Brilliance
Research of Artificial Intelligence

E-ISSN : 2807-9035
Volume 6, **Number** 4, November 2026
https://doi.org/10.47709/brilliance.v6i4.10028

Optimizing Culinary MSME Competitiveness through Artificial Intelligence Technopreneurship and Sustainable Digital Business

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open access

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Article History:
Submitted: 12-11-2026
Accepted: 23-11-2026
Published: 27-11-2026

Keywords:
Artificial Intelligence; Competitiveness; Culinary MSMEs; Digital Business; Technopreneurship.

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ABSTRACT

Background: Culinary Micro, Small, and Medium Enterprises (MSMEs) are the backbone of the local economy and food ecosystem in Bireuen Regency. However, the adoption of Artificial Intelligence (AI) remains slow because of limited digital literacy, weak organizational readiness, and a lack of contextual integration strategies. This threatens competitiveness and business resilience in the digital economy. Objective: This study designs and tests a technopreneurship strategy that integrates AI into the digital business of culinary MSMEs to improve competitiveness and sustainability. Methods: The study uses a sequential explanatory mixed-methods approach within a participatory Research and Development (R&D) design. It has four stages: diagnosis through a survey and Focus Group Discussions (FGDs), model design, a limited pilot of a WhatsApp chatbot prototype with 10–15 MSMEs, and evaluation and dissemination. Results: The design stage produced a conceptual framework that combines the Resource-Based View, the Technology-Organization-Environment framework, and technopreneurship; a five-component strategy model; a chatbot architecture; an interim interface design for customers and owners; and an evaluation framework with response time, order growth, and user satisfaction indicators. Conclusion: Contextual, participatory, and affordable AI integration can become a practical path for the digital transformation of culinary MSMEs. The expected outputs are a strategy model, a prototype design, a training toolkit, and a scientific article that can guide MSMEs, local agencies, and business mentors in adopting AI step by step at an affordable cost.

INTRODUCTION

Culinary MSMEs are the backbone of the local economy in Bireuen Regency. This sector provides jobs, secures the supply of processed food, and preserves regional flavors. However, its potential is not fully realized because business competitiveness remains limited. As digital transformation accelerates, Artificial Intelligence (AI) has become a catalyst for business growth. AI offers solutions to optimize operations, marketing, and service innovation. A national study reports that generative AI such as ChatGPT can increase the operational efficiency of MSMEs by up to 30% and can serve as a bridge to external knowledge (Rachmaniar & Rokoyah, 2024).

Nevertheless, AI adoption at the local level is slow. Low digital literacy, minimal organizational readiness, and the absence of contextual integration strategies are the main barriers (Dinul Khaq et al., 2024; Sufi & Suharti, 2021). Internally, most culinary MSME owners still rely on conventional business models and have limited digital literacy (Titin et al., 2024). Externally, supporting ecosystems such as digital infrastructure, funding schemes, and contextual technopreneurship training are still inadequate (Nugroho et al., 2025). These conditions widen the gap between the potential of AI and its use by small business owners.

AI can support customer data analysis, supply chain management, and personalized marketing (Rosandy, 2024). To make these benefits last, AI must be positioned as a strategic resource. Technopreneurship, which combines an entrepreneurial spirit with the use of technology, is relevant for this purpose because it encourages new business models (Kuratko & Audretsch, 2022; Ningsih & Tjahjono, 2024). At the same time, AI cannot be adopted instantly. The Technology-Organization-Environment (TOE) framework explains that technology adoption depends on the interaction of technological characteristics, organizational readiness, and environmental pressure (Wulandari et al., 2022; Zahra et al., 2023). Therefore, AI integration must be designed as part of a holistic digital business strategy.

Previous studies tend to discuss AI, technopreneurship, and sustainability separately. They also rarely address specific local contexts, such as culinary MSMEs in Aceh, and rarely go beyond analysis to applied solutions. To date,

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no integrative model operationalizes these three concepts into a real strategy and tests it through an affordable AI prototype. This is the research gap addressed in this article.

The research question is: how can an effective technopreneurship strategy be designed and implemented to overcome the slow adoption of AI and to optimize the competitiveness and sustainability of culinary MSMEs' digital business in Bireuen Regency? The objectives are to map digital readiness and AI adoption barriers, to design a technopreneurship strategy model integrated with AI, and to design and test a simple AI prototype in the form of a WhatsApp-based customer service chatbot. The contributions include a contextual strategy model, a prototype design that is easy to adopt, a training toolkit for MSMEs and business mentors, and recommendations for local stakeholders. This study is aligned with the food focus area of the National Research Master Plan and with the Sustainable Development Goal on decent work and economic growth.

