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SUSTAINABILITY AND DIGITALIZATION INITIATIVES AMONG YOUNG MICRO-ENTREPRENEURS IN BATAAN: BASIS FOR PROPOSED BUSINESS STRATEGIC FRAMEWORK

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ABSTRACT

Continuous industrialization and rapid digital transformation have significantly changed economic activity and human well-being. Industrial Revolution 5.0, characterized by integrating technology with human values, calls for promoting young entrepreneurs to build businesses that are sustainable, socially responsible, and capable of contributing to inclusive economic growth by supporting the 2030 Sustainable Development Goals. This study examined sustainability practices across environmental, social, and economic dimensions; assessed digital adoption through digital awareness, technology, people, products or services, and business processes. The study also explored the experiences and challenges encountered in implementing sustainability practices and adopting digital technologies. The study used a mixed-methods approach, including survey responses from 88 young micro-entrepreneurs and in-depth interview with 22 participants. This study was completed during the Academic Year 2025-2026. The findings reveal a gap between awareness and strategic implementation. Sustainability efforts focus more on internal practices, while digitalization focuses on daily operational efficiency and external reach. Altogether, sustainability and digital integration remain in their early stages. To address this, the study proposes a business strategic framework that supports the progression from survival-oriented operations toward more integrated practices.

Keywords: *business model, business strategic framework, digitalization, digital adoption, micro-enterprise, sustainability, young micro-entrepreneurs.*

INTRODUCTION

Socioeconomic, technological, and cultural transformations have consistently shaped society and influenced the way people live. This transformation has advanced through several stages, from Industry 1.0, characterized by mechanization, to the present, Industry 5.0, which emphasizes human-centered industrial change. This transformation signifies a shift in economic value to societal value and from welfare to overall well-being. Because of the challenges the world faces today, business productivity is now closely tied to effectively managing environmental, social, and governance responsibilities; the report Our Common Future, which formulated the Sustainability Goals in 1987, marked a turning point. Collective action is needed to achieve sustainability goals. As sustainability is future-oriented, fostering youth empowerment by developing business models that solve problems emerging from industrialization is necessary. According to Osterwalder and Pigneur (2010), a business model outlines the logic behind how an organization creates, delivers, and captures value.

Entrepreneurial education plays an important role in developing entrepreneurial mindsets among young people (Saptono et al., 2020; Hildianto and Iswandari, 2021). In the Philippine context, many young entrepreneurs are shifting toward more sustainable practices, especially post-pandemic, depending on whether a business is driven by necessity or opportunity (Iannone and Caruso, 2023). For businesses transitioning to Industry 5.0, integrating sustainability and digitalization is crucial. A strong digital orientation can predict and drive sustainable digital innovation in SMEs (Yousaf et al., 2021). Acopiado et al. (2022) found that younger firms are more likely to adopt digital payments. These firms are generally more adaptable to change and aim for simpler yet sustainable business operations. Existing studies show that young entrepreneurs and newly established businesses are gradually shifting toward sustainable and digitally enabled business models. However, the extent of these initiatives needs to be studied to develop more inclusive and responsive businesses that will support the Sustainability Goals as next-generations.

Strategic business does not end with the defined strategy, measures and the actual sustainability performance is important. A sustainable business model succeeds when internal and external stakeholders follow it and benefit from it. It reflects the organization's environmental orientation, regulatory compliance, and responsiveness to internal and external pressures when integrated effectively (Latifah and Soewarno, 2023). Business owners must take responsibility, set clear sustainability goals, and dedicate resources to embed sustainability in their core strategy (Kannan and Gambetta, 2025).

Fajarika et al. (2024) highlight the need to explore how technology-driven entrepreneurship advances sustainable development at the microenterprise level, identifying innovation, technology, partnerships, entrepreneurial personality, and human capital as key factors influencing business growth. However, the relationship between these factors and sustainability outcomes remains insufficiently explored.

Consequently, digital adoption is also a variable in the study; technology capabilities enable entrepreneurs to work more efficiently, particularly through the use of applications and digital tools. Successful technology adoption also requires strong

leadership, where business leaders are expected to encourage employees to embrace new technologies Fajarika et al., 2024).

Technology capabilities are essential skills needed to stay competitive in Industry 4.0, the workforce must continually improve and update its skills to meet evolving industry demands. Cueto et al. (2022) examined the experiences and challenges of young entrepreneurs during the economic disruption caused by the pandemic. They found that both extrinsic and intrinsic factors drove digital innovations in MSMEs. Similarly, Mia et al. (2024) addressed the challenges Philippine MSMEs face and found that entrepreneurs need comprehensive training to use digital technologies effectively.

Although a considerable body of research has examined the relationship between entrepreneurship and sustainability, notable gaps exist, especially regarding youth entrepreneurship in developing regions such as Bataan. Much of the existing literature focuses on macro-level analyses or urban contexts, leaving limited insight into how youth entrepreneurs in provincial or localized settings implement sustainability principles. Consequently, empirical research is needed to examine how and up to what extent the young entrepreneurs in emerging communities incorporate sustainability-oriented business models into their businesses.

The study is conceptualized in relation to Peter Drucker's Theory of the Business (1994), which offers a useful framework for understanding how organizations shape their identity, purpose, and competitive advantage, grounded in main assumptions, which include assumptions about the external environment, assumptions about the organization's mission, and assumptions about core competencies. Cohen and Levinthal's (1990) Absorptive Capacity Theory supports these assumptions by defining absorptive capacity as a firm's ability to recognize the value of new external information, assimilate it, and apply it to commercial ends. Therefore, continuous adoption is necessary for business success. However, the focus on the sustainability dimension of social supports the Stakeholder Theory (1984); stakeholders are integral to creating value and enhancing organizational performance. The theory is relevant to the study as it emphasizes the need for organizations to adopt digital technologies not just for efficiency and profit, but also to create long-term, equitable value for all stakeholders, ensuring that digital transformation supports broader sustainability outcomes.

This significance extends beyond improved business operations, acknowledging the broader contribution of young micro-entrepreneurs to environmental, social, and economic value creation. The framework aims to reinforce the entire value creation cycle, from sourcing and production to value delivery and customer engagement. Ultimately, this study seeks to provide a practical reference for young micro-entrepreneurs, policymakers, educational institutions, and business support organizations to promote a resilient, sustainable community, and an inclusive entrepreneurial ecosystem in the Philippine context.

