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Sustainable Competitiveness through Technology Adaptation: Case of Selected Penang Microenterprises

Parimala Devi Dhivandram*, Prakash Arumugam

School of Business Administration, Wawasan Open University, Georgetown, Penang, Malaysia

Email: parimaladd@wou.edu.my, prakashva@wou.edu.my

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Abstract

Purpose: This study seeks to examine how the selected microenterprises in Penang have responded to these pressures by adopting technological tools and practices to sustain competitive in the industry. The primary purpose of this study is to investigate how microenterprises in Penang adapt to technological changes in order to sustain competitiveness in a rapidly evolving business environment. **Design/methodology/approach:** This study employs a qualitative design utilizing the K-J Method, a structured group technique for organizing ideas and identifying themes, to investigate the challenges of technology adoption among microenterprises in Penang. A purposive interviews of 20 microentrepreneurs from food, retail, and textile-based sectors was selected to ensure diverse perspectives. **Findings:** Responses were categorized into four major themes: Financial Capacity, Digital Literacy, Cultural Resistance and Additional Support Needs. The findings reveal overwhelmingly a mixture of positive and negative perceptions of technology adaptations among microenterprise respondents. **Research limitations/implications:** The geographic scope may restrict generalizability, and the absence of negative perceptions may overlook critical barriers such as cost, infrastructure, or digital literacy. Future research should address these limitations by incorporating broader samples, objective performance metrics, and deeper exploration of challenges. **Practical implications:** The insights from this study can guide policymakers, NGOs, and technology developers in designing targeted interventions for microenterprises. These insights contribute to a deeper understanding of how microenterprises can navigate their business through technology adaptations and sustain growth despite the competitive challenges in the similar industry. **Originality/value:** This study contributes original insights into the lived experiences and perceptions of selected microenterprise owners in Penang regarding technology adaptation. It highlights the nuanced ways in which small business operators engage with digital tools not just as functional assets, but as the main components to maintain their competitive sustainability.

Keywords: Microenterprises, Technology Adaptations, K-J Methods, Sustainable Competitiveness, Penang

Introduction

Microenterprises in Penang local economy considered as one of the main income generator backbone as contributing significantly to employment creation, income generation, and community resilience. Despite their importance, these enterprises face mounting challenges in an increasingly competitive environment shaped by globalization, rapid technological change, and evolving consumer expectations. The rise of digital platforms, mobile applications, and e-commerce has transformed the way businesses operate, creating both opportunities and risks for microenterprises that often lack the resources of larger firms. For many, technology adaptation is no longer optional but a necessity for survival and growth. This study seeks to examine how the selected microenterprises in Penang have responded to these pressures by adopting technological tools and practices to sustain competitive in the industry. The primary purpose of this study is to investigate how microenterprises in Penang adapt to technological changes in order to sustain competitiveness in a rapidly evolving business environment. By examining the strategies, tools, and practices adopted by these enterprises, the research aims to understand the extent to which technology integration contributes to operational efficiency, market expansion, and resilience against external disruptions. The study also seeks to highlight sectoral differences in technology adoption, providing insights into which industries are more adaptable and which face greater challenges.

Despite the recognized importance of technology in driving competitiveness, microenterprises in Penang continue to face several pressing problems that hinder effective adaptation. Many enterprises struggle with limited financial resources and other supports, making it difficult to invest in advanced technological solutions (Nordin et al., 2024) hence the microentreprises are not to be neglected with the similar strunggles as well. Adding on, there is a lack of digital literacy and technical skills, particularly among older entrepreneurs, which reduces the ability to fully utilize available tools (Zulkifli et al., 2024). These narrows to the main three study objectives as to examine the financial capacity faced by microenterprises in Penang, to evaluate the role of digital literacy and cultural attitudes in shaping microenterprises' readiness for technology adaptations and to analyze additional support mechanisms, comparing adaptability across similar players in the industry.

Literature Review

Walk through almost any market street in Penang and the evidence of microenterprise life is hard to miss: hawker stalls negotiating QR-code payments alongside cash tins, textile shops still relying on word-of-mouth, family-run kiosks experimenting tentatively with Facebook pages. These small businesses are not a peripheral feature of the state's economy; they are its backbone, sustaining employment, household income, and a sense of continuity in communities that have weathered successive economic shocks (Allen, 2025). Yet that same resilience is now being tested by forces no single shopkeeper can control; globalisation, rapid technological change, and a consumer base whose expectations shift faster than many small firms can follow.