LITERATURE REVIEW

Resource-Based View and sustainable competitive advantage

The Resource-Based View (RBV) holds that a lasting competitive advantage comes from resources that are valuable, rare, hard to imitate, and hard to substitute. For culinary MSMEs, distinctive recipes, local wisdom, and closeness to customers are such resources. Hajiheydari et al. (2023) show that digital and sustainable business model innovation requires dynamic capabilities that connect sustainability with digital transformation. In other words, new technology gives an advantage only if the organization can manage it. A similar finding appears for processed-food MSMEs in Indonesia: technopreneurship strengthens competitive advantage when owners combine technology with their distinctive resources (Nugroho et al., 2025). In this study, AI is positioned as a strategic resource that strengthens local value rather than replaces it.

The Technology-Organization-Environment framework in MSMEs

The TOE framework explains technology adoption decisions through three contexts. The technological context covers the availability and fit of tools. The organizational context covers human resource capacity, business size, and owner support. The environmental context covers competitor pressure, government support, and infrastructure. The framework has been used to design MSME performance measurement instruments (Wulandari et al., 2022), to analyze e-commerce adoption (Alfarisi et al., 2025; Zahra et al., 2023), and to discuss how MSMEs adapt to AI technology (Maulida & Pranatami, 2024). This study uses TOE as the basis for a readiness diagnosis so that the strategy addresses real barriers.

Technopreneurship and business model innovation

Technopreneurship combines entrepreneurial spirit with technological mastery to create new value (Fadhilah, 2024). Kuratko and Audretsch (2022) argue that the future of entrepreneurship depends on the ability of many actors, not a few, to use opportunities and technology. This view matters for MSMEs because it shifts the focus from large innovations to technology adoption within the reach of small business owners. Ningsih and Tjahjono (2024) show that ChatGPT can support service innovation in micro and small businesses, so generative AI is no longer exclusive to large firms.

AI, digital transformation, and sustainability

Verhoef et al. (2021) distinguish digitization, digitalization, and digital transformation, and stress that true transformation requires a change of business model, not merely the use of tools. Le Dinh et al. (2025) show in a review of 50 studies that AI supports sales, operations, and decision making in SMEs, but success depends on workforce training, infrastructure, and a data-driven culture. Yesuf and Fields (2025) add that poor data quality and limited managerial knowledge remain barriers to AI-driven competitiveness. In the culinary sector, barriers to AI adoption in East Java relate to knowledge, cost, and owner readiness (Dinul Khaq et al., 2024), while in Sumatra digital literacy is associated with MSME performance (Titin et al., 2024). On ethics, Corrêa et al. (2023) review 200 AI governance guidelines and find recurring principles such as transparency, justice and fairness, accountability, and privacy. These principles are relevant for protecting MSME customer data. Kneafsey et al. (2021) link local food systems to socio-economic benefits, so the digitalization of culinary MSMEs also strengthens the regional food ecosystem.

Previous studies and the research gap

Table 1 summarizes the previous studies that form the basis of this work, together with the limitations that open room for novelty.

Table 1. Summary of Previous Studies and Research Gaps

Researchers	Focus and findings	Limitations (research gap)
Verhoef et al. (2021)	Formulates the stages of digital transformation and a research agenda: digitization, digitalization, and business model transformation.	General and conceptual; not specific to culinary MSMEs or the local context of Aceh.

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Le Dinh et al. (2025); Yesuf & Fields (2025)	Review how AI supports SME business functions, decision making, and competitiveness, and identify barriers such as data quality, skills, and finance.	Does not present an applied solution model for small businesses with limited resources.
Kuratko & Audretsch (2022)	Discusses the future of entrepreneurship and the use of technology by many business actors.	Technopreneurship is not yet operationalized with AI as a core technology in local MSMEs.
Hajiheydari et al. (2023)	Proposes a digital sustainable business model innovation model based on a dynamic capabilities approach.	Does not show how AI can be configured to support the sustainability of culinary businesses.
Dinul Khaq et al. (2024); Titin et al. (2024)	Map AI adoption barriers and the role of digital literacy in culinary MSMEs in East Java and Sumatra.	Stop at identifying factors; do not design and test an intervention or prototype.
Nugroho et al. (2025); Ningsih & Tjahjono (2024)	Show the role of technopreneurship and the use of ChatGPT for MSME advantage and service innovation.	Do not combine TOE, RBV, and technopreneurship in one model tested in Bireuen.
Darnila et al. (2025)	Applies IoT-based monitoring of pond water quality to support MSME sustainability in North Aceh Regency.	Focuses on aquaculture and IoT; does not address AI in culinary services.