Research Questions

The study aimed to analyze the sustainability and digitalization initiatives among young micro-entrepreneurs in Bataan, as a basis for a proposed business strategic framework. Specifically, the study sought to answer the following questions:

1. How does the sustainability practices of Young Micro Entrepreneurs be defined in terms of:
    1.1 awareness of the owner;
    1.2 environmental sustainability;
    1.3 social sustainability;
    1.4 economic sustainability?
2. How does the digital adoption of Young Micro-Entrepreneurs be defined in terms of:
    2.1 digitalization awareness of the owner;
    2.2 technology;
    2.3 people;
    2.4 product/ service;
    2.5 process?
3. How may the experiences sustainability practices and digital adoption of Young Micro Entrepreneurs be described?
4. How may the challenges in sustainability practices and digital adoption of Young Micro Entrepreneurs be described?
5. Based on the results of the study, what sustainability and digitalization business strategic framework may be identified?

METHODOLOGY

Research Design

Although sustainability practices and digital adoption can be described quantitatively using measurable indicators, understanding how young entrepreneurs implement these practices, the challenges they encounter, and the factors that influence them requires qualitative inquiry. Consequently, a mixed-methods approach was considered appropriate. Dawadi et al. (2021) noted that mixed-methods research allows researchers to address both confirmatory and exploratory questions simultaneously. Integrating quantitative and qualitative data enhances the richness, validity, and reliability of findings through triangulation (Ahmed et al., 2024).

The study employed a convergent-concurrent design, in which quantitative and qualitative data were collected simultaneously but analyzed separately. This approach allowed both datasets to contribute equally to the research. After independent analyses, the results were integrated and compared during interpretation to identify convergence, divergence, and complementary insights between statistical trends and qualitative narratives and themes.

Population and Sample

The study respondents were young micro-entrepreneurs in the Province of Bataan aged 18 to 30 at the time of data collection. Researchers identified participants through various organizations that support youth entrepreneurship. Participants included individuals who owned or managed businesses operating under either formal or informal arrangements. Formal businesses referred to businesses that had complied with government registration and regulatory requirements. To ensure data relevance, the study included only participants who had operated a business for at least one year.

In the quantitative phase, purposive sampling was used to select participants based on accessibility and eligibility. Records from government-agency entrepreneurship programs from 2023 to May 2025 identified participants, and 66 were current students actively operating or managing businesses. The study also included an additional 22 graduates from various institutions engaged in entrepreneurial activities, for a total of 88 young entrepreneurs who met the study's inclusion criteria.

In the qualitative phase, the study also used purposive sampling to select participants who could provide detailed, relevant information aligned with the research objectives. A total of 22 young micro-entrepreneurs participated in the interviews. The study specifically utilized extreme case sampling, selecting participants with notable or exemplary characteristics relevant to the research Nyimbili and Nyimbili, 2024). The qualitative method selected participants based on their demonstrated sustainability practices, digital adoption initiatives, business stability, and entrepreneurial experiences. This approach enabled deeper insights into effective strategies and practices that could inform the development of the localized strategic business framework.

Research Instrument

The study used two research instruments for the quantitative and qualitative phases. The questionnaire was administered through face-to-face data collection. For the quantitative phase, a structured survey questionnaire with a 5-point Likert scale was used and had three (3) parts. Part I described Personal and Business Profile; Part II determined the sustainability practices of the respondents with indicators related to environmental, social, and economic sustainability; and Part III described the digital adoption of the respondents with indicators related to awareness, processes, products, people, and technology. For the qualitative phase, the study used a semi-structured interview guide with open-ended questions. This guide enabled participants to articulate their experiences, challenges, strategies, and perspectives regarding sustainability practices and digital adoption in their businesses.

Subject matter experts reviewed the survey questionnaires and interview guides to ensure that the questions were valid, appropriate, understandable, and free from potentially sensitive or harmful content.

Data Gathering Procedure

Before data collection, the researcher secured necessary permissions from educational institutions and relevant stakeholders. Requests for data and participant referrals were made in accordance with the provisions of the Freedom of Information Act and the Data Privacy Act. The researcher completed approval letters and coordination activities before conducting surveys and interviews.

The researcher personally administered the survey questionnaires and conducted face-to-face interviews with qualified participants. Before participation, respondents signed informed consent forms and received instructions regarding the survey and interview procedures.

The researchers distributed and collected the survey questionnaires during scheduled sessions. Participants had sufficient time to complete the questionnaire and were encouraged to seek clarification when needed. The participants answered the survey questionnaire for about 15-20 minutes. For the qualitative component, interviews were held at a time and location convenient for the respondents while ensuring privacy and comfort. Each interview lasted 10-15 minutes. Interviews continued until data saturation was achieved to address the research objectives.

The researchers collected completed questionnaires immediately after administration to ensure a high retrieval rate and minimize data loss. The researchers organized, reviewed, and prepared interview recordings and notes for subsequent analysis.

Statistical Treatment and Analysis of Data

For the quantitative data, frequency counts, percentages, and weighted means were used to assess respondents' sustainability orientation and digital adoption. The computed weighted means were ranked from highest to lowest. All statistical analyses and data organization were conducted using SPSS and Microsoft Excel.

For the qualitative component, thematic analysis followed Braun and Clarke’s six-phase framework. The process included: (1) familiarization with the data, (2) generation of initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final report. This method enabled the identification of recurring patterns and meaningful themes within participants’ responses.

Finally, the study triangulated quantitative and qualitative findings. The convergence of results strengthened the study's credibility by confirming, complementing, and enriching findings from both data sources. The data were systematically organized and analyzed according to thematic analysis procedures.

RESULTS

Part I. Sustainability Orientation of the Respondents

Table 1 presents the frequency, percentage weighted mean and verbal interpretation of overall sustainability orientation of the respondents.

Table 1 Overall Sustainability Orientation of the Respondents

Sustainability Orientation	f	%	Weighted Mean	Verbal Interpretation
Awareness of the Owner	88	100 %	3.63	Good
Social Sustainability (Table 2)	88	100 %	3.49	Good
Environmental Sustainability (Table 3)	88	100 %	3.42	Good
Economical Sustainability	88	100 %	3.35	Average
Overall			3.47	Good

Note: 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree. ***Legend of the Verbal Interpretation of the Weighted Mean:*** *1.00 to 1.79 = Poor, 1.80 to 2.59 = Fair, 2.60 to 3.39 = Average, 3.40 to 4.19=Good, and 4.20 to 5.00 = Excellent*

Table 2 presents the frequency, percentage weighted mean and verbal interpretation of the social sustainability of the respondents on employees and community.

