinary roles, such as green advocates and sustainability consultants, who must bridge culinary expertise with digital and environmental knowledge [10, 11, 31, 41].

These technological and ecological shifts have given rise to hybrid professional profiles—influencer chefs, content-driven culinary entrepreneurs, AI-enhanced kitchen managers—whose success depends on digital fluency and sustainability leadership. Culinary graduates are expected to seamlessly integrate tools such as AI-powered inventory systems, e-learning platforms, and sustainability metrics into their daily practice [12, 18]. However, culinary education has not kept pace with these evolving demands. Despite widespread changes in the industry, vocational culinary curricula in many institutions remain traditional, focusing predominantly on kitchen-based technical skills such as food preparation, presentation, and safety compliance [30, 36]. While these skills remain foundational, there is a notable lack of integration of digital competencies, such as social media content creation, digital marketing, and data literacy, and sustainability-oriented practices, including food waste reduction, ethical sourcing, and green entrepreneurship [7, 33]. As a result, many graduates enter the workforce unprepared for the multifaceted roles now expected in the industry.

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This gap signals a misalignment between educational provision and industry transformation, undermining efforts to produce graduates who are not only technically proficient but also digitally agile and ecologically responsible. Emerging frameworks such as Competency-Based Education (CBE) and digital competency models like DigComp offer a promising foundation for reform. These models emphasize measurable learning outcomes, flexible pathways, and alignment with real-world demands [15, 39]. Yet, their application in culinary education remains fragmented and under-researched. Moreover, this study aims to explore how curriculum developers at vocational culinary institutions in Indonesia perceive and respond to these digital and sustainability demands. By centering the voices of curriculum makers—the key actors responsible for translating policy and market signals into programmatic content—this research seeks to illuminate the structural and pedagogical barriers that hinder curriculum reform. It also aims to identify actionable strategies to bridge the gap between evolving industry needs and formal culinary training.

RQ1: How do curriculum developers perceive the role of digital and sustainable competencies in culinary education?
RQ2: What challenges exist in integrating these competencies into the current curriculum?
RQ3: What frameworks or strategies can support curriculum reform aligned with industry transformation?

II. LITERATURE REVIEW

Digital Transformation in the Culinary Industry

Digital technologies have significantly reshaped the culinary sector, extending beyond operations to redefine professional roles and career trajectories. The rise of social media platforms such as TikTok, YouTube, and Instagram has enabled chefs to become content creators, branding themselves as "influencer chefs" who share recipes, kitchen hacks, and sustainability practices with global audiences [14, 22]. These platforms demand not only culinary expertise but also digital fluency—skills in video editing, audience engagement, and personal branding—which are often not taught in formal culinary education [33].

Parallel to this shift is the growing application of artificial intelligence (AI) and smart kitchen technologies. Tools like Winnow use real-time data to help chefs minimize food waste, monitor consumption patterns, and optimize kitchen inventory—contributing simultaneously to cost efficiency and environmental sustainability [12, 23]. Moreover, innovations such as cloud kitchens, data-driven menu engineering, and virtual restaurant concepts have become mainstream, especially in response to post-pandemic changes in dining behavior [9, 29]. These digitally enabled business models offer new pathways for culinary entrepreneurship, particularly for chefs operating in remote or resource-constrained environments.

Digital transformation has also influenced consumer expectations, with increasing demand for interactive, immersive, and personalized dining content—especially in culinary tourism and gastronomy media [32, 40]. To succeed in this environment, culinary professionals must be adept at using digital ecosystems to manage brand identity, connect with niche markets, and deliver value through online platforms. As such, these evolving roles and tools must be systematically addressed through strategic curriculum reform in vocational culinary education.

Sustainability in Culinary Practices

Sustainability has evolved from a niche concern to a fundamental expectation within the culinary industry. Today's consumers are increasingly environmentally conscious, driving demand for food businesses that uphold ethical sourcing, waste minimization, and transparent supply chains. This has led to the emergence of green kitchens, zero-waste cooking practices, and circular food systems as operational norms rather than experimental innovations [31, 42]. As a result, culinary professionals are no longer seen solely as food preparers but as agents of environmental change, with a growing responsibility to embed sustainability principles in sourcing decisions, menu design, and public engagement [11, 37]. Chefs today are expected to not only reduce food waste and support local producers but also to communicate their sustainability practices transparently to consumers. This includes using digital tools to track food origins, measure carbon impact, and share ethical narratives—often via social media, apps, or product labeling systems. Technologies such as AI-enabled waste monitoring systems (e.g., Winnow) and blockchain-based traceability platforms are increasingly used in progressive kitchens to ensure accountability and efficiency [21, 44].