Table 1 shows three main gaps. First, studies of AI for MSMEs usually stop at identifying factors or barriers and do not produce an applied solution model. Second, studies of technopreneurship and sustainability rarely treat AI as a core technology. Third, existing studies are rarely specific to culinary MSMEs in Aceh, particularly Bireuen Regency. Regional initiatives show that technology-based mentoring is feasible in Aceh, for example IoT-based monitoring of pond water quality for MSMEs in North Aceh Regency (Darnila et al., 2025), but this work addresses aquaculture rather than AI-supported services in culinary MSMEs. This study fills the gaps by integrating AI, technopreneurship, and sustainable digital business into one strategy model tested through a prototype.

Conceptual framework

Figure 1 shows the conceptual framework of the study. Technological, organizational, and environmental factors (TOE) determine the readiness of MSMEs. The readiness diagnosis becomes the basis for integrating AI into the technopreneurship strategy. This integration is expected to produce a sustainable digital business, a sustainable competitive advantage in the RBV sense, and ultimately the competitiveness and resilience of culinary MSMEs. Local wisdom and customer relationships act as distinctive resources that strengthen the whole chain.

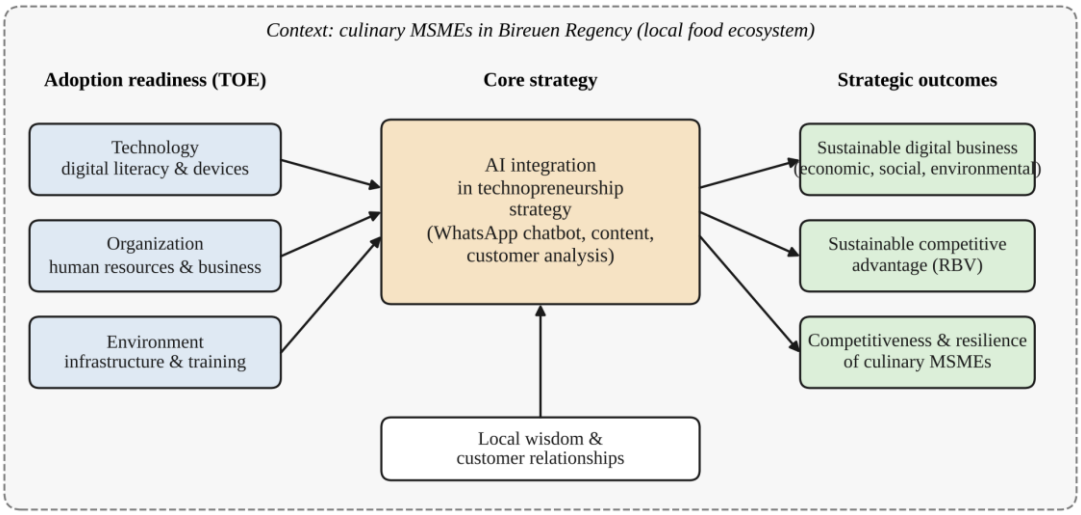

Figure 1. Conceptual framework: integration of AI in technopreneurship strategy based on TOE and RBV

METHOD

Research design

The study uses a sequential explanatory mixed-methods approach integrated with a participatory Research and Development (R&D) design. The quantitative stage reveals the pattern and level of technology adoption delays among culinary MSMEs in Bireuen Regency. The qualitative stage deepens these findings and develops an applied solution, namely a technopreneurship strategy that integrates AI. This design follows MSME technology adoption studies that

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combine readiness measurement with contextual exploration (Wulandari et al., 2022; Zahra et al., 2023). The study runs for one year in 2026 under the Early-Career Lecturer Research scheme. The Technology Readiness Level (TRL) is expected to rise from TRL 1 to TRL 2.

Research stages

Figure 2 presents the research flow, which consists of a preparation phase and four stages. Stage I (diagnosis and mapping) includes a literature review and the development of the RBV and TOE theoretical framework, the development of instruments (a questionnaire and an FGD guide), field data collection, and analysis of digital readiness, barriers, and specific needs. Stage II (model and solution design) includes needs analysis and identification of relevant AI tools, workshops with MSMEs and experts, and the drafting of the technopreneurship strategy model integrated with AI together with a prototype design. Stage III (implementation and pilot testing) includes the selection of 10–15 pilot MSMEs, training and implementation of the WhatsApp chatbot, and mentoring and impact data collection. Stage IV (evaluation and dissemination) includes analysis of impact data, refinement of the model and toolkit, publication of a scientific article, and submission of Intellectual Property Rights (IPR).