Table 2 Social Sustainability of the Respondents

Social Sustainability	f	%	Weighted Mean	Verbal Interpretation
People in my organization	88	100 %	3.74	Good
CSR activities	88	100 %	3.24	Average
		Overall	3.49	Good

Note: 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree. ***Legend of the Verbal Interpretation of the Weighted Mean:*** *1.00 to 1.79 = Poor, 1.80 to 2.59 = Fair, 2.60 to 3.39 = Average, 3.40 to 4.19=Good, and 4.20 to 5.00 = Excellent*

Table 3 presents the frequency, percentage weighted mean and verbal interpretation of the environmental sustainability of the respondents.

Table 3 Environmental Sustainability of the respondents

Environmental Sustainability	f	%	Weighted Mean	Verbal Interpretation
Use of Environmental Friendly or Natural Products	88	100 %	3.52	Good
Waste Management	88	100 %	3.43	Good
Energy and Fuel Consumption	88	100 %	3.32	Average
Water Saving	88	100 %	3.27	Average
		Overall	3.42	Good

Note: 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree. ***Legend of the Verbal Interpretation of the Weighted Mean:*** *1.00 to 1.79 = Poor, 1.80 to 2.59 = Fair, 2.60 to 3.39 = Average, 3.40 to 4.19=Good, and 4.20 to 5.00 = Excellent*

Part II. Digital Adoption of the Respondents

Table 4 presents the frequency, percentage weighted mean and verbal interpretation of overall digital adoption of the respondents.

Table 4 Digital Adoption of the Respondents

Digital Adoption	f	%	Weighted Mean	Verbal Interpretation
People	88	100 %	3.81	Good
Product / Service	88	100 %	3.79	Good
Technology	88	100 %	3.65	Good
Process	88	100 %	3.56	Good
Digitalization Awareness of the Owner	88	100 %	3.51	Good
Overall			**3.66**	**Good**

Note: 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree. ***Legend of the Verbal Interpretation of the Weighted Mean:*** *1.00 to 1.79 = Poor, 1.80 to 2.59 = Fair, 2.60 to 3.39 = Average, 3.40 to 4.19=Good, and 4.20 to 5.00 = Excellent*

Part III. The experiences of Young Micro Entrepreneurs Sustainability Practices and Digital Adoption

Sustainability Practices

The key themes identified according to the Sustainability experiences of Young Micro entrepreneurs in implementing sustainability practices are: (1) business strategy and culture, (2) community & customer engagement, (3) financial management, (4) environmental practices, and (5) product development.

Table 5 presents the theme emerged in sustainability experience of the participants in terms of business strategy and culture.

Table 5 Theme 1: Business Strategy and Culture

Participant	Response	Category
P8	Training and inclusive work culture	Employee Education and Training
P17	Educating staff to reuse materials; refillable packaging	Employee Education and Training
P14	Need to promote sustainability internally	Employee Education and Training
P10	Educating both internal and external stakeholders	Employee Education and Training
P4	Lack cuctainable practices implementation	Employee implementation
P16	Sustainability becomes a company habit once it is consistent	Employee implementation
P6	Environmental practices must start internally	Employee implementation
P9	Employee participation in the 7Rs of waste management is needed	Employee implementation
P15	Part of personal values of the employees	Employee implementation
P5	Sustainability embedded in employee culture promotes efficiency and resource savings.	Employee implementation

Ten participants identified business strategy and organizational culture as key to sustainability. They stressed the importance of educating employees about sustainable practices and encouraging their active participation in implementing these initiatives.

Table 6 presents the theme emerged in sustainability experience of the participants in terms of community and customer engagement.

Table 6 Theme 2: Community and Customer Engagement

Participant	Response	Category
P2	Focus on customer relationships and satisfaction	Customer Relationsip
P6	Customer satisfaction is the priority	Customer Relationsip
P7	Eco-friendly efforts must align with customer preferences	Customer Relationsip
P15	Understanding customer and employee needs	Customer Relationship and Employee Fairness
P20	Fairness to employees noted, but no broader outreach yet	Employee Fairness
P13	Sourcing locally, identifying customer needs	Local Suppliers
P8	Supporting locally available materials	Local Suppliers
P14	Locally sourcing of raw materials	Local Suppliers
P1	Community outreach, feeding programs, and school donations	Community engagement

Nine participants emphasized that sustainable practices strengthened relationships with stakeholders, including customers, employees, suppliers, and the local community.

Table 7 presents the theme emerged in sustainability experience of the participants in terms of financial management.

Table 7 Theme 3: Financial Management

Participant	Response	Category
P17	Monitors expenses to stay within budget and maintain stability	Monitoring and Record Keeping
P20	Prioritizes daily operations and expense monitoring	Monitoring and Record Keeping
P6	Organizing, budgeting, and records help sustain profits	Monitoring and Record Keeping
P8	Cost-cutting via recycling and sourcing local materials	Cost Efficiency
P9	Saves money by reducing utility consumption	Cost Efficiency
P5	Sustainability becomes a culture, influencing long-term finances and the economy.	Cost Efficiency
P13	Materials are local sourced and low cost	Cost Efficienvy
P14	Looking for investors to sustain the business	Financial Support Needs
P15	Looking for government programs for financial support	Financial Support Needs

Nine participants highlighted financial management as an important sustainability practice. They emphasized monitoring and record-keeping, implementing cost-efficient measures, and the need for financial support to sustain and expand their businesses.

Table 8 presents the theme emerged in sustainability experience of the participants in terms of environmental practices.

Table 8 Theme 4: Environmental Practices

Participant	Response	Category
P1	Waste segregation and recycling	Waste Minimization
P3	Reducing paper use, lowering electricity use, and going paperless	Waste Minimization
P5	Waste disposal and disposal of non-functional assets	Waste Minimization
P8	Recycling and eco-friendly habits	Waste Minimization
P17	Refillable packaging to reduce single-use waste	Waste Minimization

Five participants emphasized environmental practices as part of their sustainability efforts. They primarily focused on waste minimization by reducing, reusing, and properly managing business waste.

Table 9 presents the theme emerged in sustainability experience of the participants in terms of product development.

Table 9 Theme 5: Product Development

Participant	Response	Category
P18	Considering sustainable ingredients as product development	Product Development
P19	Added Value of the sustainable ingredients	Product Development

Two participants described innovation as an important sustainability practice. They highlighted product development by improving existing products and introducing new offerings to meet changing customer needs.

