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Project-Based Learning for Local Food Innovation in Vocational Education: Innovation in Culinary Training

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Abstract: Vocational education plays a vital role in preparing skilled, innovative, and adaptive human resources capable of responding to global industrial changes and community needs. In Indonesia, the *Link and Match 8+i* policy and Teaching Factory initiatives have emphasized the integration of real-world learning with local innovation and entrepreneurship. This conceptual paper explores the potential of Project-Based Learning for Local Food Innovation (PjBL-LFI) as a pedagogical model to enhance creativity, sustainability, and entrepreneurship in vocational education. Using the case of developing a papaya-leaf powdered drink, the study demonstrates how local food resources can be transformed into authentic learning projects that strengthen students' technical competence, problem-solving ability, and entrepreneurial awareness. By linking PjBL with local innovation, vocational education can fulfill its dual function building employability and promoting sustainable community empowerment. The proposed model aligns with Indonesia's national agenda of *Link and Match 8+i*, supports the goals of *Merdeka Belajar–Kampus Merdeka*, and contributes to Sustainable Development Goals (SDG 2: Zero Hunger and SDG 4: Quality Education). It concludes that integrating PjBL with local food innovation can transform vocational institutions into centers of applied research, entrepreneurship, and cultural sustainability.

Keywords: Vocational Education; Project-Based Learning; Entrepreneurship; Local Food Innovation; Papaya-Leaf Drink

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Introduction

Vocational education in Indonesia has evolved from a system focused solely on producing skilled labor into one that fosters creativity, innovation, and entrepreneurship. This shift responds to the growing complexity of industrial demands and the need for educational models that integrate sustainability, technology, and community relevance. The government's *Link and Match 8+i* program encourages strong collaboration between schools, industries, and communities, emphasizing innovation as the key to building human resources who are competitive and independent. Within this policy context, vocational institutions are expected not only to prepare students for employment but also to cultivate innovators who can contribute to local and national development. To achieve this transformation, pedagogical approaches must prioritize experiential learning, real-world problem solving, and local contextualization—qualities best embodied in *Project-Based*

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Learning (PjBL).

PjBL is a student-centered learning model that engages learners in authentic projects requiring inquiry, planning, implementation, and reflection. Through these processes, students integrate theory with practice and develop essential 21st-century skills such as creativity, critical thinking, and collaboration (Thomas, 2000; Bell, 2010). In the context of vocational education, PjBL allows students to experience production-oriented learning that mirrors real industry environments. This approach aligns well with Indonesia's *Teaching Factory* model, which integrates industrial processes into educational settings, enabling learners to participate directly in product development, quality assurance, and entrepreneurship (Rama, 2023). Consequently, vocational classrooms become innovation laboratories where students gain not only technical expertise but also entrepreneurial experience through practice-based learning.

The integration of local wisdom (*kearifan lokal*) into vocational education further enhances the relevance and sustainability of learning. Local food resources, traditional knowledge, and regional industries provide rich learning contexts for students to explore and innovate. Developing products such as papaya-leaf powdered drinks exemplifies how PjBL can merge scientific inquiry with local innovation. Papaya leaves, traditionally valued for their medicinal and nutritional benefits, can be reimagined as a sustainable and functional food product through vocational projects. This type of learning not only strengthens students' technical competence in food processing but also promotes cultural preservation and community-based entrepreneurship.

Moreover, linking local innovation with PjBL supports several national and global priorities. It contributes to Sustainable Development Goals (SDGs) particularly SDG 2 (*Zero Hunger*), which emphasizes food diversification and local food security, and SDG 4 (*Quality Education*), which promotes inclusive and relevant learning. It also aligns with Asta Cita and the National Research Master Plan (RIRN), which highlight innovation and local empowerment as the basis for sustainable development. Vocational institutions thus become catalysts for change, bridging education, industry, and community within a single learning ecosystem.

At the institutional level, the Faculty of Vocational at Universitas Negeri Malang (UM) exemplifies this transformation. Through the integration of research, teaching, and community service, UM has developed vocational programs that promote product-based learning rooted in local resources. In the culinary program, for example, students engage in developing functional food products through project-based and entrepreneurship-oriented learning supported by teaching factory facilities. The development of papaya-leaf powdered drink innovation not only strengthens students' creative and business skills but also supports the university's contribution to food security and sustainable development goals.