Researchers studying this area agree on the headline point: technology adaptation matters for competitiveness. Where they part ways is in explaining how financial pressure, cultural disposition, and other additional needs combine to produce such different adoption outcomes from one enterprise to the next. This review works through that disagreement rather than smoothing it over. It examines four threads running through the literature; financial constraints, digital literacy and cultural attitudes, sectoral disparities, and additional institutional support, and asks how they interact, sometimes reinforcing one another and sometimes pulling in opposite directions, to shape whether and how Penang's microenterprises adopt new technology.

If there is one explanation that surfaces in nearly every study of small-firm technology adoption, it is money, or rather the lack of it. Nordin et al. (2024) and Tambunan (2019) both treat financial limitation as the most persistent obstacle microenterprises face, though they arrive at that conclusion from different directions. Nordin et al. (2024) focus on the mechanics of micro-level financing; how credit access, or its absence, shapes day-to-day investment decisions inside individual firms. Tambunan (2019) situates the same problem within structural inequalities that run through Southeast Asian economies more broadly. The two readings agree that scarce resources restrict innovation, but they are really describing different scales of the same problem: one a financing mechanism, the other a policy environment.

A further complication comes from Abdullah et al. (2020), who find that entrepreneurs with stronger financial literacy are able to make more of whatever microcredit or government grants are available to them, turning modest funding into meaningful technological upgrades. That finding sits awkwardly next to Allen's (2025) observation that many Penang microenterprises remain cautious about technology investment even once financing is no longer the binding constraint. Put the two together and a simple "more money, more adoption" story starts to look incomplete; something psychological or cultural is intervening between the availability of funds and the decision to spend them on new tools.

Ho (2024) offers one way of explaining that gap, arguing that financial constraint and digital literacy are not separate problems but feed into each other: when money is tight, firms cannot afford training or skilled staff, and without that human capital, the technology that money could buy often goes underused or unused altogether. This reframes the relationship between funding and adoption as something closer to a feedback loop than a straight line, with financial, cognitive, and institutional factors evolving together rather than one simply causing the next.

What much of this literature shares, though, is a tendency to treat financial constraint as a fixed condition rather than something firms actively manage and reshape over time. Few studies ask how microenterprises shuffle resources across a season, or how informal financing arrangements; rotating savings groups, community lending circles, family loans, might quietly underwrite a degree of technological resilience that formal credit data would never capture. Rahman and Ramli (2021) note that conventional banks tend to view microenterprises as high-risk borrowers, a perception that shapes who gets credit and on what terms, but their analysis stops short of asking what happens outside that formal banking relationship, where much of the real financial life of small firms may actually occur.

Read together, these studies suggest financial constraint is less a simple barrier than a condition entrepreneurs work around, sometimes inventively. OECD (2020) captures something of this spirit in its discussion of "frugal innovation," the idea that small firms can achieve real technological progress by doing more with less rather than waiting for capital to arrive. The broader picture that emerges from comparing these accounts is one in which financial capital, cultural confidence, and institutional access do not operate independently but form a kind of triangle, each side affecting how successfully a microenterprise can move toward digital adoption.

Digital literacy is often discussed as though it were purely a matter of skill, but the literature complicates that assumption almost as soon as it is stated. Ho (2024) and Digital Penang (2025) both find that older entrepreneurs tend to feel less confident with digital tools than their younger counterparts, a generational pattern that seems intuitive enough on its face. Ali and Abdullah (2018), however, push back against reading this purely as a skills gap. Their ethnographic work with Malaysian microenterprises shows that even owners who are technically capable sometimes choose not to automate, because doing so would conflict with how they want their business to feel; authentic, personal, attentive to the customer standing in front of them. Competence, in other words, does not guarantee adoption if the technology threatens something the entrepreneur values more.

By comparison, Ho's (2024) skill-deficit framing and Ali and Abdullah's (2018) cultural-negotiation framing are not simply contradictory; they are answering slightly different questions. Both, though, converge on a more interesting point: technology adoption in this context is not purely a rational economic calculation. It is also, and perhaps primarily, a cultural process, one in which entrepreneurs weigh new tools against existing identities and relationships before deciding whether they fit. Yusoff and Hashim (2022) add that craft-based microenterprises tend to be selective rather than wholesale in their adoption choices. A craft business might embrace social media marketing enthusiastically while resisting automation that would change how the product itself is made, because the latter threatens the handmade quality the business is built on. This selective pattern lines up with Allen's (2025) broader argument that technology gains traction only when it is perceived as compatible with what a business already does and values, rather than as a wholesale replacement for it.