Despite these trends, formal culinary education often lags behind, with sustainability typically treated as a peripheral or theoretical subject rather than a core practical competency. Few vocational institutions provide hands-on modules that integrate digital sustainability tools or simulate real-world environmental decision-making in culinary contexts. This gap leaves graduates underprepared to meet the dual demands of environmental responsibility and technological fluency required by the modern food industry. Furthermore, as consumer expectations evolve toward data-driven and transparent sustainability practices [17], the need for chefs who can lead green innovation and communicate sustainability impact through digital platforms

becomes increasingly urgent—yet remains insufficiently addressed in current curricula.

Curriculum Innovation in Vocational Education

Curriculum development in vocational education is increasingly guided by Competency-Based Education (CBE), which emphasizes observable, industry-aligned learning outcomes [4, 15]. In culinary training, CBE supports the integration of real-world competencies such as food preparation, hygiene, and customer service [19, 30]. However, emerging industry demands now require the addition of digital and sustainability competencies. Frameworks like DigComp (for citizens) and DigCompEdu (for educators) offer structured approaches to digital literacy development, covering domains such as digital content creation, online collaboration, data protection, and ethical digital behavior [24, 39]. Despite their applicability, these frameworks are rarely adapted for the culinary context, where hands-on skills must integrate with multimedia production, digital marketing, and sustainability tools [14].

Global case studies show the potential of integrating digital learning into culinary education. For example, hybrid models using e-learning platforms, digital portfolios, and online branding tasks have proven effective in engaging digital-native students [6, 45]. Yet, in Indonesia and other Global South contexts, such models remain rare, hindered by infrastructure limitations, teacher readiness, and rigid national competency standards [7].

Identified Gaps in Culinary Curriculum

While digital transformation and sustainability have rapidly redefined, the competencies required in the culinary industry, the pace of curriculum reform within vocational education has not kept up. Despite the availability of broader competency frameworks and growing awareness among educators, the integration of digital and green competencies into culinary programs remains uneven and underdeveloped. Vocational institutions often face structural, pedagogical, and conceptual challenges that hinder their ability to align learning outcomes with the dynamic needs of the industry. This misalignment is particularly evident in three critical areas that illustrate the gap between educational provision and labor market expectations. Three significant gaps are evident in existing culinary curricula:

1. Lack of Tailored Digital Competency Frameworks: While general frameworks like DigComp exist, there is no culinary-specific digital competency model to guide curriculum developers. As a result, vocational institutions lack reference points to define learning outcomes for influencer chefs, digital food entrepreneurs, or sustainability-focused kitchen professionals [6, 38].
2. Underutilization of Digital Tools in Teaching: Digital storytelling, content creation, and social media marketing are now crucial career tools. However, these are not systematically included in curriculum modules, often relegated to extracurricular initiatives or informal learning [1, 22].
3. Neglect of Personal Branding and Sustainability Literacy: Curricula still prioritize technical kitchen skills while overlooking the ability to build a personal brand, communicate sustainability practices to consumers, or use digital platforms to advocate for change [11, 31].

This gap creates a disconnect between graduate competencies and industry demands, reinforcing the urgency for curriculum innovation that reflects the hybrid nature of modern culinary careers. Without such reform, vocational education risks producing graduates ill-equipped for the digital and sustainable future of gastronomy.

Figure 1 Data Analyses Phase Process of this Study.
Source: Adopted from (Braun & Clarke, 2006)

III. METHODOLOGY

This study employed a qualitative case study approach, guided by Merriam's (1998) interpretive framework, to investigate how curriculum developers in Indonesian vocational culinary institutions perceive and respond to the integration of digital and sustainability competencies. Merriam's model emphasizes understanding meaning from the perspective of participants within a bounded system [43], making it highly suitable for this research, which focused on curriculum development within vocational culinary programs as the unit of analysis. Two culinary institutions were selected as case sites based on their formal authority in curriculum design and engagement with vocational education reform. The study boundaries were defined by institutional context, level 5 program focus, and participants' roles as curriculum decision-makers.

Research Setting, Participants and Data Collection

The study was conducted at two vocational institutions offering Level 5 culinary programs in Indonesia. These institutions were purposively selected based on their formal responsibility in curriculum development and

exposure to national policy shifts. Two key informants—curriculum developers or program heads—were selected using maximum variation sampling to capture diversity in institutional context and leadership background [26].

Two primary methods were employed:

1. Semi-Structured Interviews: open-ended questions explored perceptions of digital and sustainability competencies, their integration in curricula, and related institutional strategies, pedagogical practices, and barriers.
2. Document Analysis: curriculum frameworks, syllabi, and program plans were reviewed to assess the presence of digital tools, entrepreneurship themes, and sustainability practices.