Therefore, this research aims to present a conceptual exploration of how *Project-Based Learning for Local Food Innovation (PjBL-LFI)* can be effectively implemented in vocational education. The discussion elaborates on its theoretical foundations, pedagogical significance, and relevance to Indonesia's vocational transformation agenda. The proposed framework emphasizes the integration of innovation, entrepreneurship, and local wisdom to produce graduates who are not only technically competent but also capable of contributing to community resilience and sustainable national progress.

Theoretical Framework

Vocational education serves as the foundation for developing competent, innovative, and adaptive human resources capable of contributing to sustainable national development. It integrates knowledge, skills, and attitudes into an applied learning system designed to meet the evolving needs of industry and society. According to Finch and Crunkilton (1999), effective vocational education combines

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cognitive, psychomotor, and affective domains to ensure learners' readiness for real-world challenges. In Indonesia, the modernization of vocational education is reflected in the *Link and Match 8+i* initiative, which emphasizes partnerships between schools, industries, and communities, with innovation as a central component. This model positions vocational institutions not merely as training centers but as collaborative innovation ecosystems that align education with technological, social, and cultural transformation (UNESCO-UNEVOC, 2022).

The *Link and Match 8+i* policy reflects the government's commitment to strengthening synergy between vocational education and industry needs. The "8" represents eight key forms of collaboration including curriculum co-design, joint certification, teacher internships, and industrial classes while the "i" symbolizes innovation, which connects learning outcomes with creativity and entrepreneurship. Within this framework, vocational learning is expected to move beyond technical repetition toward meaningful innovation rooted in local resources and community values. This transformation underscores the urgency of adopting pedagogical models that promote contextual learning, creativity, and entrepreneurship, all of which are embodied in PjBL.

PjBL is a pedagogical approach that engages students in complex, authentic projects that stimulate inquiry, collaboration, and innovation. Grounded in constructivist theory, PjBL promotes learning by doing, where students actively construct knowledge through exploration and reflection rather than passive absorption (Thomas, 2000; Bell, 2010). In vocational contexts, PjBL mirrors real industry processes—students plan, design, implement, and evaluate projects that integrate technical and managerial aspects. Teachers act as facilitators, mentors, and project supervisors, guiding learners through decision-making and problem-solving stages. This aligns closely with the *Teaching Factory* model (Rama, 2023), in which schools simulate industrial settings to provide authentic production and quality control experiences. When integrated, PjBL and Teaching Factory approaches transform vocational institutions into innovation incubators that link education, production, and entrepreneurship.

In culinary education, PjBL can take the form of product innovation projects that utilize local resources, encouraging creativity while preserving cultural identity. For instance, students may develop a functional drink from papaya leaves—an ingredient traditionally valued for its nutritional properties but rarely commercialized. Through such projects, learners engage in research, formulation, production trials, packaging design, and marketing simulation. This hands-on experience cultivates both technical competence and entrepreneurial literacy, turning vocational classrooms into micro-enterprise laboratories. Research in Indonesian vocational settings confirms that PjBL enhances creativity, self-efficacy, and entrepreneurial intention among students (Abdillah, 2024; Ningrum, 2024).

Entrepreneurship education thus complements vocational learning by equipping students not only to seek employment but also to create business opportunities. Fayolle and Liñán (2020) emphasize that entrepreneurship education should develop awareness, intention, and behavior domains best achieved through experiential projects rather than theoretical instruction. In Indonesia's vocational framework, entrepreneurship learning has evolved into practice-oriented programs that integrate production, marketing, and value creation. Supported by collaborations with local MSMEs, students experience real business ecosystems, learning how to identify opportunities, manage risk, and deliver innovative products to consumers (Ambarita et al., 2024). This approach aligns with **A**sta Cita, which calls for increased productivity and competitiveness through innovation and local resource utilization.

Local wisdom and food innovation form the cultural backbone of vocational

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education reform. Indonesia's vast biodiversity and culinary heritage provide abundant learning contexts for students to explore sustainability and creativity. Local food innovation refers to transforming traditional ingredients and recipes into modern or functional products while maintaining cultural authenticity. Studies by Azis and Andini (2022), Sari and Lestari (2020), and Kusumaningrum et al. (2021) indicate that local food-based product development not only enhances consumer interest but also strengthens community resilience and economic empowerment. In the context of PjBL, local food innovation provides meaningful, interdisciplinary learning experiences that combine science, technology, culture, and entrepreneurship. By engaging in projects like papaya-leaf powdered drink production, students learn to integrate food science principles with sustainable practices and social responsibility, contributing to the government's agenda on food diversification and independence.