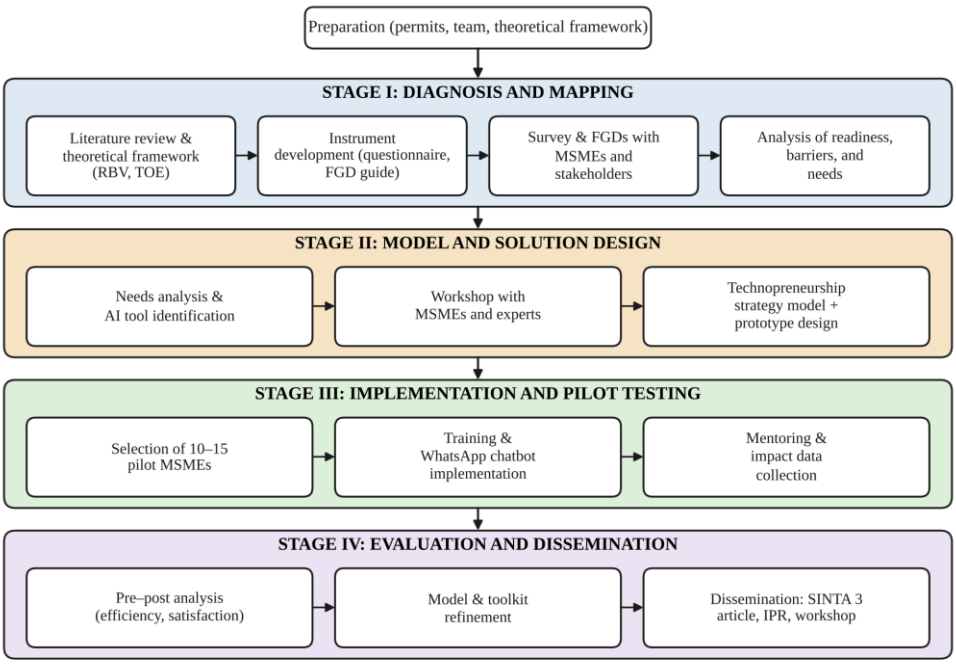

Figure 2. Four-stage research flow with the preparation phase

Responsibilities are assigned according to the expertise of the team, and Table 2 summarizes the outputs, achievement indicators, and persons in charge of each stage. The lead researcher coordinates all stages, prepares the schedule, manages the budget, and designs the prototype. The informatics members study and translate AI concepts into technical solutions, design the pilot scenarios, and provide technical mentoring to MSMEs. The management member develops the business model concept, prepares the digital mindset and technopreneurship module, and analyzes the value chain and competitiveness of the sampled MSMEs. A student member helps develop the Android application interface, integrates the cloud services, and supports data collection and documentation.

Table 2. Stages, Outputs, Achievement Indicators, and Persons in Charge

Stage	Output	Achievement indicator	Person in charge
I. Diagnosis and mapping	Validated instruments; map of digital readiness, barriers, and MSME needs	Instruments pass validity and reliability tests; survey and FGD data collected as planned	Lead researcher (coordination); management member (business instruments); student member (data collection)
II. Model and solution design	Technopreneurship strategy model integrated with AI; training module; prototype design	Model agreed in workshop; prototype design completed	Management member (business model, module); informatics members (technical design); lead researcher
III. Implementation and pilot testing	WhatsApp chatbot prototype running in pilot MSMEs; impact data	10–15 MSMEs trained and mentored; pre–post data recorded	Informatics members (technical mentoring); student member (Android interface, cloud,

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			documentation)
IV. Evaluation and dissemination	Final report; SINTA 3 article; IPR; training toolkit	Article accepted or published; IPR submitted; results workshop held	Lead researcher and all team members

Types and sources of data

The study uses primary and secondary data, as summarized in Table 3. Primary data come from culinary MSME owners and local stakeholders. Secondary data come from office documents and the literature.