These data sources enabled triangulation, offering complementary insights to curriculum-making processes, priorities, and challenges.

Data Analysis

Data were analyzed using Braun & Clarke's (2006) six phase thematic analysis: familiarization, coding, theme generation, reviewing themes, defining/naming themes, and writing up [3]. Interview transcripts and documents were repeatedly read to identify recurring phrases, meanings, and issues. Open coding was used to label data fragments, which were grouped into categories and refined into broader conceptual themes aligned with the study's objectives.

This led to the development of six major thematic clusters, each reflecting a key dimension of how curriculum developers perceive and respond to digital and sustainability imperatives within vocational culinary education. These clusters serve as the foundation for presenting the study's findings and are summarized in Table 3.1.

Table 1 Emerging Themes for Data Analysis

Emergence Theme	*Description*
Perception of Digital and Sustainability Trends	Interpretations of industry shifts and their relevance to curriculum reform.
Curriculum Content Focus	Observations on curriculum gaps, priority areas, and institutional readiness.
Curriculum Adaptation Strategies	Both formal revisions and informal pedagogical efforts to address emerging demands.
Non-Formal Innovations and Practices	Student- or faculty-led digital and sustainable initiatives operating outside formal curriculum.
Institutional Support and Barriers	Factors that enable or constrain reform, including policy, infrastructure, and leadership.
Reflections and Recommendations	Insights from participants about how future curricula should evolve to meet global trends.

These themes were refined through cross-case comparison and validated via member checking. Reflexive journaling, thick description, and triangulation enhanced credibility, transferability, and dependability.

IV. FINDINGS AND DISCUSSION

This section presents the results of the qualitative case study, based on in-depth interviews with curriculum developers and program leaders across vocational culinary institutions in Indonesia. Data were analyzed thematically using a constant comparative approach, resulting in the identification of four major themes and corresponding subthemes (Table 1). The results are organized in relation to the three research questions and presented without interpretation.

A. Curriculum Developers' Perceptions of Digital and Sustainable Competencies (RQ1)

The analysis revealed that curriculum developers largely recognize digital and sustainability competencies as essential to modern culinary education. Their responses coalesced into four major patterns: (1) openness to technological advancement, (2) acknowledgment of hybrid competency needs, (3) awareness of new professional profiles, and (4) linkages between educational design and sustainability goals.

Table 2 Summary of Curriculum Developer's Perception

Aggregate Theme	Second-Order Coding	First-Order Code	Construct Name
Stakeholder Perceptions	Positive perception of technology	Optimism toward digital advancement	Perception of Digital Disruption
Institutional Pressure	Global competitiveness as driver	Fear of falling behind	Industry-Aligned Curriculum Pressure
Tech–Sustainability Nexus	Digital-green integration	Inventory prediction for food waste	Integrated Digital-Green Practice
Graduate Profiles	Expanding job roles	New digital-green professions	Sustainable Digital Culinary Roles
Competency Requirements	Future-proofing graduate skill sets	Competency hybridization	Hybrid Culinary Competency

Stakeholder Perceptions of Digital Disruption

Both participants described digital transformation not as a threat but as a necessary evolution in culinary education. this perception was rooted in a belief that adaptation to digital tools is essential for professional relevance. One interviewee stated: *"We must embrace it and be optimistic… we must take advantage and adapt to follow the technology."* - Interviewee 1. Reflecting a readiness to respond to digital transformation in curriculum planning. This perspective aligns with the Perception of Digital Disruption, reflecting a readiness to accept technological change as an opportunity rather than a disruption.

Institutional Pressure and Strategic Fit

Several developers recognized external industry trends as drivers of curricular reform. Institutions were

seen as at risk of losing competitiveness if they failed to integrate digital competencies. One respondent noted, *"If universities don't keep up, they will be less competitive than those already using technology."* - Interviewee 2. Framing reform as a response to global and national competition. This perception was categorized as Industry-Aligned Curriculum Pressure, falling under the Institutional Pressure theme.

Integration of Digital and Sustainability & The Needs of Hybrid Competencies

Participants identified the growing demand for multi-dimensional competencies. A respondent noted: *"[Graduates] must master digital capabilities… and have an understanding of sustainability issues."* - Interviewee 2. Moreover, participant noted that digital technologies can actively support sustainable culinary practices. Smart inventory systems and computerized kitchen tools were cited as examples. A respondent shared, *"The system can input the shelf life and expiration date… good computerization will help reduce food waste."* - Interviewee 1, emphasizing how digital tools contribute to sustainability. These views contributed to the construct Hybrid Culinary Competency, suggesting that traditional kitchen skills must be complemented with digital literacy and sustainability knowledge to prepare future-ready graduates.