The synthesis of vocational education, PjBL, entrepreneurship, and local innovation produces what can be described as contextualized innovation learning. Vocational education provides the structural and competency foundation; PjBL delivers the pedagogical method that transforms theory into practice; entrepreneurship education injects the economic and creative mindset; and local innovation ensures sustainability and cultural grounding. Together, they form an educational ecosystem that not only enhances employability but also builds innovation capacity. This integration reflects Billett's (2014) notion of "workplace learning with meaning," in which knowledge acquisition is embedded in authentic social and economic contexts.

Within this theoretical perspective, the present study proposes the PjBL-LFI framework as a transformative model for vocational education. The model aims to integrate local resource utilization, innovation, and entrepreneurship into structured, PjBL cycles that align with the national *Link and Match 8+i* agenda and global sustainable development priorities. Through this framework, vocational institutions can cultivate graduates who are not only technically skilled but also capable of innovation, entrepreneurship, and community leadership. The next section elaborates on this conceptual model, illustrating how PjBL-LFI can be systematically applied to strengthen the linkage between vocational schools.

Method

The conceptual framework proposed in this paper PjBL-LFI integrates four essential dimensions of vocational education: technical competence, project-based pedagogy, entrepreneurship, and local innovation. The framework envisions vocational institutions as innovation ecosystems where students learn through authentic, meaningful, and productive experiences that connect education with community development and sustainability. Within this framework, PjBL functions not merely as a teaching method but as a holistic learning process that allows students to explore, create, and commercialize products rooted in local culture and resources.

At its core, the PjBL-LFI model is designed to foster a dynamic learning cycle that begins with the exploration of local potential, continues through product design and implementation, and culminates in entrepreneurial dissemination. The cycle starts with identifying local ingredients or cultural practices that can be developed into innovative products. Teachers facilitate student inquiry to uncover local wisdom and sustainability values embedded in regional resources. In the next stage, students formulate project proposals, integrating vocational competencies such as food processing, hygiene, and product design with creativity and problem-solving. During implementation, learners engage in production trials, evaluate quality, and refine their prototypes through feedback and reflection. The final stage connects learning to entrepreneurship students simulate marketing, cost analysis, and business

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modeling, linking their technical outputs to real market dynamics. This cyclical process transforms vocational learning into a contextual and entrepreneurial experience that prepares students to become innovators rather than mere job seekers.

Each dimension of the PjBL-LFI framework contributes a distinct but interdependent function. Vocational education provides the structural foundation through competency-based standards and the *Link and Match 8+i* framework that aligns curriculum with industrial needs. PjBL serves as the pedagogical core that emphasizes inquiry, collaboration, and product-oriented outcomes. Entrepreneurship introduces the creative and economic perspective, encouraging students to develop a sense of initiative, risk-taking, and opportunity recognition. Local food innovation, as the contextual dimension, grounds learning in sustainability and cultural identity, ensuring that students' projects reflect both scientific knowledge and social value. The integration of these four dimensions results in a comprehensive learning model that connects education with community empowerment and food security.

The strength of PjBL-LFI lies in its interdisciplinary nature. By combining science, culture, and business literacy, the model enables students to work across domains and develop holistic competencies. For instance, the development of a papaya-leaf powdered drink provides students with opportunities to apply food science principles while practicing entrepreneurial and marketing strategies. The process involves ingredient selection, product formulation, packaging design, sensory testing, and branding all conducted under the guidance of teachers who act as facilitators and innovation mentors. This hands-on, end-to-end experience enhances learners' confidence, creativity, and understanding of how vocational knowledge translates into tangible social and economic impact.

The conceptual framework also emphasizes collaboration among schools, industries, and communities. Through partnerships with local MSMEs, farmer groups, and community organizations such as PKK, vocational institutions can co-develop projects that are both educational and economically relevant. These collaborations strengthen the *quadruple helix* approach linking academia, industry, government, and society to support the goals of *Merdeka Belajar Kampus Merdeka*. The Faculty of Vocational at Universitas Negeri Malang, for example, has implemented this integration by encouraging students to engage in product-based learning projects that combine academic research, community service, and entrepreneurship development.

The PjBL-LFI framework is not limited to culinary programs; it can be adapted across vocational fields such as fashion, agriculture, and technology. Its universal structure allows each institution to embed local characteristics into project design, making learning both context-specific and transferable. The model promotes a balance between standardization and flexibility: while competencies are guided by national standards, the content and products are derived from local realities. This adaptability ensures that vocational education remains relevant, innovative, and responsive to regional development needs.