Table 3. Types and Sources of Research Data

Data type	Data source	Collection technique	Purpose
Primary	Culinary MSME owners in Bireuen (survey of about 20–25 MSMEs; 15 FGD participants); stakeholders (Cooperatives Office, associations, local AI experts)	Questionnaire survey; FGDs; in-depth interviews; participant observation during the pilot	Map digital readiness and adoption barriers; identify specific needs; obtain input for the solution design
Secondary	MSME profile data from the Bireuen Cooperatives Office; journals, policy reports, and case studies of AI in MSMEs	Document study; systematic literature review	Complete the research context; build the theoretical framework of technopreneurship and AI

Population, sample, and data collection

The population is all culinary MSMEs in Bireuen Regency registered with the Cooperatives and MSMEs Office. The survey sample is drawn by purposive sampling and consists of about 20–25 MSMEs. FGD and interview participants are recruited by snowball sampling to reach relevant owners and stakeholders: 15 participants in two FGDs and five in-depth interviews. The pilot group consists of 10–15 MSMEs selected from the survey respondents based on willingness and minimum readiness.

A structured questionnaire with a 1–5 Likert scale measures digital readiness and perceptions of AI. The FGDs explore experiences and challenges in using digital technology. In-depth interviews with government and association stakeholders explore policy perceptions and technical aspects. Participant observation is carried out during the pilot. The instruments are tested for content validity and reliability before use, for example with Cronbach's alpha, and the FGD guide is reviewed by experts.

Data analysis and evaluation

The data analysis is designed to diagnose the causes of slow adoption and to formulate a solution (Table 4). Survey data are analyzed with descriptive statistics and correlation to map digital literacy, perceived benefits of AI, and inhibiting factors (Majapahit et al., 2025). FGD and interview data are analyzed thematically to understand cultural context, technology anxiety, and specific needs. Pilot performance data are analyzed with a pre–post comparison to measure operational efficiency and customer satisfaction. The change in each indicator is calculated with Equation (1), where X is the indicator value before (pre) and after (post) implementation.

$$\Delta X_k = \frac{X_{post} - X_{pre}}{X_{pre}} \times 100\% \quad (1)$$

Table 4. Data Analysis Plan and Validity Indicators

Type of analysis and sample	Focus	Method	Criteria and key indicators
Quantitative; 20–25 culinary MSMEs	40%	Structured questionnaire survey (Likert scale, multiple choice)	Criteria: content validity and reliability. Indicators: mean digital literacy score, correlation between owner age and AI adoption intention, perceived usefulness score.
Thematic qualitative; 15 participants from 2 FGDs and 5 interviews	35%	FGDs, semi-structured interviews, participant observation	Criteria: credibility through depth of sources. Indicators: themes of cost barriers, lack of local success examples, need for training in the local language, and relational values to be preserved.
Comparative evaluation; 10–15 pilot MSMEs	25%	Time-series (pre–post) data analysis	Criteria: measurement consistency and control of confounding variables. Indicators: customer response time, growth of orders through the chatbot, user satisfaction score.

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The validity of the findings is maintained through source and technique triangulation, depth of sources in the qualitative data, control of confounding variables in the pilot, and confirmation of results with participants. Ethical considerations follow the principles of Corrêa et al. (2023): participants give consent, customer data are protected, and the way the chatbot works is explained openly to business owners.

RESULTS

Status and scope of the results

This article reports the outputs of the initial design stage, namely the conceptual framework, the strategy model, the prototype design, and the evaluation framework. Empirical results from the survey, the FGDs, and the field pilot belong to later stages and will be reported once the data have been collected and analyzed. This separation allows readers to distinguish designs from tested findings.

Working hypotheses on AI adoption barriers

A synthesis of the literature and the proposal yields four groups of barriers that will be verified in the diagnosis stage. The first is limited digital literacy and information technology knowledge (Sufi & Suharti, 2021; Titin et al., 2024). The second is organizational readiness, including limited time, staff, and funds (Dinul Khaq et al., 2024). The third is an integration strategy that is not yet contextual, where AI tools are used without a link to the business model and local values (Maulida & Pranatami, 2024). The fourth is an inadequate supporting ecosystem, covering infrastructure, funding, and technopreneurship training (Nugroho et al., 2025). These four groups are the main dimensions of the questionnaire and the FGD guide.

Instrument design and conversation scenarios

The questionnaire is designed with six dimensions: digital literacy, technological readiness, organizational readiness, environmental support, perceived usefulness of AI, and adoption intention. Each dimension is measured with several items on a 1–5 Likert scale adapted from TOE-based instruments (Wulandari et al., 2022). The FGD guide directs the discussion to experience with digital technology, cost and skill barriers, local success stories, training needs, and the relational values with customers that owners want to keep. For the prototype, the conversation scenarios cover the questions that MSMEs receive most often: menu, price, opening hours, ordering, delivery, and complaints. Other questions are handed over to the owner.