Recognition of Hybrid Professional Roles

Some developers acknowledged the rise of new culinary roles, particularly those driven by digital platforms and green advocacy. These include roles such as sustainability consultants and influencer chefs. One stated: "*Influencers… who specifically deal with sustainability… consultants with specific knowledge."*— Interviewee 1. This data corresponds to the construct Sustainable Digital Culinary Roles, capturing perceptions of emerging career paths that blend culinary skills with content creation and sustainability leadership.

B. Challenges in integrating Digital and Sustainable Competencies (RQ2)

To address Research Question 2 (What challenges exist in integrating these competencies into the current curriculum?), five key institutional and structural barriers were identified from interviews with curriculum developers. These findings are organized into four aggregate themes: Curriculum Gap, Structural Challenges, Framework Constraints, and Institutional Misalignment. Each is supported by first-order evidence from stakeholder responses.

Table 3 Summary of Challenges in Curriculum Integration

Aggregate Theme	Second Order Coding	First Order Code	Construct Name
Curriculum Gap	Partial digital integration	Outdated tools and limited content	Digital Integration Gap
Curriculum Gap	Misalignment with industry tech	Basic digital curriculum	Digital Curriculum Mismatch
Curriculum Gap	Partial implementation issues	Fragmented sustainability efforts	Incomplete Sustainability Practice
Framework Constraints	Regulatory rigidity	Use of limited national frameworks	Framework Misalignment
Structural Challenges	Insufficient industry feedback	Partial knowledge base	Weak Industry-Curriculum Synchronization

Curriculum Gaps and Digital Mismatch

A key challenge identified by curriculum developers is the persistent disconnect between the digital competencies required by the culinary industry and those currently addressed in vocational curricula. Several participants noted that despite the increasing digitalization of culinary operations—from inventory tracking to content creation—the instructional tools and learning environments remain outdated.

One interviewee explained, *"the use of technology has not changed significantly"* – Interviewee 1, referring to the continued reliance on conventional, non-digital tools in teaching and assessment. This was categorized as a Digital Integration Gap, highlighting the limited infrastructure and pedagogical shift toward technology-enhanced learning environments. Even where digital subjects have been formally introduced, respondents observed that course content tends to be generic and outdated.

One participant stated, *"digital courses are already compulsory… but the content is still very basic"* – Interviewee 2. This theme was coded as Digital Curriculum Mismatch, reflecting that integration efforts often stop at token inclusion, failing to incorporate applied digital tools relevant to culinary contexts such as social media branding, AI-driven kitchen systems, or digital entrepreneurship platforms. Such gaps are compounded by insufficient curriculum review cycles and limited collaboration with industry practitioners who could inform relevant digital standards. The lack of integration means students graduate without exposure to tools and systems that are increasingly standard in professional kitchens and food enterprises.

These findings suggest the need for a deeper curricular redesign that goes beyond surface-level digital inclusion. A transformation is required to ensure alignment between educational outputs and the digitally driven roles now emerging in the culinary sector.

Fragmented Sustainability Practices

Efforts to incorporate sustainability into vocational culinary education were consistently described as fragmented and inconsistent. Curriculum developers acknowledged that while sustainability themes were present in institutional discourse, they were often limited to surface-level behaviors or isolated modules rather than being holistically embedded across programs. One participant noted, *"field trips still use plastic cups… the implementation is still partial"* – Interviewee 1. This illustrates a symbolic rather than structural application of sustainability values in practical learning environments. Such examples were categorized under Incomplete Sustainability Practice, indicating the divergence between conceptual awareness and consistent, campus-wide implementation.

Another respondent described sustainability as being present through value-oriented behavioral messaging rather than embedded pedagogical structures. For instance, one institution promotes practices such as *"turning off the lights… the value is sustainability"* – Interviewee 2. While these actions promote environmental awareness, they were not supported by formal sustainability frameworks or assessed learning outcomes. This was coded as Sustainability in Daily Practice, falling under the broader theme of Curriculum Pedagogy. Furthermore, the integration of sustainability was frequently driven by individual educators or departments rather than guided by institution-wide mandates. For example, one interviewee observed, *"what already exists is pastry business management… and the inclusion of sustainability was an initiative from the department"* – Interviewee 2. This reflects a Bottom-Up Curriculum Adjustment model, where sustainability education emerges informally rather than as part of a coherent institutional policy.