Digital Adoption

The themes identified according to the experiences of Young Micro entrepreneurs in digital adoption are: (1) operational efficiency, (2) enhanced marketing, and (3) technology learning curve.

Table 10 presents the theme emerged in experience in digital adoption of the participants in terms of operational efficiency.

Table 10 Theme 6: Operational Efficiency

Participant	Response	Category
P2	Digital tools sped up tasks and improved productivity.	Efficiency on Daily Operations
P3	Enabled smooth, secure operations through tech; ensured peace of mind.	Efficiency on Daily Operations
P21	Streamlined processes	Efficiency on Daily Operations
P17	A digitized supply chain makes product delivery and production more efficient.	Efficiency on Daily Operations

P3	Efficient monitoring of finances	Record Keeping
P4	Utilize tools like Excel to manage data	Record Keeping
P22	It has helped us since we monitor daily operations using spreadsheets	Record Keeping
P5	AI reduced the need to hire and saved time.	Labor Efficiency
P12	Improved reach while reducing operational costs.	Labor Efficiency

Nine participants shared that digital adoption improved operational efficiency. They reported greater efficiency in daily operations, better record-keeping, and reduced labor through digital tools.

Table 11 presents the theme emerged in experience in digital adoption of the participants in terms of enhanced marketing.

Table 11 Theme 7: Enhanced Marketing

Participant	Response	Category
P1	Leveraged digital marketing to understand and encourage customer	Customer Reach
P7	Online platforms helped reach more customers	Customer Reach
P16	Only applies digital tools in marketing	Customer Reach
P11	Used social media mainly for promotions;	Customer Reach
P15	Digital tools helped in finding more potential customers.	Customer Reach
P9	Expanded customer base digitally	Customer Reach
P18	Uses basic tools like Facebook to reach the customer	Customer Reach

Seven of the twenty-two participants reported that digital adoption enhanced their marketing efforts by expanding customer reach. They used digital platforms to promote products, communicate with customers, and attract a wider market.

Table 12 presents the theme emerged in experience in digital adoption of the participants in terms of technology learning curve.

Table 12 Theme 8: Technology Learning Curve

Participant	Response	Category
P8	Acknowledges lack of skills in using modern apps; plans to study.	Gradual Digital Adoption
P13	Struggles with unfamiliar digital tools and platforms.	Gradual Digital Adoption
P10	Can use basic tech but struggles with high-tech systems.	Gradual Digital Adoption
P18	still transitioning to complete digitalization.	Gradual Digital Adoption
P15	Started with basic online promotion as a first step into digital transformation.	Gradual Digital Adoption

Five participants described digital adoption as a gradual learning process. They emphasized the need to keep learning and adapting to new technologies before fully integrating digital tools into their business operations.

Part IV. The challenges of Young Micro Entrepreneurs in terms of sustainability practices and digital adoption.

The themes generated for both sustainability and digital adoption show similarities. Namely: (1) Lack of Awareness and Education, (2) Resistance to Change, (3) Financial Management Knowledge, (4) Knowledge and Skills Gap, (5) Financial Constraints.

Table 13 presents the theme emerged in challenges in sustainability and digital adoption of the participants in terms of lack of awareness and education of both employees and customers.

Table 13 Theme 9: Lack of Awareness and Education

Participant	Response	Category
P1	Sustained training and reinforcement are necessary for building a sustainability culture.	Employees
P17	Teach and supervise them to ensure that sustainability practices are being followed	Employees
P9	Initial education on sustainability practices is hard to sustain without supervision.	Employees
P10	Lack of awareness externally and internally	Employees(1) customer (2)
P14	Lack of knowledge about sustainable products limits adoption	Customer Knowledge
P6	Customer preferences make it hard to stick to sustainable long term strategy	Customer Knowledge
P12	Low awareness and openness to sustainability among people	Customer Knowledge
P15	Educating others about sustainability and product value is challenging	Customer Knowledge

Eight participants emphasized that sustainability and digital adoption require continuous learning and adaptation before digital tools can be fully integrated into business operations. Participants also noted that both employees and customers need greater awareness and knowledge of sustainable business practices.

Table 14 presents the theme emerged in challenges in sustainability and digital adoption of the participants in terms of resistance to change of the customer.

Table 14 Theme 10: Resistance to Change of the Customer

Participant	Response	Category
P3	Older customers resist sustainability initiatives; it is hard to change their mindset.	Resistance of the Customer
P4	Resistance and undisciplined behavior make it challenging to implement sustainability.	Resistance of the Customer
P5	Resistance to change among people hinders sustainability efforts	Resistance of the Customer
P8	Resistance to change and a lack of customer engagement limit sustainability	Resistance of the Customer
P12	Employees lack initiative and ownership in sustainability efforts	Resistance of the Customer
P16	Customers still lack concern for the environment; the mindset change is slow.	Resistance of the Customer
P7	Customers prefer familiar products over eco-friendly alternatives	Resistance of the Customer

P13	Some people are hesitant to buy it	Resistance of the Customer

Eight participants described resistance to change as a sustainability challenge. They highlighted that many customers are reluctant to adopt and explore sustainable products, making it difficult for businesses to promote environmentally friendly alternatives.

Table 15 presents the theme emerged in challenges in sustainability and digital adoption of the participants in terms of barriers in knowledge in costing and financial management.

Table 15 Theme 11: Barriers in Financial Management Knowledge

Participant	Response	Category
P16	Basic accounting knowledge; unsure of pricing/costing accuracy	Knowledge in Costing and Financial Management
P12	Lack of knowledge in managing finances	Knowledge in Costing and Financial Management
P10	Views finance management as crucial for long-term growth and profitability	Knowledge in Costing and Financial Management

Three participants emphasized the lack of knowledge in costing and financial management. While some participants possessed basic financial management skills, they acknowledged the need for further learning to manage business finances effectively.

Table 16 presents the theme emerged in challenges in digital adoption of the participants in terms of knowledge and skills gap.