In summary, the PjBL-LFI framework provides a transformative pathway for vocational education in Indonesia. By merging project-based pedagogy, entrepreneurship, and local wisdom, it enables institutions to create learning environments that are productive, sustainable, and culturally meaningful. The model aligns with the *Link and Match 8+i* policy, supports SDG 2 (Zero Hunger) and SDG 4 (Quality Education), and reinforces vocational education's role as a driver of national innovation and independence. Through the PjBL-LFI framework, students are empowered to become creators, innovators, and change agents linking their learning directly to community well-being and economic growth.

Results & Discussion

The integration of PjBL-LFI represents a

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strategic response to the transformation of vocational education in Indonesia, which is shifting from a purely competency-based approach to an innovation-oriented model. This pedagogical transformation aligns with the global trend that views vocational institutions not merely as centers for technical training but as incubators of creativity, entrepreneurship, and community empowerment. Within this framework, students are positioned as active agents of change who design, develop, and refine tangible products that respond to local challenges and potentials. The PjBL-LFI model encourages students to work collaboratively in authentic projects that reflect real-world practices. For example, when learners develop a local product such as a papaya-leaf powdered drink, they experience a complete cycle of innovation—from identifying local potential, conducting simple food processing, and testing product feasibility, to planning marketing and entrepreneurial strategies. This comprehensive learning process nurtures technical competence, critical and creative thinking, and cultural appreciation simultaneously. In doing so, it transforms vocational classrooms into living laboratories where theory and practice converge naturally.

The implementation of PjBL-LFI strongly supports the national Link and Match 8+i policy and the Teaching Factory model promoted by the Indonesian Ministry of Education. These frameworks emphasize collaboration between educational institutions, industry, and community stakeholders to ensure that learning outcomes align with labor market and innovation needs. PjBL-LFI operationalizes this vision by providing a learning structure in which innovation arises organically from real projects. Local product innovation becomes the medium through which students practice technical, managerial, and entrepreneurial skills that are directly relevant to industry.

Teaching factories provide the ideal environment for this learning model to flourish, as they simulate industrial workflows and allow students to experience quality control, production management, and marketing functions in a controlled yet authentic setting. When implemented properly, the synergy between PjBL-LFI, Link and Match, and the Teaching Factory concept produces graduates who are job-ready and innovation-oriented.

In broader terms, PjBL-LFI also contributes to several Sustainable Development Goals (SDGs) and the Indonesian government's Asta Cita vision. It supports SDG 2 (Zero Hunger) by promoting food diversification and local food security, SDG 4 (Quality Education) through the creation of relevant and experiential learning environments, and SDG 8 (Decent Work and Economic Growth) by fostering entrepreneurship and local business development. It also aligns with Asta Cita's emphasis on increasing national productivity, innovation, and competitiveness through education. By integrating these global and national frameworks into the design of vocational learning, PjBL-LFI ensures that education contributes directly to sustainable development and economic independence at the community level.

However, implementing the model in Indonesia still faces several challenges. Many vocational teachers remain unfamiliar with facilitative, student centered pedagogies such as PjBL. Teacher readiness, therefore, is a critical factor that must be addressed through continuous professional development focusing on project management, entrepreneurship integration, and assessment for learning. Limited resources and infrastructure also pose barriers, particularly in institutions that lack adequate laboratories or teaching factories to support production-based learning. Curriculum rigidity is another concern, as project-based innovation often requires flexibility in scheduling and assessment beyond conventional classroom structures. Furthermore, partnerships with industries and small enterprises must be strengthened to ensure sustained collaboration and mutual benefit. Lastly, ethical and cultural sensitivity is essential when adapting local knowledge, as

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traditional practices and community wisdom must be respected and acknowledged as shared intellectual property.

Despite these challenges, the opportunities offered by PjBL-LFI are substantial. The model can be embedded into Merdeka Belajar–Kampus Merdeka programs, allowing universities and vocational schools to grant academic credit for innovation and community projects. It also opens pathways for collaboration with micro, small, and medium enterprises (MSMEs), where students can apply their skills to real product development and marketing. Research outcomes, such as the papaya-leaf drink innovation, can be translated into teaching materials that make learning more contextual and meaningful. Moreover, the use of digital technology for documentation, marketing, and online collaboration enhances the scalability of this model and prepares students for the era of digital entrepreneurship. Through regional specialization, each vocational institution can develop its own signature product that reflects local identity and builds community-based innovation branding.