Framework Constraints and Regulatory Rigidity

Several curriculum developers noted that both national and regional curriculum frameworks posed limitations to integrating digital and sustainability content. One respondent stated, "SKKNI is not flexible…", pointing to the rigidity of the national standard that restricts curricular updates. At the regional level, the ASEAN framework was also criticized. A participant shared, "This ASEAN framework is too rigid", and another remarked, "Marzipan is still treated as a unit of competency" – Interviewee 2, reflecting outdated structures that do not reflect current professional realities.

One informant added, *"The ASEAN framework is rigid… it lacks digital or green competencies"* - Interviewee 2, which illustrates the absence of future-focused skill sets in existing guidelines. These findings were categorized as Framework Misalignment, Framework Relevance Issue, and Inflexible Curriculum Framework, underscoring the systemic misalignment between educational policy and evolving industry expectations.

Structural and Institutional Barriers

Beyond regulatory rigidity and curriculum gaps, informants consistently cited structural and institutional limitations as significant obstacles to integrating digital and sustainable competencies. These challenges reflect issues of weak industry engagement, inadequate systemic support, and limited institutional responsiveness. One of the most commonly reported issues was the absence of consistent, industry-informed feedback loops. As one participant explained, *"we have not received sufficient qualitative input… we rely only on trends from seminars or social media"* – Interviewee 1. This situation was categorized as Weak Industry-Curriculum Synchronization, where curriculum decisions are made reactively and lack grounding in current labor market needs.

In addition, faculty readiness and institutional adaptation to digital change were uneven. One informant stated, *"one of the younger lecturers… the impact of digital curriculum is starting to be seen"* – Interviewee 1. While younger faculty show more responsiveness to digital trends, this momentum was not matched by institutional strategy or resource support. This was coded as Institutional Digital Responsiveness, signaling internal disparities in readiness and execution.

Another issue concerned the overall purpose of vocational education. A participant affirmed, *"the core of vocational education is to meet industry needs* – Interviewee 2, but emphasized that this mission is undermined by poor alignment mechanisms. This was captured as Practical Industry Relevance, suggesting that while the institutional intent is clear, operational structures for ensuring alignment are underdeveloped. Collectively, these findings point to a need for structural reform that includes the establishment of formal industry advisory boards, increased investment in faculty development, and mechanisms for real-time feedback from industry partners to ensure that vocational curricula remain relevant and responsive.

C. Frameworks and Strategies to Support Curriculum Reform (RQ3)

This section addresses Research Question 3: what frameworks or strategies can support curriculum reform aligned with industry transformation? Interview data identified three major strategic approaches perceived by curriculum developers as critical to bridging the gap between existing culinary education and evolving industry needs: (1) institutional responsiveness and faculty adaptation, (2) policy-aligned sustainability integration, and (3) industry-aligned curricular design.

Table 4 Perceived Frameworks and Strategies for Curriculum Reform

Strategic Theme	Category	Construct Name
Internal Capacity & Support	Faculty-driven change	Institutional Digital Responsiveness
Policy Linkage	Green economy alignment	Policy-Driven Sustainability Integration
Curriculum Design Strategy	Industry-based alignment	Practical Industry Relevance
Framework Reform	Regional framework critique	Framework Relevance Issue

Institutional Responsiveness and Faculty Adaptation

Curriculum developers identified internal institutional dynamics—especially proactive faculty behavior—as critical drivers of curriculum reform. While structural and policy constraints persist, several informants emphasized that change is often initiated at the departmental or individual level, particularly by younger or digitally competent faculty. One respondent noted, *"One of the younger lecturers is already showing impact from the digital curriculum"* – Interviewee 1. This was categorized as Institutional Digital Responsiveness, highlighting that grassroots innovation can emerge from educators who actively integrate digital content and tools into their teaching methods. These faculty members often introduce updates such as digital marketing modules or blended learning techniques, even in the absence of formal institutional mandates.

Another participant shared, *"It was the department's initiative to include sustainability in the pastry business course—not something directed by the national framework"* – Interviewee 2. This reflects a Bottom-Up Curriculum Adjustment process, where reform is driven internally rather than through centralized policy, and emphasizes the importance of granting departments autonomy to experiment and align with contemporary industry values. Moreover, institutional support for innovation was found to be uneven. While some departments allow experimentation with digital content (e.g., developing online portfolios or integrating social media tasks), others lack the infrastructure or training needed to scale these initiatives. One developer commented, *"We depend on individual enthusiasm… there is no formal support system to train or encourage digital teaching"* – Interviewee 1. This reveals a gap between individual faculty readiness and institutional capacity, suggesting that formal faculty development strategies are necessary to sustain broader reforms.