Table 16 Theme 12 Knowledge and Skills Gap in Digital Adoption

Participant	Response	Category
P7	Limited knowledge of digital tools; overwhelmed by technology	Limited Knowledge
P10	Basic digital skills only; it is not easy to engage the audience online	Limited Knowledge
P11	Intimidation and lack of comfort with new technology	Limited Knowledge
P14	Limited knowledge about digital adoption	Limited Knowledge
P15	Unfamiliarity with social media platforms	Limited Knowledge
P18	Lack of technical skills among staff limits adoption	Limited Knowledge
P4	Adaptation to new tools takes patience and persistence	Learning Curve
P2	Digital adoption requires attention, time, and effort	Learning Curve
P13	Familiarity with tools takes time, especially with constant changes	Learning Curve
P9	Rapid technology updates require continuous learning and adaptation	Learning Curve
P11	It requires patience and effort learning new things about technology and digitalization, especially if you're not very tech-savvy.	Learning Curve

11 participants described the knowledge and skills gap as a challenge in digital adoption.

Table 17 presents the theme emerged in challenges in sustainability and digital adoption of the participants in terms of financial constraints in technology and sustainable alternative materials.

Table 17 Theme 13 Financial Constraints

Participant	Response	
P6	High capital needed for technology upgrades	Financial Constraints in Technology
P8	Initial costs of implementing technology are significant	Financial Constraints in Technology
P12	The cost of the internet and equipment like cameras is high	Financial Constraints in Technology
P20	Budget constraints limit the ability to upgrade digital systems	Financial Constraints in Technology
P22	Costly subscription systems and long learning time hinder adoption	Financial Constraints in Technology
P3	Upgrading digital equipment is an ongoing, costly process	Financial Constraints in Technology
P7	Sustainable products and alternatives are often expensive	Cost of Sustainable Alternatives
P18	Higher upfront costs prevent the adoption of sustainable options	Cost of Sustainable Alternatives

Six participants described financial constraints as a challenge in digital adoption. Two participants emphasized the challenge of sustainability practices because sustainable alternatives are costly.

Part V. The Sustainability and Digitalization Business Strategic Framework

Findings suggest that the sustainability framework therefore views sustainability practices as essential inputs for value creation, achieved through sustainable products, improved processes, and responsible use of resources. It also supports value delivery by providing environmental and social benefits to customers and stakeholders, and enables value capture through efficient operations, responsible supplier relationships, and long-term financial stability.

Accordingly, the framework combines sustainability orientation and digital adoption, treating them as interconnected rather than separate concerns. The study developed a three-level strategic framework, which is:

The 1st level is the Basic stage, where sustainability and digital adoption are largely awareness-based rather than strategically implemented. Businesses at this level rely on basic digital tools and implement simple sustainability initiatives for operational survival.

The 2nd level is the Developing Stage, where businesses have developing systems and structured efforts. Businesses begin becoming more proactive through process improvements, workforce development, and improved customer engagement.

The 3rd level is the Integrated Stage, where businesses have more strategic, data-driven, and sustainability-oriented practices. Sustainability and digitalization are integrated in business operations, decision-making, and growth strategies.

DISCUSSION

Sustainability

The convergence of quantitative and qualitative findings provides a comprehensive understanding of how young micro-entrepreneurs practice and implement sustainability and digital adoption within their business operations.

In terms of sustainability awareness of the respondents in Table 1, it indicates that respondents demonstrate “good” a level of awareness reflected in their overall score of weighted mean 3.47.

The findings indicate that respondents has the highest level of awareness general sustainability as reflected in their overall score of weighted mean 3.63 and interpreted as “good”.

The findings further converge under the theme of business strategy and culture (Table 3). Quantitative data on owner awareness suggest that entrepreneurs possess foundational knowledge of sustainability. This is complemented by qualitative insights indicating that sustainability is gradually being viewed as part of business strategy and organizational culture. The result was supported by a study by Iannone and Caruso (2023), who emphasized that there is an increasing trend toward minimizing waste and adopting long-term, sustainable business models as many young entrepreneurs in the Philippines shift toward more sustainable practices, Furthermore, the findings are also aligned with the ASEAN (2025) report, which emphasized that younger and more highly educated individuals tend to demonstrate greater awareness and acceptance of sustainable and environmentally friendly products.

Social sustainability, specifically presented in Table 2 had an overall weighted mean of 3.49 or good interpreted as good level. This indicates that respondents demonstrated an understanding of social sustainability through their business practices, particularly in community engagement or CSR and maintaining fair relationships with employees. Themes such as local stakeholder prioritization and employee fairness emerged strongly (Table 6). Community engagement activities CSR had a weighted mean of only 3.24, indicating “average” performance. The findings of the study indicate that young micro-entrepreneurs have greater emphasis on internal social sustainability practices with a weighted mean of 3.74 or “good”. Particularly inclusive hiring, employee development, and employee engagement. At the same time, partnership with government agencies, non-government organizations, and other external engagement remains less practiced.

However, there are qualitative narratives and themes that shown the challenges in social sustainability implementation. Sustainability implementation is not fully integrated in the business due to the lack of awareness and education of both employees and customer in sustainability as Table 13 presented.The present findings also support the observation of Latifah and Soewarno (2023), effectiveness of waste management practices is often limited by awareness, inadequate training, and weak managerial capabilities.

Environmental sustainability which is specifically presented in Table 3 with an overall weighted mean of 3.42 indicates that the respondents have a “good” performance in practicing environmental sustainability. The results show that respondents' businesses have adopted eco-friendly workplace practices to a good extent, as evidenced by an overall weighted mean of 3.52, interpreted as “good”. This indicates that young micro-entrepreneurs have mindfulness in integrating environmentally sustainable practices into their daily operations. These findings are contrast with the study of Empas et al. (2025), eco-friendly packaging ranked lower than other environmental sustainability practices.

For waste management (Table 3), the findings show that respondents' businesses show effective waste management and sustainability practices with an overall weighted mean of 3.43 which interpreted as “good”. This shows that most businesses are actively involved in waste reduction initiatives though the implementation varies among specific practices. Among the indicators, proper waste segregation received the highest rating. Some practices were also rated as “good” which are reusing materials within the business, regularly reviewing processes, repurposing old materials and repair. These results show that businesses are making efforts to extend the lifecycle of materials and reduce waste. Theme on environmental practices (Table 8) supports the qualitative findings.

However, the lowest practice is seeking partnerships to sell or donate residual materials. This shows that external partnership for waste management and value recovery is not widely practiced.

These findings are consistent with the study of Empas et al. (2025) waste management was the most implemented environmental sustainability practice among MSMEs. Tereshchenko et al. (2023) integrating waste reduction, resource conservation, and eco-innovation can strengthen the sustainability of MSMEs.

The findings of the study also reveal that the respondents’ businesses demonstrate a moderate level of engagement in energy-related sustainability practices. As indicated by the weighted mean of 3.32, interpreted as “average”. This indicates many businesses are transitioning toward more energy efficient technologies but not yet consistent among businesses or not yet implemented fully.