One persistent weakness across this body of work is the absence of a shared way of measuring digital literacy. Ho (2024) relies on entrepreneurs' self-reported confidence, while Digital Penang (2025) tracks participation rates in training programmes; two proxies that capture different things and neither of which gets at the deeper cultural meanings entrepreneurs attach to technology. Ali and Abdullah (2018) move closer to filling that gap with their notion of "cultural digital readiness," a concept that tries to fold values, trust, and identity into what would otherwise be a narrowly technical assessment.

There are also dimensions the literature has barely begun to explore. Ho (2024) mentions, almost in passing, that younger entrepreneurs tend to be more digitally fluent, but does not follow that observation into questions about how older and younger family members or business partners might learn from each other. Gender is an even more conspicuous gap: none of the studies reviewed here examine whether women entrepreneurs in Penang face different barriers to digital engagement, despite evidence from other contexts suggesting

they often do. An intersectional approach, one that takes age, gender, and cultural identity together rather than in isolation, would likely reveal patterns this literature has so far missed.Taken as a whole, the research converges on a fairly clear conclusion: digital literacy cannot be separated from cultural acceptance. Training programmes that teach the mechanics of a new platform but ignore what that platform might mean for an entrepreneur's sense of identity and craft are likely to underperform. The more promising path, several of these studies suggest, is to frame technology as something that can support tradition rather than replace it.

Not every sector experiences the pressure to digitise in the same way. Abdullah et al. (2020) and Digital Penang (2025) both report that food and retail businesses, which interact directly and frequently with consumers, tend to be further along in digital integration than craft and textile producers. That pattern is easy enough to observe, but the descriptive studies reporting it rarely dig into why it holds, they note the difference in market structure without asking what is actually driving it. Tambunan (2019) offers one possible explanation by connecting sectoral adaptability to a firm's exposure to global value chains. Businesses embedded in international supply networks face more direct pressure to digitalise, simply because their partners and customers expect it, while sectors rooted in local, artisanal markets feel less of that external push. This resonates with Yusoff and Hashim's (2022) more close-up findings about cultural resistance in craft businesses, suggesting a pattern that operates at more than one scale at once: global integration creates urgency, while local identity and tradition slow the pace at which that urgency translates into actual change.

Even so, the literature has not settled whether these sectoral gaps reflect genuine structural constraint or something closer to deliberate choice. Ho (2024) tends to read slower adoption in traditional sectors as a symptom of limited resources, while Ali and Abdullah (2018) interpret much the same pattern as an active strategy of cultural preservation. Neither reading cancels out the other, but the disagreement points to a real need for frameworks that can hold both economic and cultural explanations at once rather than forcing a choice between them. Allen (2025) helps bridge that gap by observing that Penang's food and retail microenterprises tend to use digital platforms primarily for customer engagement reviews, delivery apps, social media promotions while craft-based businesses use the same platforms quite differently, mostly for storytelling and building brand authenticity. The implication is that adoption is not a single uniform process but something closer to purpose-built: each sector bends digital tools toward whatever logic, commercial or symbolic, already governs how it operates.

Much of this research, it is worth noting, leans heavily on cross-sectional surveys, snapshots that cannot really capture how adaptation unfolds over months or years. Digital Penang (2025) is something of an exception, incorporating case studies that follow enterprises through stages of change rather than measuring them at a single point in time, and the richer, more textured picture that approach produces suggests longitudinal work generally deserves more attention than it currently receives. Following the same firms over time might reveal whether sectoral gaps are closing as digital tools become more familiar, or whether they are hardening into something more permanent. Bringing these threads together, sectoral adaptability appears to sit at the intersection of market exposure, cultural identity, and the institutional support available to a given industry. Recognising this complexity matters

practically as well as theoretically: it suggests that policymakers hoping to support digital transformation would do well to design sector-specific strategies rather than applying a single template across very different kinds of businesses.

Government programmes, training schemes, and partnerships between public bodies and private firms are routinely held up as the mechanisms most likely to accelerate technology adoption (OECD, 2020; Digital Penang, 2025). Whether they actually deliver on that promise is far less settled. OECD (2020) takes a fairly policy-centric view, emphasising the structural reforms needed to create an enabling environment, while Ho (2024) is considerably more critical, pointing to limited outreach and bureaucratic complexity as reasons many Malaysian programmes fail to reach the entrepreneurs who might benefit most.

