

THE FUTURE OF SMALL AND MEDIUM ENTERPRISES (SMEs) ON A SKILLS-DRIVEN ECONOMY: TEVT'S ROLE IN ENHANCING COMPETITIVENESS AND SUSTAINABILITY IN PERAK

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Abstract

Keyword:

SMEs, skills-driven economy, TVET, competitiveness, sustainability



This study investigates the strategic role of Technical and Vocational Education and Training (TVET) in enhancing the competitiveness and sustainability of small and medium enterprises (SMEs) in Perak, Malaysia. By integrating TVET as a mediating variable, the research offers a novel conceptual framework that links policy support, technological adoption, and networking initiatives to SME performance outcomes. Drawing on empirical evidence, the study reveals that TVET significantly amplifies the impact of these enablers by addressing skill gaps, improving operational efficiency and fostering market adaptability. The findings also highlight persistent systemic barriers such as financial constraints, limited access to TVET resources, and urban-rural disparities that hinder SME development. Practical recommendations are proposed for policymakers, TVET institutions and SME stakeholders, including streamlined regulatory reforms, customized training modules, and sustainability-focused programs. The study contributes theoretically by bridging gaps in existing literature and practically by offering actionable insights for ecosystem strengthening. Ultimately, this research underscores the transformative potential of TVET in driving inclusive, resilient, and environmentally responsible SME growth, positioning Perak's enterprises as vital contributors to regional and national development.



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Introduction

Small and Medium Enterprises (SMEs) are critical to global economic development, comprising

approximately 90% of businesses and over 50% of employment as of 2025 (World Bank, 2023). In facing rapid technological shifts, financial constraints, and evolving markets, SMEs increasingly rely on a skills-driven economy to remain competitive. Technical and Vocational Education and Training (TVET) programs serve as a vital tool by equipping the workforce with both technical and soft skills tailored to industry needs (OECD, 2024).

In Malaysia, SMEs constitute 97.4% of businesses and contribute 38.3% to the national GDP (Department of Statistics Malaysia, 2024). Government initiatives such as the National TVET Council aim to bridge skills gaps and improve alignment with market demands (Wan, 2025). In Perak, where SMEs operate across diverse sectors, TVET integration has led to measurable improvements in productivity and innovation (Hafizah & Hasan, 2021).

Case studies like Tech Innovators Sdn Bhd and GreenFarm Enterprises highlight the value of TVET partnerships, showing tangible gains in sustainability and operational efficiency. These outcomes underscore the role of TVET in fostering SME resilience and long-term growth. Moving forward, strategic investment in TVET will be essential for SMEs to thrive amid dynamic economic landscapes (Abdul Rahman & Jamaludin, 2021).

Background of the Study

In Perak, small and medium-sized enterprises (SMEs) are central to economic development, contributing significantly to employment and GDP (Department of Statistics Malaysia, 2020). As the backbone of the economy, SMEs play a key role in fostering innovation and entrepreneurship (Yunus & Abdullah, 2019). However, many faces persistent challenges, notably limited access to skilled labour, which impedes adaptability to technological and market shifts (Palanimally, 2016).

Technical Education and Vocational Training (TEVT) programs address this gap by offering training aligned with industry needs, focusing on both technical competencies and soft skills such as communication and problem-solving (World Economic Forum, 2021). Studies show TEVT enhances SME productivity and encourages a culture of continuous learning (Abdul Rahman & Jamaludin, 2021), a crucial factor in the context of the Fourth Industrial Revolution (Malaysia Productivity Corporation, 2024).

Additionally, TEVT supports sustainable business practices by embedding environmental awareness in its curriculum (UNIDO, 2024). Partnerships among educational institutions, government bodies, and industries further ensure the relevance and effectiveness of training programs (European Commission, 2023). Ultimately, empowering SMEs in Perak through robust TEVT initiatives fosters innovation, competitiveness, and long-term sustainability in a rapidly evolving economic landscape (The Star, 2024).

Problem Statement

Small and Medium Enterprises (SMEs) in Perak are facing increasing pressure to remain competitive amid rapid technological and economic changes. Despite their importance to economic growth, many SMEs struggle with a shortage of skilled labour worsened by the pandemic's impact on workforce transitions (Loheswar, 2023). TVET programs, while intended to bridge this skills gap, often fall short in addressing SMEs' specific needs (Ramzi et al., 2022).

SMEs also face difficulties adopting digital technologies due to limited digital literacy and financial resources (Musa & Chinniah, 2016). While TVET aims to equip workers with digital competencies, misalignment between training content and industry needs leaves many graduates unprepared (Paryono, 2020). Financial constraints further hinder SME growth, with limited access to capital restricting their ability to innovate and invest in upskilling (Okoth, 2023).

This study seeks to investigate how TVET programs can be more effectively aligned with SME needs

in Perak. Strengthening partnerships, improving curriculum relevance, and expanding access to work-based training are among the proposed strategies. Addressing these issues is vital for cultivating a skilled, adaptable workforce that drives SME innovation, sustainability, and broader economic resilience.