A notable findings also is that businesses tend to adopt low-cost and easily implementable energy-saving practices as presented in theme environmental practices (Table 8), while more resource-intensive and long-term sustainability investments remain less widely practiced these and considered a challenge as theme financial constraints shown in table 13.

These findings are contrast with the study by Empas et al. (2025) that energy efficiency was one of the most widely implemented environmental sustainability practices.

These studies show that MSMEs the adoption of long-term and more sustainable energy solutions remains limited even though they acknowledge the value of energy efficiency and have begun implementing basic conservation practices.

Lastly, the results in relation to water conservation practices indicate that respondents' businesses demonstrate an "average" level with a weighted mean of 3.27. This shows that practices are not yet consistent even though some efforts are being made to conserve water.

These findings are contrast with the study by Empas et al. (2025) that found that water conservation was one of the most widely implemented environmental sustainability practices. However, Kabbera et al. (2024) emphasized that integrating water conservation and other environmental sustainability practices into business operations supports not only environmental protection but also business growth.

The results reveal that respondents have a moderate level of financial or economical sustainability practices (Table 1). As reflected by the overall weighted mean of 3.35 or "average" level. This indicates that businesses demonstrate awareness of financial management strategies. The findings suggest that businesses are financially aware but still developing strategic financial management, as Table 7 with a theme financial management shown. Also, emphasis on financial planning, and access to financial support systems is necessary to strengthen long-term economic sustainability.

However, financial management knowledge also considered as gap of some young micro-entrepreneurs as Table 13 presents.

The present research acknowledges the research by Munandar et al. (2025) emphasizing the economic dimension of sustainability and economic impacts can enhance competitiveness even for SMEs. However as Table 17 presents with a theme of financial constraints such as cost of technology upgrades and cost of sustainable raw materials limit the respondents' competitiveness to support strategic financial management for economical sustainability.

Innovation also emerged as a convergent theme, particularly in product development (Table 9). Respondents incorporate sustainability into their products by using local, environmentally friendly, and value-added inputs. This enhances product value. However, findings suggest that customer resistance to change (Table 14) is a significant barrier. This reflects a gap not only in business practices but also in consumer awareness and acceptance of sustainable products.

Digital Adoption

The results indicate the respondents have a "good" level of digital adoption with an overall weighted mean of 3.66. The respondents demonstrate a "good" level of human resource support (Table 4, people) for digital adoption, with a weighted mean of 3.81.

This suggests that businesses recognize the importance of equipping their workforce with digital competencies. Businesses also acknowledge the importance of continuous learning and regular upskilling to keep pace with rapid technological advancements, even as challenges in employee knowledge and the learning curve for digital adoption emerge, as presented in Table 16.

Related literature also identifies these gaps; Mia et al. (2024) recommend implementing extensive training programs to help entrepreneurs use digital technologies effectively. Cueto et al. (2022) identified a need for capacity-building initiatives because the pandemic triggered a digital transition and made digital skills essential today. Saryani et al. (2022) noted that young entrepreneurs must learn continuously to remain competitive amid technological advancements in Industry 4.0.

The results show that respondents demonstrate a “good” level of digital adoption in terms of product delivery and customer service, with a weighted mean of 3.79 as presented in Table 4 (product or service). This shows that respondents recognize innovation as an important factor of business growth and customer satisfaction. Businesses use data-driven strategies to develop their products and services. Businesses understand the value of integrating customer service and improving customer experience. However, implementation may vary in consistency and intensity of use.

The findings align with Martínez-Peláez et al. (2023): digital transformation requires MSMEs to develop organizational capabilities, adopt appropriate technologies, and maintain a strategic focus on customers and stakeholders. Marmol (2024) local producers need to adapt their marketing strategies and platforms to changing customer and market demands.

Digital technology adoption has a weighted mean of 3.65, interpreted as “good.” Businesses use advanced transactions only to a limited extent, even though they have strong access to basic digital devices, particularly mobile and portable technologies.

The qualitative findings support this gap, specifically limited knowledge and a learning curve (Table 16) in terms of time and effort to learn new technologies among employees, as it indicates that despite recognizing the importance of digitalization, some employees may be hesitant to adopt new technologies; financial constraints (Table 17) in adopting advanced technology are also a factor in this gap.

Use of advanced technology is a potential barrier to full digital transformation. This aligns with Yousaf et al. (2021): access to technology is not enough; businesses need to understand how to apply it strategically to integrate digital tools into operations. The limited use of formal digital systems shows a lack of digital orientation and capability among businesses.

In terms of digital adoption in process, respondents show a “good” level of operational (process) digital adoption, with a weighted mean of 3.56. This shows that businesses are integrating digital practices in their operations while also recognizing the importance of safeguarding their digital assets. Some businesses are beginning to align

with modern financial technologies to improve transaction efficiency and customer convenience. Respondents are also aware of the risks of digital operations. However, many businesses do not consider most external service providers.

In contrast, respondents did not recognize this in the qualitative study. Table 10 shows that digital adoption in process only supports the theme of operational efficiency by streamlining processes and record-keeping.

These findings align with Acopiado et al. (2022): younger, growth-oriented firms are more likely to adopt digital payment systems. Adoption is often motivated by operational efficiency and advancement. Yousaf et al. (2021) found a connection between a firm's digital orientation and its use of digital payment systems, which allows sustainable digital innovation.

Lastly, respondents reported an overall weighted mean of 3.51 for digitalization awareness, indicating a "good" level. This shows that many respondents are not only familiar with basic digital tools but also understand more advanced technological concepts. This result suggests that businesses can gain a competitive advantage through innovation and digital transformation.

Conversely, qualitative findings indicate that a significant barrier is advanced technology and a learning gap (Table 16). Yet, the narrative in Table 12 acknowledges willingness and support for their gradual learning process. This supports Fajarika et al. (2024): technology adoption also requires strong leadership to embrace new technologies.

The convergence analysis reveals that sustainability and digital adoption are interconnected processes. They share similar enabling factors and constraints. Both require knowledge, financial resources, and behavioral change for effective implementation. Despite existing challenges, respondents show a positive attitude and openness to innovation. They recognize the potential of sustainability and digitalization to enhance value creation, delivery, and capture within their business.

Findings suggest that while young micro entrepreneurs are in the early stages of adopting sustainable and digital practices, there is strong potential for growth through program interventions in education, financial support, and capacity building.