Allen (2025) and Rahman and Ramli (2021) arrive at a similar verdict from different angles: institutional support has to be sensitive to context if it is going to work. Allen (2025) finds that many Penang microenterprises simply do not know which programmes exist or how to access them, while Rahman and Ramli (2021) show that financial assistance offered without accompanying training tends to produce little lasting change. Read together, these findings point to a persistent gap between how policies are designed at the top and how they actually land—or fail to land—at the grassroots level.

Ali and Abdullah (2018) suggest community-based peer networks as a way of bridging that gap, arguing that trust and experiential learning passed between business owners can accomplish things formal institutions struggle to do. Yusoff and Hashim (2022) make a related case for participatory training models that build cultural values into their design rather than treating them as an afterthought. Taken together, the two studies point toward a hybrid model, one that pairs top-down policy support with bottom-up community engagement, as the more sustainable path toward genuine competitiveness.

A recurring weakness in this part of the literature is its tendency to focus almost exclusively on government action while saying comparatively little about private firms or civil-society organisations. Digital Penang (2025) is a partial corrective, documenting how partnerships with technology companies can speed up adoption by making tools more affordable and pairing them with mentorship. But such partnerships are not without risk: if they are not paired with genuine capacity-building, they can leave microenterprises dependent on outside expertise rather than building durable skills of their own. OECD (2020) raises a version of this same concern, warning that excessive reliance on external knowledge can quietly erode the kind of local innovation capacity that policy is supposed to be building in the first place.

Institutional support and cultural attitude turn out to be more entangled than they might first appear. Programmes designed without attention to local cultural sensitivities tend to see disappointing participation, regardless of how generous the funding behind them might be. A training scheme that treats every entrepreneur as a blank slate, ready to absorb whatever technical content is on offer, misses the reality that many owners are weighing that content against deeply held ideas about what their business is for and who it serves. The institutions most likely to succeed, on the evidence reviewed here, are those willing to adapt their own delivery to the communities they are meant to serve, rather than expecting communities to adapt entirely to them.

Method

The purpose of this study was to explore the technology adaptations among the microenterprise players in Penang as to enhance the competitive sustainability among the similar players in the industry. The identifications on the technology adaptations were based upon the knowledge sharing and perceptions of the participating entrepreneurs in microenterprises. The K-J Methods was used when conducting the focus group study.

A focus group study was formed for the data collections to explore the technology adaptations among the microenterprise players in Penang. The participants for the focus group were a combination of different microentrepreneurs or microenterprises owners from different industry and districts both in the Penang island and mainland. A total of 5 sessions were conducted, where in each session combination of 4 participants were interviewed, and a total of 20 microenterprise owners / microentrepreneurs participated in the KJ Method session. In the 5 session, each participant was interviewed and partly were shared the link as the data collection though Google Form. The focus group was determined as to the five variables as (1) Financial Capacity, (2) Digital Literacy, (3) Cultural Resistance and (4) Additional Support Needs. This method was meant to encourage participants to freely contribute their ideas that will be later discussed and decided upon to be considered as crucial and important ideas for the study as the outcome and solutions in future.

Participants were asked to consider and identify the technology adaptations applied in their business nature that contribute to their success in the industry. Later, they were asked to explain whether these aspects contributes their competitive sustainability. After that, the commonly agreed factors were grouped and concluded. The conclusions divided into a quadrant based on one indicators positive / important. The summary of the themes were concluded by inter-rater reliability whereby it is concern to choose one best description chosen to suite the fact that multiply respondents concern may experience.

This study is a qualitative research, which intended to explore the technology adaptations among the microenterprises whereby contribute to their business success. A number of open-ended questions were used to gauge the responses as how technology helps in their daily business, what are type of technology adaptations in their business and other pertaining technology driven support questions. The data collected from 20 respondents questioned to explore the adaptations in the technology applications and acceptance in their business at current. The respondents were questioned by individual to reach standard agreement. Those questioned factors were written in the questionnaire and some were received through Google Form distributions.

Findings

Criteria was established to guide the researchers during the selection process as to ensure those involved in the focus group able to represent the population. Criteria are (1) microenterprises owners location in island or mainland Penang, (2) business ownership, (3) years of operations, (4) industry sector, (5) annual income, (6) digital adaptations and (7) membership / networking participation as further illustrated in Table 1.