Policy-Aligned Sustainability Integration

Participants frequently emphasized the importance of aligning culinary education reforms with broader sustainability policies and national development strategies. Many curriculum developers saw sustainability not merely as an academic trend but as a state priority, warranting structured inclusion in curriculum design.

One respondent affirmed, *"We want to contribute to national food resilience… sustainability should be included in national frameworks"* – Interviewee 2. This was coded as Policy-Driven Sustainability Integration, suggesting that embedding sustainability in curriculum is viewed as a national responsibility and a long-term strategic contribution to food system stability.

Another interviewee reflected this institutional mindset by noting, *"The green economy is a national direction… we need to prepare graduates who can operate in that system"* – Interviewee 1. This underscores a recognition that national economic agendas—such as those developed under BAPPENAS or guided by ILO green jobs initiatives—can provide a strong policy foundation for embedding environmental and social responsibility into vocational learning.

Yet despite this awareness, curriculum developers also acknowledged that current frameworks such as SKKNI do not adequately reflect these strategic goals. As one informant put it, *"The framework does not yet include green skills… we have to work around that limitation"* – Interviewee 2. This reveals a disconnect between policy intent and formal regulatory mechanisms, suggesting that policy-aligned integration will remain partial unless competency standards are also updated.

In some cases, sustainability was added to the curriculum through externally driven initiatives, such as NGO collaborations or thematic projects linked to the SDGs. While valuable, these efforts were often described as temporary or dependent on external funding, rather than institutionally embedded. This further highlights the role that formal national frameworks must play in creating sustainable, scalable, and standardized curricular reforms. Overall, findings show that while proactive educators can serve as catalysts for curricular innovation, their efforts require structural backing—through training, recognition, and institutional funding mechanisms—to have sustainable impact.

Industry-Aligned Curriculum Design

Curriculum developers consistently emphasized the foundational purpose of vocational education as serving the labor market. One respondent articulated this clearly: *"The essence of vocational education is to respond to industry needs"* – Interviewee 2. This view, coded as Practical Industry Relevance, affirms the expectation that culinary curricula must directly align with current and future job demands, and not remain confined to traditional technical competencies. Developers highlighted that this alignment requires responsive curriculum review mechanisms, active engagement with employers, and iterative updates to ensure relevance.

However, many noted that current practices often fall short of these goals. A common critique was that curriculum reform processes are slow and disconnected from industry transformation.

A major barrier to industry alignment cited by participants is the inflexibility of existing qualification frameworks. One developer commented, *"The ASEAN framework is too rigid… it doesn't include digital or green skills"* – Interviewee 2. This statement was coded as Framework Relevance Issue and reflects a broader concern that competency-based systems are not keeping pace with the emergence of hybrid roles—such as digital content creators, green kitchen consultants, or tech-enabled chef-entrepreneurs.

A participant also acknowledged missed opportunities to build formal partnerships with industry actors. One noted, *"Curriculum changes are usually internal, lack of industrial involvement"* – Interviewee 2. This highlights the absence of structured cross-sector collaboration, which weakens the responsiveness of vocational programs to shifting skill demands. Overall, the findings point to the need for dynamic, forward-looking curriculum development processes that go beyond compliance with static national frameworks. Effective reform strategies must incorporate mechanisms for continuous labor market feedback, integrate emergent digital and sustainability roles, and establish deeper linkages between culinary institutions and the industries they aim to serve.

Discussion

Drawing on case-based thematic analysis, the findings offer a nuanced understanding of curriculum responsiveness in the face of digital disruption and green demands. This section interprets those findings in light of existing scholarship and highlights their significance for policy, institutional practice, and future research.

Interpreting the Result

This study examined how Indonesian vocational culinary curriculum developers perceive, respond to, and strategize around the integration of digital and sustainable competencies. Using thematic analysis, the findings reveal significant misalignments between current curricula and industry needs. This section interprets the results through three major lenses: (1) conceptual-practical misalignment, (2) systemic barriers to innovation, and (3) emergent strategies for reform—each linked with relevant literature to frame their broader implications.