Technopreneurship strategy model integrated with AI

The strategy model has five interrelated components (Table 5). The model moves from a readiness diagnosis, through the affirmation of the local value proposition, the stepwise adoption of AI tools, and training and mentoring, to data governance and ethics. This order follows the logic of TOE and RBV: readiness is mapped first, and then distinctive resources are strengthened with AI.

Table 5. Components of the Technopreneurship Strategy Model Integrated with AI

Component	Description	Form of intervention	Sustainability dimension
Digital readiness diagnosis	Maps the technological, organizational, and environmental readiness of each MSME (TOE).	Readiness questionnaire; FGDs	Economic
Local value proposition	Affirms distinctive resources (recipes, stories, customer relations) that AI strengthens (RBV).	Business model canvas	Socio-cultural
Stepwise AI adoption	Starts with simple, affordable tools before advanced features.	WhatsApp chatbot; content creation; customer analysis	Economic
Training and mentoring	Builds a digital mindset and technopreneurship skills among business owners.	Training modules; toolkit; technical mentoring	Social
Governance and ethics	Protects customer data and keeps the workings of AI transparent (Corrêa et al., 2023).	Data use and consent guideline	Social-environmental

WhatsApp chatbot prototype design

The AI prototype is designed to be simple so that it is easy to adopt. WhatsApp was chosen because it is already the daily channel between MSME owners and customers, so it requires no change of habit. Figure 3 shows the prototype architecture. Customers interact through WhatsApp. The messaging gateway forwards the conversation to an AI engine, which answers questions about the menu, prices, opening hours, and promotions from the MSME knowledge base and receives orders. Orders and conversation logs are stored in the cloud. The owner monitors orders, edits the menu, and views reports through an Android interface.

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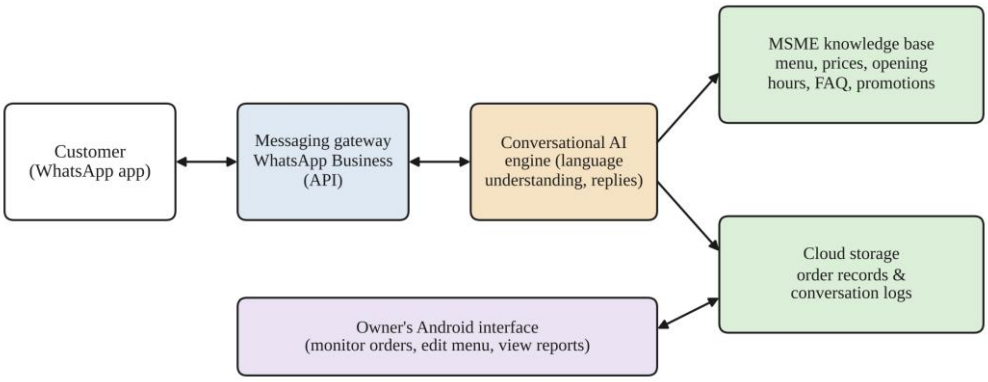

Figure 3. Architecture of the WhatsApp chatbot prototype for culinary MSMEs

Interim prototype interface

An interim interface was designed from the architecture in Figure 3. It follows three principles. First, it is simple: the customer side runs inside WhatsApp, so customers need no new application, and replies are short and in everyday Indonesian. Second, it keeps a human in the loop: when the chatbot cannot answer, it hands the conversation to the owner. Third, the owner stays in control: the menu, prices, and opening hours can be edited without technical help.