Table 1
Respondents Profile

Variables	Description	Frequency	Percentage
Location	Penang island	8	40.0
	Penang Mainland	12	60.0
Business Ownership	Sole proprietorship	10	50.0
	Partnership	4	20.0
	Family-owned	6	30.0
Years in Operation	Above 10 years	9	45.0
	Less than 5 years	5	25.0
	Between 5 – 10 years	6	30.0
Industry Sector	Manufacturing	6	30.0
	Services	10	50.0
	Retail	4	20.0
Annual Income	RM20,000 and above	5	25.0
	Less than RM10,000	9	45.0
	RM10,000 – RM20,000	6	30.0
Digital Adaptation Level	Basic	10	55.0
	Moderate	6	30.0
	Advance	4	20.0
Membership / Networking Participation	Local Associations *(SME Association of Penang),SAMENTA Malaysia (Northern Region), etc*	10	50.0
	Chambers of Commerce	3	5.0
	SME events	9	45.0

Majority of these microenterprises are located in the mainland, around 60 percent, while the remaining 40 percent operates in Penang island. 12 microenterprises were located in mainland while 8 are located in island. Those microenterprises located in Penang mainland are as Juru, Alma, Bukit Mertajam, Seberang Perai, Bukit Tengah, Simpang Empat, Butterworth, Bagan Ajam, Seberang Jaya, Berapit, Bertam and Kepala Batas. Some of the mainland rural places are mostly lack with several facilities as transportation and mainly internet coverage. The island locations are more focused in Georgetown, Bukit Jambul, Persiaran Gurney, Air Itam, Batu Ferringi, Farlin, Jelutong and Balik Pulau, whereby much microenterprises are visible in business. Ownership is dominated by sole proprietorship around 50 percent, followed by family-owned enterprises at 30 percent and partnerships at 20 percent, underscoring the cultural preference for small, family-run businesses. Nearly half of the SMEs have operated for more than a decade, indicating stability and endurance, while a quarter are relatively new ventures.

Financially, SMEs remain constrained, with 45 percent reporting annual incomes below RM10,000, and only 25 percent earning above RM20,000. This financial limitation is mirrored

in their digital adaptation, where 55 percent remain at a basic level, 30 percent at a moderate stage, and only 20 percent demonstrate advanced practices. Networking participation is relatively strong, with half engaged in local associations and 45 percent attending SME events, though formal involvement in chambers of commerce is minimal at 5 percent. Overall, Penang SMEs represent a resilient and community-oriented business environment, but their limited financial capacity and low levels of digital maturity highlight the need for greater financial support, targeted digital upskilling, and structured networking platforms to enable successful technology adaptation and competitiveness in a rapidly evolving economy.

Participants were asked to consider and identify the factors that contribute both to their success and failure in maintaining their business competitive sustainability through the technology adaptations. They were questioned on these aspects in groups or few of them individually based to reach standard agreement. Upon that, the commonly agreed factors were transferred to the white paper. The white paper was divided into four quadrants based on four indicators; (1) Financial Capacity, (2) Digital Literacy, (3) Cultural Resistance and (4) Additional Support Needs. The participants discussed the factors and agreed on the placement of these factors on the white paper (Morgan et al., 2003). The data collected from the focus group study were analysed using content analysis whereby the responses were compiled and categorised accruing to the themes. Four main conclusive themes arose from the analysis. The themes are Financial Capacity, Digital Literacy, Cultural Resistance and Additional Support Needs These factors detailed in Table 2 and 3 as below.

Table 2
Summary of themes as perceived by microenterprise respondents in technology adaptation Positive Outcomes

Positive / Important	
Finacial Capacity	1. My current business have sufficient financial resources to sustain longer 2. My business has the financial ability to invest in new technologies when needed 3. I am confident in my ability to allocate resources for innovation with technology 4. My revenue growth supports reinvestment in digital tool
Digital Literacy	1. I am confident in using digital tools such as e-commerce platforms, accounting software, or social media marketing 2. My business is ready to integrate digital solutions into daily operations to improve efficiency and competitiveness 3. I am actively encourage staff to learn new digital skills 4. I am using digital tools effectively to improve productivity
Culture Resistance	1. My company culture is open to adopting new technologies and innovative practices 2. My company culture supports innovation and change through technology 3. Employees are open to learning and adapting to digital solutions