Business Strategic Framework

The sustainability framework is supported by Drucker's Theory of the Business, which explains the importance of understanding customer needs, the external environment, organizational mission, and core competencies. It is also supported by Stakeholder Theory that emphasizes the role of internal and external stakeholders in achieving sustainable business.

The sustainability framework therefore views sustainability practices as essential inputs for value creation, achieved through sustainable products and responsible use of resources. It also supports value delivery by providing environmental and social benefits

to customers and stakeholders. It also enables value capture through efficient operations and long-term financial stability.

The findings also indicate that micro-entrepreneurs are still at an early stage of sustainability adoption. As most practices concentrated on internal operations and aimed at supporting daily business functions and survival. Although they are aware of sustainability and have adopted certain practices. These actions have not yet evolved into strategically integrated approaches.

In comparison, digitalization is applied more broadly to daily operation efficiency and external business activities specifically, in expanding market reach, customer communication, and product promotion. The entrepreneurs face ongoing challenges in integrating digital technologies into their internal business processes.

The digitalization strategic framework is supported by the Absorptive Capacity Theory of Cohen and Levinthal (1990). This explains the importance of acquiring, assimilating, transforming, and applying knowledge to improve organizational capabilities and performance. The findings show good levels of awareness, technology use, people readiness, product and service development, and process digitalization.

Addtionally, the proposed framework supports previous literature, the present study validates the of role of entrepreneurial education is important developing entrepreneurial mindsets among young people (Saptono et al., 2020; Hildianto and Iswandari, 2021). Sustainable and digitally enabled business is a collective reponsibility of both internal and external pressure, Latifah and Soewarno (2023). Young micro-entrepreneurs show awareness and have started to implement relevant practices but these efforts are more operational and not yet fully implemented in their business. Business owners set clear sustainability goals into their core strategy, Kannan and Gambetta (2025). The present findings shows young entrepreneurs have an awareness, practical initiatives and leadership.

Conclusions

Young micro-entrepreneurs in Bataan build sustainable, digitally enabled businesses using limited, practical, low-cost strategies rather than comprehensive, strategic initiatives.

The framework considered digitalization and sustainability, treating them as connected rather than separate concerns. The present sustainability framework focuses more on internal factors, business culture, sustainable inputs consideration, and employee fairness and welfare. In contrast, the present digitalization framework focuses more on daily operational efficiency and external factors, such as marketing and customer reach. Although the two frameworks emphasize different areas, they can be integrated into a holistic strategic approach to strengthen the sustainability and digital maturity of young micro-entrepreneurs and prepare them for Industry 5.0.

Ultimately, Industry 5.0 calls for integrating technology and human values, enabling young entrepreneurs to build businesses that are innovative, sustainable,

socially responsible, and capable of contributing to inclusive economic growth and achieving the 2030 Sustainable Development Goals.

The proposed sustainability and digitalization framework offer a strategic foundation for transforming young micro-entrepreneurs' business to become more socially and environmentally responsible.

Recommendations

Based on the study's findings and conclusions, the following recommendations are proposed to strengthen the sustainability practices and digital adoption of young micro-entrepreneurs in the Province of Bataan.

Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) through entrepreneurship and digital capability development; SDG 8 (Decent Work and Economic Growth) by strengthening youth entrepreneurship and business competitiveness; SDG 9 (Industry, Innovation and Infrastructure) by promoting digital transformation and innovation; SDG 12 (Responsible Consumption and Production) through the adoption of sustainable and circular economy practices; and SDG 17 (Partnerships for the Goals) by encouraging collaboration among educational institutions, government agencies, businesses, and other stakeholders to foster sustainable and digitally enabled entrepreneurial ecosystems.

1. Young Micro-Entrepreneurs

Young micro-entrepreneurs are encouraged to continuously strengthen their sustainability practices and digital adoption initiatives that provide value to the business.

For sustainability, young entrepreneurs are encouraged to strengthen a stronger sustainability orientation by developing personal values, ethical responsibility. Additionally, they are also encourage to cultivate external environmental stewardship and social responsibility

For digital adoption, young entrepreneurs should focus on enhancing their technical knowledge and digital competencies to utilize the capabilities of available technologies fully. They are encouraged to explore digital tools more strategically by maximizing their use for business planning, customer relationship management, financial management, operational efficiency, innovation, and business growth.

Continuous learning and active participation in sustainability and digital capability-building programs are likewise encouraged to enhance entrepreneurial competencies, improve business resilience, and support long-term competitiveness and sustainable growth.

2. Training and Capability Development Based on Maturity Levels

Since most respondents were categorized under Level 1 (Basic/Awareness Stage), training interventions should be progressive and aligned with young micro-entrepreneurs' maturity level. Capacity building programs may gradually transition entrepreneurs from foundational awareness toward strategic sustainability and digital integration.

Table 18 presents the capability building program for level 1 or basic stage.

Table 18 Level 1: Basic Stage Capability Building Program

Level and Goal	Expected Outcome	Leadership	Environmental Sustainability	Social Responsibility and Workplace Ethics	Financial Management	Digitalization
Level 1: Basic / Awareness Stage To build awareness, strengthen foundational business discipline, develop sustainability consciousness, and improve basic digital competencies.	Young entrepreneurs become more aware of sustainability concepts and are able to utilize basic digital tools to improve day-to-day business management.	● Opportunity recognition ● Problem-solving and resilience ● Sustainable entrepreneurship awareness ● Growth mindset for young entrepreneurs	● Proper waste segregation and disposal ● Basic recycling and waste reduction practices ● Sustainable packaging awareness ● Energy-saving practices for micro-businesses ● Introduction to environmentally responsible entrepreneurship.	● Fair employee treatment ● Inclusive and community-based hiring ● Customer relationship basics ● Ethical business practices	● Financial literacy and budgeting ● Basic bookkeeping and cash flow management ● Cost-saving strategies for micro-enterprises ● Pricing and profit fundamentals	● Smartphone productivity for business ● Basic social media usage for business (Facebook, Messenger, Instagram) ● Digital communication and online customer interaction ● Introduction to spreadsheets for simple record-keeping

Table 19 presents the capability building program for level 2 or developing stage.