Misalignment Between Conceptual Awareness and Curriculum Practice

Curriculum developers widely acknowledged the relevance of digital fluency (e.g., social media, branding, entrepreneurship) and sustainability competencies (e.g., zero waste, SDGs, ethical sourcing). However, the thematic codes Curriculum Gap, Digital Integration Gap, and Sustainability in Theory Only reveal that these competencies are only minimally integrated into formal instruction. As one developer remarked, "The use of technology has not changed significantly," while another noted, "Digital courses are compulsory, but the content is still very basic." This finding echoes Wiek et al. (2011), who argue that sustainability is often referenced in educational discourse but poorly translated into actionable learning outcomes [42]. Similarly, Vuorikari et al. (2022) criticize generalized digital competency frameworks for overlooking sector-specific applications [38, 39], an issue also identified in this study, where DigComp and SKKNI were seen as too rigid or generic for culinary education. The gap between cognitive recognition and actual curriculum transformation mirrors the "knowing-doing gap" discussed by [5] and reflects what this study identifies as a Conceptual-Practical Misalignment —where the urgency of digital and green skills is understood but lacks institutional embedding in curriculum objectives, pedagogy, or assessment.

Misalignment Between Conceptual Awareness and Curriculum Practice

The study revealed several systemic barriers to curricular transformation. These include outdated qualification frameworks (e.g., SKKNI, rigid ASEAN guidelines), weak infrastructure, and limited institutional support for faculty development. Informants repeatedly cited difficulties in updating curriculum due to policy constraints, lack of training, and limited access to digital tools. For instance, one noted, *"We depend on individual enthusiasm… there is no formal system to support digital teaching."* - Interviewee 1. This reflects what Busulwa et al. (2022) term the innovation disconnect—where education systems lag behind the pace of technological and industry change [6]. The thematic categories Framework Misalignment and Weak Industry-Curriculum Synchronization reinforce this disconnect, where curriculum reform is often reactive and uninformed by continuous industry input. One developer explained, "We have not received sufficient qualitative input… we rely only on trends from seminars or social media."

These structural constraints mirror findings from Chabongwa et al. (2024), who argue that national education systems—particularly in the Global South—often lack agile governance structures to support curriculum adaptation in the face of global transformation [7]. This study contributes to that literature by illustrating how vocational culinary programs are constrained by both policy rigidity and institutional inertia.

Bottom-Up Innovation and the Role of Faculty Agency

Despite these challenges, the findings highlight emerging pockets of innovation. Several informants

shared cases where younger, digitally native faculty initiated digital curriculum enhancements or piloted sustainability practices. One shared, *"The impact of the digital curriculum is already visible from one of our younger lecturers,"* – Interviewee 1, while another noted, *"The inclusion of sustainability in the pastry course was a department initiative—not from the national framework."*- Interviewee 2. These developments were coded as Institutional Digital Responsiveness and Bottom-Up Curriculum Adjustment, and suggest that reform is possible—even within rigid systems—when faculty agency is supported. This aligns with Lee and Tao (2021), who found that institutional change often originates from individual educator initiatives that later spread through organizational learning mechanisms.

However, the lack of structural support and absence of formal faculty development pathways means such innovations remain isolated. Without institutional reinforcement, these practices risk becoming temporary or overly dependent on individual enthusiasm. This reinforces Clarke et al. (2016)'s call for structured academic-industry collaboration and leadership development in vocational teaching institutions [8].

Collectively, these findings illustrate a multi-layered challenge: although curriculum developers are aware of digital and green transitions, institutional, regulatory, and infrastructure-related constraints inhibit full integration. Nevertheless, localized innovation and proactive faculty action indicate potential for scalable reform—provided systemic mechanisms such as updated competency frameworks, continuous industry engagement, and capacity-building strategies are developed. This study extends existing knowledge by providing grounded empirical evidence from the Indonesian culinary education sector and highlights the urgency of designing adaptive, sector-specific reform frameworks that link bottom-up innovation with top-down structural change.

Conceptual Framework for Culinary Curriculum Reform

To synthesize the study's key findings and support practical implementation, this research proposes a conceptual framework that maps the dynamics of curriculum transformation in vocational culinary education. Figure 4.1 visually represents the interrelated factors influencing the integration of digital and sustainable competencies across institutions, from perception to practice.

At the top of the framework are the external drivers—namely, digital disruption and green economy demands—that are reshaping job roles and skill expectations in the culinary sector. These include the rise of influencer chefs, AI-powered kitchen technologies, zero-waste kitchens, and ESG-conscious culinary branding. These trends set the strategic context that curriculum developers are increasingly expected to respond to.