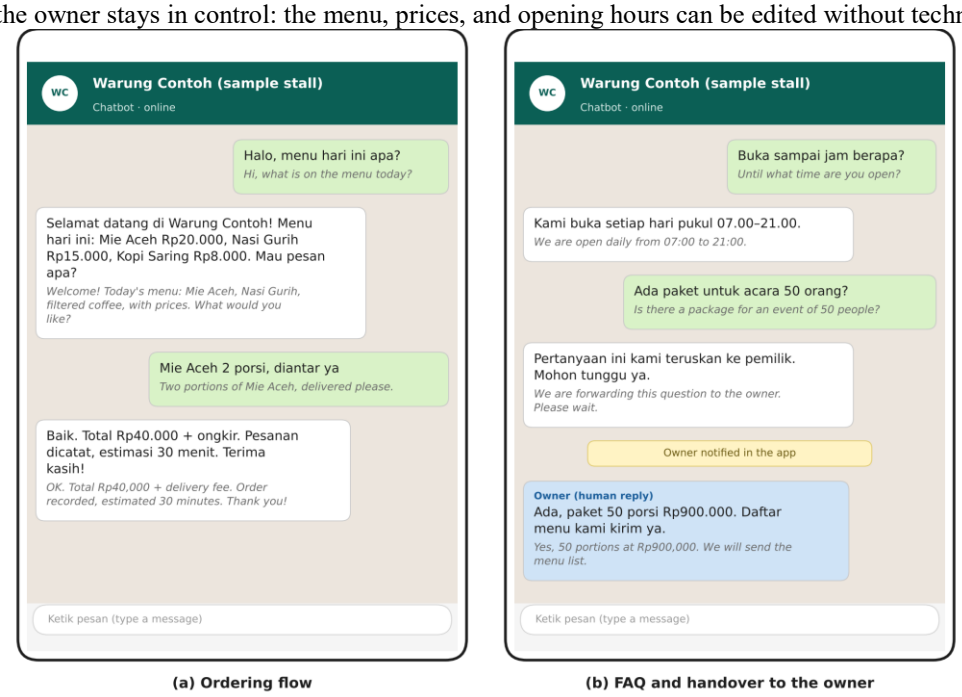

Figure 4. Interim prototype interface, customer side (WhatsApp): ordering flow and handover to the owner (illustrative data)

Figure 4 shows the customer-side conversation. In the ordering flow, the chatbot greets the customer, lists the menu with prices, records the order and the delivery address, and confirms the order with a summary and an estimated time. In the handover flow, a question that is not in the knowledge base is forwarded to the owner, and the customer is told that the owner will reply. Figure 5 shows three owner-side screens of the Android application. The dashboard shows the number of orders today, the share of orders received through the chatbot, and the average response time. The orders screen lists new orders and their status. The knowledge base screen lets the owner edit menu items, prices, availability, and opening hours. All names, prices, and numbers in Figures 4 and 5 are illustrative and are not research findings. The dialogue is shown in Indonesian, as customers would see it, with an English gloss.

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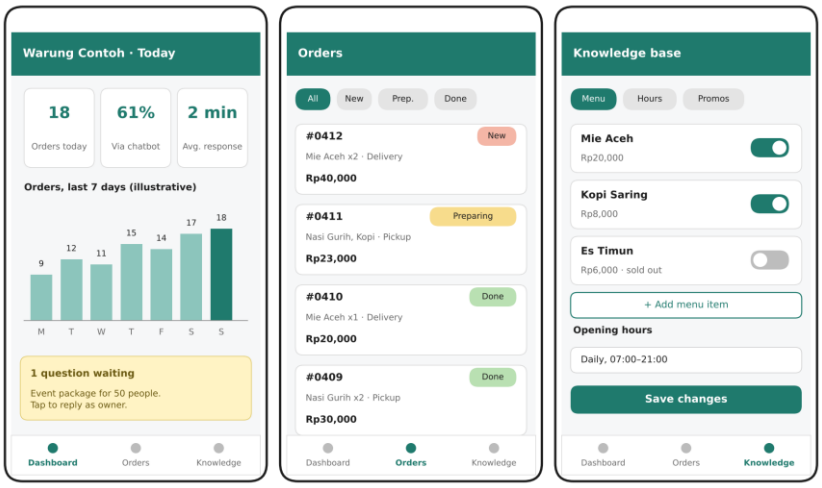

Figure 5. Interim prototype interface, owner side (Android): dashboard, orders, and knowledge base (illustrative data)

Evaluation framework and achievement indicators

The effectiveness of the model and the prototype will be assessed with the indicators in Table 6. The indicators are chosen because the MSMEs themselves can observe them: response time to customers, the number of orders received through the chatbot, and user satisfaction. Numeric targets will be set after a baseline measurement in the pilot MSMEs so that the targets are realistic.