Table 19 Level 2: Developing Stage

Level and Goal	Expected Outcome	Leadership	Environmental Sustainability	Social Responsibility and Workplace Ethics	Financial Management	Digitalization
Level 2: Developing / Structured Stage To strengthen business systems, improve operational efficiency, and integrate sustainability and digital tools into business processes.	Entrepreneurs establish more structured operations, improve efficiency, and begin incorporating sustainability into strategic business decisions.	● Team communication and conflict management ●. Employee training and motivation ● Design thinking for entrepreneurs	● Circular economy principles for MSMEs ● Waste management partnerships ● Sustainable sourcing and procurement ● Green business practices and eco-efficiency ● Resource optimization	HR ● Basic HR policies and documentation Community and CSR Engagement ● Community partnership building ● Local environmental initiatives ● Youth entrepreneurship networking.	● Cost tracking and operational efficiency ● Budgeting for sustainability investments ● Business planning and goal setting ● Risk management for MSMEs	● Digital inventory management ● Cloud-based record keeping ● E-wallet and cashless payment systems ● POS system training ● Basic business analytics and reporting

Table 20 presents the capability building program for level 3 or integrated stage.

Table 20 Level 3: Integrated Stage

Level and Goal	Expected Outcome	Leadership	Environmental Sustainability	Social Responsibility and Workplace Ethics	Financial Management	Digitalization
Level 3: Advanced / Integrated Stage To develop strategic, innovative, and scalable enterprises through advanced sustainability integration and digital transformation.	Entrepreneurs become more competitive, innovation-driven, and strategically capable of embedding sustainability and digitalization into long-term business growth.	**Strategic Leadership** ● Change management ● Innovation leadership ● Strategic decision-making ● Building organizational culture ● Mentoring and coaching employees	**Advanced Sustainability and ESG** ● Sustainability strategy development ● Environmental, Social, and Governance (ESG) basics for MSMEs ● Circular economy implementation ● Sustainable supply chain management	**Business Growth and Scaling** ● Investment readiness ● Partnership and stakeholder management ● Government and CSR collaboration ● Expansion planning and scalability	**Impact Measurement** ● Sustainability metrics and KPIs ● Social impact assessment ● Data-driven performance evaluation ● Business intelligence dashboards	**Advanced Digital Transformation** ● Data analytics for decision-making ● CRM systems and analytics ● AI tools for productivity and marketing ● E-commerce and omnichannel Innovation and Product Development ● Service customization using technology ● Business model innovation.

3. Educational Institutions

Educational institutions should strengthen entrepreneurship education by adding sustainability and digitalization into the curriculum. Experiential learning programs may also be part of curricular activities. Entrepreneurship education should consider the environmental, social, and economic dimensions of sustainability, along with digital competencies. This helps to explore their creativity and opportunity recognition through practical real-world application.

Furthermore, institutions should establish mentorship programs, business incubators, entrepreneurship boot camps, and industry partnerships. This enables students and out-of-school youth to develop sustainable, digitally enabled business solutions that address community and market needs.

4. Policymakers and Government Agencies

Policymakers and relevant government institutions should strengthen support for young micro-entrepreneurs by promoting business formalization. This promotes sustainability and supports digital transformation for businesses and young entrepreneurs. Programs may include simplified business registration, compliance assistance, financial incentives, and digital capability-building programs.

By strengthening circular economy initiatives, government agencies should improve access to facilities and support systems for sustainable business practices. Facilities that enhance waste segregation can improve recycling facilities and enable more environmentally friendly alternatives. The initiatives will encourage young entrepreneurs to adopt more sustainable and innovative business practices while supporting their growth from survival-driven enterprises to strategically sustainable and digital businesses.

5. Business Sector and External Stakeholders

Businesses and external stakeholders are encouraged to actively promote sustainability and digitalization within local communities actively. Prominent businesses may strengthen their CSR initiatives by conducting knowledge-sharing programs and mentorship opportunities for young entrepreneurs.

Businesses may also gradually shift to digital practices so communities can more easily adopt digital payment systems and participate in digital marketing. Strengthening collaboration among young entrepreneurs for possible supply chains or networks may also be considered. Sustainability and digitalization are community actions that create shared benefits within a connected economic and social ecosystem.

6. Future Researchers

Future researchers are encouraged to research more the scope of this study. This study has limitations in terms of geographic coverage and respondent profile. Future studies may explore sustainability practices and digital adoption of young entrepreneurs in other areas and sectors.

Researchers may also consider using comparative studies between registered and informal businesses to better understand the behavioral changes over time. Additionally, future studies may explore themes such as financial readiness and the role of external factors in supporting young entrepreneurial development.

Compliance with Ethical Standards

The study rigorously observed ethical principles throughout. Before data collection, the researchers obtained approval and authorization from participants, relevant institutions, and coordinators overseeing youth entrepreneurship programs. The study protected participants' rights and welfare.

Potential participants received informed consent forms detailing the study's purpose, the nature of participation, confidentiality measures, and their right to withdraw at any time without penalty. Consent forms were distributed in advance to allow participants sufficient time to consider their participation.

Before administering the survey and interviews, participants were briefed on the study objectives, expected duration, procedures involved, and potential benefits of the

research. The researcher addressed any questions or concerns participants raised before data collection began.

Subject matter experts reviewed the survey questionnaires and interview guides to ensure that the questions were appropriate, understandable, and free from potentially sensitive or harmful content. The researchers maintained confidentiality and anonymity by ensuring that personal information was not disclosed in any report or publication resulting from the study.

Data collection was conducted through face-to-face surveys and individual interviews. Interviews within school settings were held in private locations under appropriate supervision. For participants who were no longer students, interviews were arranged at their convenience, typically in quiet areas to minimize distractions and ensure participant comfort.

All information collected was used solely for academic purposes. Authorized personnel stored data securely and accessed it only as needed. Furthermore, all sources used in the study were properly cited to uphold academic integrity and comply with ethical research standards.

The researcher used tools such as ChatGPT, Jenni, and Grammarly in this study. These tools were used for grammar checking and Tagalog-to-English translation, assisting in finding related literature and studies, reviewing the synthesis of related studies and the research findings and results, and improving the logical flow of the analysis and presentation. The manuscript underwent anti-plagiarism and AI detection.

To maintain the highest standards of research integrity, data transparency, and academic honesty, the author explicitly discloses that this manuscript is extracted from a larger, comprehensive research work of the same research title. This paper focuses exclusively on a descriptive evaluation of the respondents'sustainability practices and digital adoption levels. The author intentionally excluded all inferential group comparisons from this manuscript to ensure it serves as a distinct, standalone study with its own independent research objectives, focused literature review, and specialized discussion. Furthermore, we maintained full transparency during the journal submission process, and we handled and reported all data in strict compliance with academic publishing ethics.

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