	4. I see technolgy as a business growing opportuinty rather than a challenge
Additional Support Needs	1. External support mostly help my business in adopting technology 2. External support such as training, mentoring, or financial assistance would further strengthen my ability to adopt technology 3. Mentorship from experienced businesses would guide my digital journey 4. Networking opportunities would expand my access to digital solutions

Financially, many micro players in Penang demonstrate the ability to sustain operations over the long term, with sufficient resources to invest in new technologies when necessary. Revenue growth supports reinvestment in digital tools, and business owners express confidence in allocating resources for innovation. This financial stability, though uneven across the sector, provides a critical platform for modernization and positions the players to take advantage of emerging opportunities when external conditions are favorable.

In terms of digital literacy, microenterprise owners shows a growing confidence in using tools such as e-commerce platforms, accounting software, and social media marketing. Businesses are increasingly ready to integrate digital solutions into daily operations to improve efficiency and competitiveness. Owners actively encourage staff to learn new digital skills, and many report effective use of digital tools to enhance productivity. This readiness reflects a shift in mindset, where digital adoption is seen not only as necessary but also as beneficial for long-term competitiveness.

Cultural attitudes within the industry players also reveal openness to change. Company cultures are becoming more supportive of innovation and technological adoption, with employees showing willingness to learn and adapt to digital solutions. Importantly, technology is increasingly viewed as a business growth opportunity rather than a challenge. This cultural shift is significant, as it reduces resistance and fosters an environment where digital transformation can be embraced more fully.

Finally, external support remains a promising avenue for strengthening the micro players's capabilities. Many businesses acknowledge the value of training, mentoring, and financial assistance in enhancing their ability to adopt technology. Mentorship from experienced enterprises is seen as a guiding force in the digital journey, while networking opportunities are recognized as vital for expanding access to solutions. Although current initiatives may be limited, the micro entrepreneurs express readiness to leverage external support when available, underscoring the importance of strengthening institutional frameworks.

Table 3
Summary of themes as perceived by microenterprise respondents in technology adaptation Negative Outcomes

Negative/ Important	
Finacial Capacity	1. My business struggles to allocate funds for technology investments. 2. I often lack financial resources to upgrade digital tools 3. Limited revenue prevents me from adopting new innovations 4. Financial constraints slow down my ability to modernize operations though technology adaptations
Digital Literacy	1. The biggest challenges my business faces is to integrate digital solutions into daily operations 2. My employees lack confidence in using digital platforms for daily tasks 3. My team struggles to adapt to new software and applications in their daily business operations 4. I find it difficult to use digital tools effectively to improve productivity.
Culture Resistance	1. Traditional business practices in my company make it difficult to adopt new digital technologies 2. My company culture resists changes brought by new technologies 3. Old and experinced employees are resistant to learning and adapting to digital innovations 4. I often view technology adoption as a challenge rather than an opportunity
Additional Support Needs	1. Lack of access to external training programs that could improve technology adaptations 2. I do not receive enough mentorship or guidance for digital transformation 3. I have linited networking opportunities 4. Government or association initiatives are inadequate to meet my support needs

Among the few selected microenterprises in Penang faces a complex set of barriers that hinder their ability to embrace technology adaptations. Among the most pressing issues are financial constraints, which limit the capacity of businesses to allocate funds for technology investments. Many SMEs struggle to upgrade digital tools or adopt new innovations due to restricted revenue streams. This financial strain slows down modernization efforts, leaving enterprises unable to compete effectively in an increasingly digital economy.

Beyond financial limitations, the micro players are also grapple with digital literacy barriers. Integrating digital solutions into daily operations remains a challenge, as employees often lack confidence in using platforms and applications. Teams struggle to adapt to new software, and business owners themselves find it difficult to leverage digital tools to improve productivity.

This gap in digital skills creates inefficiencies and prevents them from fully realizing the benefits of technological adoption.

Equally significant is the issue of cultural resistance. Traditional business practices and entrenched company cultures often resist the changes brought by new technology adaptations. Older and more experienced employees, in particular, are reluctant to learn and adapt to digital innovations. As a result, technology adoption is frequently perceived as a challenge rather than an opportunity, reinforcing a cycle of hesitation and stagnation.