Table 6. Achievement Indicators and Evaluation Framework for the Pilot

Indicator	Measurement	Instrument	Expected direction
Customer response time	Mean time (minutes) from incoming message to reply, before and after	Conversation logs; observation	Decrease
Orders through the chatbot	Share of orders received through the chatbot among all orders	Order records in the cloud	Increase
MSME user satisfaction	Owner satisfaction score for the tool (Likert 1–5)	Post-pilot questionnaire	Increase
Digital readiness	Technology, organization, and environment readiness score before and after training	Readiness questionnaire	Increase

Research outputs

The mandatory output is an article in a nationally accredited journal at SINTA level 3. Additional outputs are the technopreneurship and digital business strategy model, the AI application prototype design, IPR, and a training toolkit. The outputs of this stage are at TRL 1 with a target of TRL 2, and they continue the authors' earlier work on technopreneurship and AI (Fadhilah, 2024).

DISCUSSION

The design results show that AI integration in culinary MSMEs should start from a readiness diagnosis, not from the choice of a tool. This view is consistent with the TOE framework, which treats technology as one of three contexts of an adoption decision (Wulandari et al., 2022; Zahra et al., 2023). The five-component model adds an element that rarely appears in adoption studies: a value proposition based on local wisdom. This element comes from RBV. Without distinctive resources that are strengthened, AI yields only efficiency that competitors can easily copy. Hajiheydari et al. (2023) make a similar point: digital and sustainable business model innovation brings long-term benefits only when it is supported by dynamic capabilities.

Compared with studies of AI adoption barriers in culinary MSMEs (Dinul Khaq et al., 2024) and studies of digital literacy (Titin et al., 2024), this study goes one step further, from identifying barriers to designing an intervention that is tested. It also complements technopreneurship studies (Nugroho et al., 2025) by treating AI as a core technology. The choice of a WhatsApp chatbot agrees with the finding that generative AI can support service innovation in micro and small businesses (Ningsih & Tjahjono, 2024). Regional initiatives such as IoT-based monitoring for MSMEs in North Aceh (Darnila et al., 2025) show that technology-based mentoring is feasible in Aceh. The present model extends this direction to AI-supported services in culinary MSMEs. In terms of digital transformation, the design aims to go beyond digitalizing tools toward changing how customers are served, as Verhoef et al. (2021) stress. Involving the Cooperatives Office, associations, and business owners in the FGDs and workshops is also in line with the attention to the resilience of local food systems (Kneafsey et al., 2021).

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E-ISSN : 2807-9035
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https://doi.org/10.47709/brilliance.v6i4.10028

The practical implications are threefold. For MSMEs, the model offers a stepwise, low-cost adoption path. For government offices and associations, the diagnosis framework and the toolkit can serve as training material. For business mentors, the documentation of good practices and lessons learned can work as a knowledge map for MSMEs (Majapahit et al., 2025). In the long term, this study is the first step of a five-year roadmap: diagnosis and initial design in 2026, model development in 2027, capacity building and replication in 2028, scalability and supporting ecosystem in 2029, and program sustainability and long-term impact evaluation across Aceh in 2030.

This study has several limitations and threats to validity. First, this article reports only design outputs, so the effectiveness of the model cannot yet be concluded empirically. Second, purposive sampling and a small sample limit generalization to all culinary MSMEs in Aceh. Third, a pilot with 10–15 MSMEs and a pre–post design without a control group is exposed to confounding variables and novelty effects. Fourth, connectivity and device readiness may affect prototype performance. Fifth, the use of customer data requires careful privacy management in line with AI ethics principles (Corrêa et al., 2023). The planned mitigation includes data triangulation, a baseline measurement before implementation, and recording of disturbing conditions during the pilot.

CONCLUSION

This study answers the research question by designing a technopreneurship strategy integrated with AI for culinary MSMEs in Bireuen Regency. Its contributions are a conceptual framework that combines RBV, TOE, and technopreneurship; a five-component strategy model; an affordable WhatsApp chatbot design with an interim interface for customers and owners; and an evaluation framework built on observable indicators. The strategy is designed to be contextual, participatory, and sustainable, so it can speed up digital transformation and strengthen the competitiveness and resilience of the local economy. Further research should present empirical evidence from the survey, the FGDs, and the pilot, widen the sample and add a comparison group, and develop the prototype toward a higher technology readiness level and replication in other regions. For practitioners, the suggested first steps are to map business readiness, to start with a simple AI tool such as a customer service chatbot, and to prepare a data use guideline before more complex features are adopted.

ACKNOWLEDGMENT

The authors thank the Institute for Research and Community Service of Universitas Islam Kebangsaan Indonesia, the Bireuen Cooperatives and MSMEs Office, and the culinary MSME owners who agreed to become research partners.

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E-ISSN : 2807-9035
Volume 6, **Number** 4, November 2026
https://doi.org/10.47709/brilliance.v6i4.10028

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