Pedagogically, the adoption of PjBL-LFI transforms the student learning experience. Learners become more engaged because projects are authentic, creative, and relevant to their environment. Collaboration among peers promotes communication, teamwork, and leadership skills highly valued in modern workplaces. Reflective learning, through journaling and evaluation, fosters metacognitive growth and continuous improvement. Most importantly, students experience empowerment through ownership: they see their ideas materialize into products that have social and economic value. This sense of agency contributes to self-efficacy and long-term entrepreneurial motivation. As a result, graduates are not only technically proficient but also capable of initiating and sustaining innovation within their communities.

At the institutional and policy level, several strategies are recommended to support the wide scale implementation of PjBL-LFI. First, the Ministry of Education should recognize product-based innovation projects as legitimate learning outcomes within the national vocational education framework. Second, schools and universities must allocate resources and funding to establish teaching factories and project-based laboratories. Incentives should be given to teachers who lead innovation projects and engage with industry partners. Third, continuous capacity building through workshops, mentoring, and collaboration with higher education institutions is needed to develop teachers' pedagogical and entrepreneurial competencies. Finally, monitoring and evaluation mechanisms should be introduced to measure the impact of PjBL-LFI on student competence, entrepreneurial outcomes, and community empowerment. Through these policy and institutional measures, the model can evolve from a theoretical construct into a practical and scalable approach that revitalizes vocational education across Indonesia.

In conclusion, the discussion of the PjBL-LFI model demonstrates its potential to integrate pedagogy, culture, and economy within a single learning framework. By emphasizing authentic, collaborative, and innovation-oriented learning experiences, vocational education can fulfill its dual mandate: producing skilled professionals and fostering sustainable local development. This conceptual model, when supported by policy commitment and institutional readiness, offers a transformative pathway for Indonesia's vocational education to align with global trends while remaining rooted in local wisdom.

Conclusions

The integration of Project-Based Learning for Local Food Innovation (PjBL-LFI) within vocational education represents a strategic response to the evolving demands of modern industry, sustainability, and community development. This conceptual model demonstrates that vocational learning is most effective when it connects theory and practice through authentic, context-based

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projects rooted in local culture and resources. By adopting PjBL as the core pedagogy, students gain not only technical and scientific competencies but also the capacity for creativity, critical thinking, and entrepreneurship. When these projects are grounded in local food innovation such as the development of a papaya-leaf powdered drink they become powerful instruments for experiential learning that link education to real social and economic contexts.

PjBL-LFI transforms vocational classrooms into dynamic spaces where learners act as innovators and problem solvers rather than passive recipients of instruction. Through the process of product design, testing, and commercialization, students acquire integrated knowledge across multiple domains: science, culture, technology, and business. The approach aligns with Indonesia's national priorities, including the Link and Match 8+i policy, the Teaching Factory initiative, and the Merdeka Belajar–Kampus Merdeka program, all of which emphasize collaboration, autonomy, and innovation in vocational institutions. It also directly supports Sustainable Development Goals, particularly SDG 2 on food security and SDG 4 on quality education, by promoting sustainable use of local resources and improving the relevance of vocational training.

The successful implementation of this model, however, requires institutional and policy commitment. Teachers need continuous professional development to master PjBL facilitation and entrepreneurial integration, while schools must provide adequate facilities, resources, and flexibility for cross-disciplinary project execution. Industry partnerships should be strengthened through mutually beneficial collaborations that connect student innovation with real market opportunities. Moreover, ethical engagement with communities is essential to ensure that local knowledge and traditional practices are respected and shared responsibly. When these conditions are met, the PjBL-LFI model can serve as a scalable strategy to bridge education, innovation, and community empowerment.

In conclusion, vocational education that embeds project-based learning and local innovation becomes a transformative force for human resource development in Indonesia. It cultivates graduates who are not only job-ready but also innovation-ready capable of creating, adapting, and contributing meaningfully to their local economies. This conceptual paper highlights the need to view vocational institutions as centers of creativity and cultural sustainability, where students learn not only how to work, but how to innovate for a better future. The Faculty of Vocational at Universitas Negeri Malang, through its continuous research and educational initiatives, exemplifies how universities can play a pivotal role in bridging education with local industry and society. Moving forward, the model invites further empirical research and cross-institutional collaboration to validate its practical impact and to refine the integration of local wisdom within modern vocational pedagogy.

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