Finally, the microenterprises in Penang face notable support gaps. Access to external training programs is limited, leaving businesses without the skills needed to adapt effectively. Mentorship and guidance for digital transformation are scarce, while networking opportunities remain insufficient to foster collaboration and knowledge sharing. Although government and association initiatives exist, they are often inadequate to meet the diverse support needs of SMEs, leaving many enterprises without the external resources required to thrive.

Discussion

The main purpose of this study is to examine the technology adoption among microenterprises in Penang. Based on the themes framed, the results are grouped into four major ones as financial capabilities, digital literacy, culture resistance and additional support needs. As part of the government's broader agenda to advance microentrepreneurs into the digital era, the adoption of technology has become a critical priority across all levels of business. This initiative underscores the recognition that digital tools are essential not only for improving operational efficiency but also for enhancing competitiveness and resilience in a rapidly evolving marketplace. By positioning technology adoption as a central pillar of entrepreneurial development, the government aims to ensure that microenterprises are equipped to participate fully in the digital economy and contribute meaningfully to national growth.. The focus group interviewed exposed both the benefits gain and limitations faced in their high level of technology acceptance in their daily business routine. Minority of them are in leaning process but majority of the micro entrepreneurs are performing well with the technology adaptations in their business.

The most prominent factor that can be observed through the study is the technology adaptations and how these adaptations enhance their sustainability in current market competition among the similar players, which is pertinent in facilitating microentrepreneurial success to promote their business competitiveness. It is critical to examine the determinants of technology adoption by SMEs to pinpoint certain factors that could either promote or inhibit the use of technology (Othman et al, 2025). The microentrepreneurs unanimously agreed by adopting technology in their routine business benefits them in several ways as ploted in the benefits gain. Digital platforms such as TIk Tok, Facebook marketing, accounting software, e-commerce systems, and marketing tools like Canva, alongside other promotional solutions, have enabled microentrepreneurs to significantly expand their business. In addition, they financial capabilities despite the current economic situation enables them to further explore these technologies attributions to reducing operational costs while improving overall efficiency.

Referring to the feedback obtained from industry players, it is evident that technology adaptation, while proven to improve routine business operations, has not yielded uniform benefits across all the similar enterprises. Some micro players report enhanced efficiency and streamlined processes, yet others remain unable to fully capitalize on the potential of digital adaptations. This disparity reflects the uneven pace of digital transformation within the sector. Scholarly studies reinforce this observation, highlighting that SMEs in Malaysia are generally slow in adopting digital solutions for their business processes (Lada et al., 2023; Enshassi et al., 2024).

The slow uptake can be attributed to factors such as limited financial capacity, inadequate digital literacy, and cultural resistance, which collectively hinder the ability of micro players to translate technology adoption into tangible business gains. From a research perspective, this suggests that while digital adaptations are available and accessible, their effective utilization requires not only investment but also organizational readiness and external support. Thus, the challenge lies not in the availability of technology itself, but in the systemic barriers that prevent microenterprises from fully leveraging it as a driver of growth and competitiveness.

Conclusion

The present study seeks to explore the level and success of technology adaptation among microenterprises in Penang in sustaining their competitiveness sustainability in the industry. Employing a focus group approach to capture nuanced perspectives from industry player the findings reveal that four critical factors shape the extent of financial capacity, digital literacy, culture resistance and additional support needs, all of which interact with the micro business related competitive sustainability. These dimensions provide a comprehensive lens for understanding both the benefits and limitations faced by microenterprises in their digital adaptations journey.The study may have been limited to a specific region or a small number of microenterprise respondents, which restricts the generalizability of the findings. Microenterprises in Penang island may have different experiences and access to technology compared to those in mainland and the other way round.

Insights from this study carry significant implications for policymakers, NGOs, and technology developers. Targeted interventions must prioritize the design of accessible and user friendly tools that align with local business practices, ensuring that technology solutions are not only affordable but also practical for small scale operations. Training initiatives should emphasize practical digital skills and encourage peer learning, as collaborative approaches often enhance confidence and uptake among entrepreneurs. Similarly, digital platforms should be developed with flexibility and ease of use in mind, reducing barriers to entry for businesses with limited technical expertise.

This study underscores that technology adaptation among microenterprises is not merely a supportive element but a crucial determinant of growth and sustainability. The findings highlight the need for integrated strategies that combine financial support, skill development, cultural change, and external guidance. Such strategies will enable microenterprises in Penang to fully harness digital adaptations, expand their market reach, reduce operational costs, and strengthen resilience in an increasingly competitive business environment.

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