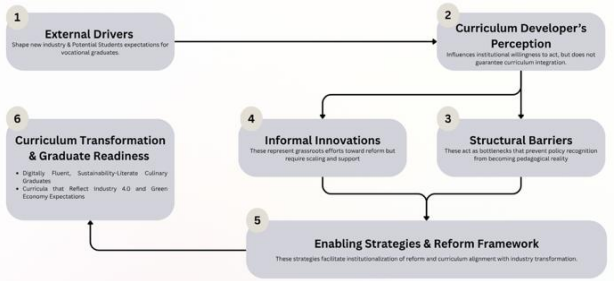

Figure 2 Conceptual Framework Culinary Curriculum Reform

The second tier—curriculum developer perceptions—captures how these industry shifts are understood within vocational institutions. While the study found widespread acknowledgment of the importance of digital and sustainable competencies, the thematic analysis revealed a perception-practice gap: recognition of these priorities does not always translate into formal curriculum integration or pedagogical innovation. This disconnect is shaped by a set of entrenched structural and institutional barriers, including outdated qualification frameworks (e.g., SKKNI), limited institutional flexibility, inadequate faculty development, and a lack of digital infrastructure. These systemic challenges often inhibit innovation, even when awareness and intent are present.

In parallel, informal and bottom-up innovations were found to emerge in isolated pockets. Examples include sustainability content embedded in pastry business courses, lecturer-led digital marketing tasks, and collaborations with external actors like NGOs or food banks. Although promising, these efforts are largely decentralized and lack mechanisms for institutional scaling. At the core of the model are a set of enabling strategies and reform pathways, which serve as bridges between grassroots initiatives and systemic transformation. These include aligning curricula with national sustainability and food resilience goals (e.g., those promoted by BAPPENAS), updating digital and green competency frameworks, facilitating cross-sector collaboration with industry stakeholders, and investing in continuous professional development for faculty. These pathways represent strategic levers for curriculum reform at both institutional and policy levels.

The ultimate outcome, illustrated at the base of Figure 4.1, is a reformed culinary curriculum that produces digitally fluent and sustainability-literate graduates—professionals equipped to succeed in emerging hybrid roles such as digital chefs, green entrepreneurs, and culinary content creators. This model not only reflects the empirical findings of this study but also contributes to a broader theory of vocational education reform by connecting digital transformation,

innovation ecosystems, and human capital development.

Significance of the Study

This research contributes to the understanding of how curriculum reform can be made more agile and aligned with the dual imperatives of digital transformation and sustainability. The study reinforces the need for sector-specific digital competency models and sustainability-integrated learning outcomes for culinary education—gaps rarely addressed by generic frameworks like DigComp or SKKNI. Practically, the findings support the case for (1) updating national frameworks to include anticipatory competencies, (2) formalizing partnerships with industry actors for continuous feedback, and (3) expanding faculty development programs to sustain reform momentum. These strategies are essential if vocational culinary programs are to remain relevant and produce graduates capable of operating as influencer chefs, digital entrepreneurs, and green kitchen leaders.

Limitations and Future Research

This study focused on a purposive sample of curriculum developers within the Indonesian vocational context. While rich in qualitative depth, the findings may not fully generalize across all vocational fields or regions. Additionally, the perspectives of students, industry representatives, and national policymakers were not included in the current study and should be addressed in future research. Further investigation is needed into how digital and sustainable competencies are received and applied by graduates in real-world culinary careers. Mixed-method studies that integrate curriculum analysis with labor market outcomes would help verify whether educational reforms lead to improved employability and entrepreneurial success.

V. CONCLUSION

This study set out to explore how vocational culinary education in Indonesia is responding to the dual imperatives of digital transformation and sustainability. Through a qualitative case study of curriculum developers, it examined perceptions, structural barriers, and emergent reform strategies aimed at aligning culinary training with evolving industry demands. The findings demonstrate a strong conceptual awareness among educators of the importance of digital and sustainable competencies. However, this awareness has not yet translated into comprehensive curriculum change. The study identified several systemic challenges—including outdated competency frameworks, limited faculty capacity, weak industry-academia linkages, and insufficient institutional infrastructure—that continue to hinder meaningful integration of these skills.

Despite these constraints, the emergence of informal innovations at the faculty and department levels—such as sustainability-themed projects, digital marketing assignments, and partnerships with external actors—reflects a growing readiness to adapt. These grassroots initiatives suggest that reform is possible, but must be matched by supportive policy frameworks, structured capacity-building, and strategic alignment with industry standards. The conceptual framework developed in this study (Figure 5.1) offers a pathway for connecting external pressures, internal institutional dynamics, and actionable strategies to achieve curriculum reform. It emphasizes that effective transformation requires more than awareness—it demands structural responsiveness, cross-sector collaboration, and targeted investment in human capital development.

In sum, this research contributes both empirically and conceptually to the discourse on vocational education reform in the digital and green economy era. It underscores the urgency of designing culinary curricula that not only preserve traditional craftsmanship but also empower graduates to thrive as digitally fluent, sustainability-literate, and entrepreneurially capable professionals in an increasingly dynamic food system.

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