Literature Review

Overview of SMEs in Perak

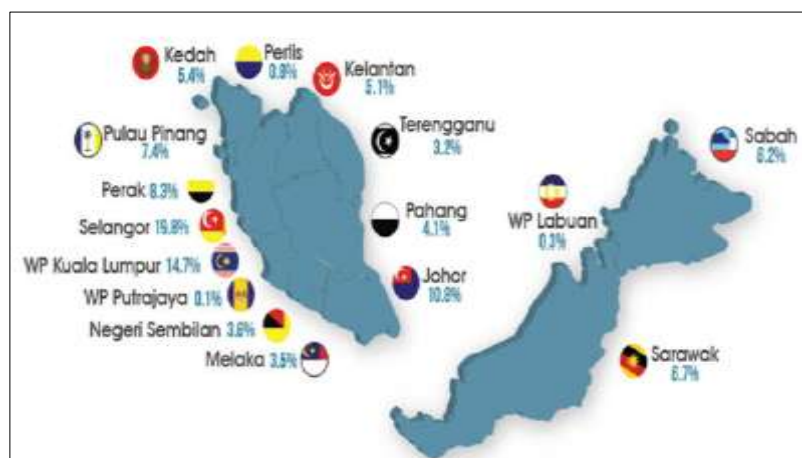
Small and Medium Enterprises (SMEs) are central to Malaysia's economic landscape, representing over 97% of business establishments and contributing significantly to job creation and GDP (SME Corporation Malaysia, 2024). Operating across manufacturing, services, and agriculture, SMEs drive innovation and inclusive growth nationwide. Government initiatives, including financing schemes and entrepreneurship development programs, have been instrumental in enhancing SME sustainability and competitiveness.

In Perak the second-largest state in Peninsular Malaysia SMEs are pivotal to local economic activity. Historically known for its tin-mining heritage, Perak's economy now thrives on a more diversified base, with SMEs active in textiles, food processing, fabricated metals, and machinery manufacturing (Department of Statistics Malaysia, 2023). Perak's SMEs play a crucial role in regional employment and value creation.

Recent efforts such as the Perak State Entrepreneur Open Day and the Perak Entrepreneur Grant (GeRAK) demonstrate the state government's commitment to SME development. These programs offer financial support and upskilling opportunities to strengthen business resilience. Despite challenges like limited access to financing and heightened market competition, SMEs in Perak continue to grow and adapt. Their dynamic role underscores the importance of targeted support mechanisms and policy frameworks to sustain long-term regional development (The Star, 2023).

In Malaysia, Technical and Vocational Education and Training (TVET) play a key role in bridging skills gaps and supporting economic advancement. The government has expanded public and private TVET institutions, coordinated through the National TVET Council (Majlis TVET Negara), to ensure alignment with industry needs (Ministry of Education Malaysia, 2023). Recent reforms emphasize competency-based education, digital integration, and industry collaboration to improve program relevance (ASEAN Secretariat, 2023).

In Perak, TVET initiatives are tailored to local workforce demands. Pusat Aspirasi Anak Perak (PASAK) leads efforts to upskill the population through industry-aligned programs and strategic training partnerships. The state government bolsters this with investments in infrastructure and institutional support (PASAK, 2025).



Source: Department of Statistics Malaysia (2023)

Figure 1. SMEs by Geographical Location

The formation of TVET Collaboration Hubs (TCH), such as PUO TVET Hub, fosters cross-sector partnerships and innovation. Events like the TVET Collaboration Hub Engagement in Ipoh highlight Perak's proactive approach in evolving its TVET landscape (Aziz, 2023). Strategic initiatives, including the Majlis TVET Negeri Perak, aim to chart a clear path for sustaining workforce development. By positioning TVET as a credible and responsive educational pathway, Perak is equipping its workforce to navigate future challenges and drive inclusive economic growth (Rashid, 2024).

Pusat Aspirasi Anak Perak (PASAK) is a key human resource development agency under the Perak State Government, initially established in 2011 as Pusat Kerjaya Amanjaya (PeKA). Rebranded to better support job seekers, PASAK manages employment matching and skills training initiatives. A major development is the Talent Perak application (launched in 2022), which connects job seekers to relevant opportunities. PASAK also runs programs like PERINTIS and TVET to enhance workforce readiness. With a vision to position Perak as a TVET corridor by 2030, PASAK focuses on building a sustainable talent pipeline through industry-aligned training and strategic ecosystem development.

Sustainability of SMEs

Measuring the sustainability of Small and Medium Enterprises (SMEs) is vital for evaluating their economic, environmental, and social impact. Although SMEs are key contributors to national GDP and employment, they often face challenges in adopting sustainable practices due to resource limitations. Tailored indicators are essential for capturing their sustainability performance. Mengistu and Panizzolo (2023) identified relevant indicators emphasizing financial gains, cost efficiency, competitiveness, and social well-being.

A comprehensive sustainability assessment must consider internal and external factors, aligning with the Sustainable Development Goals (SDGs) (Prabawani, 2013). Models such as the sustainability maturity framework by Carlsson and Nevzorova (2024), which utilizes Global Reporting Initiative (GRI) indicators, help SMEs visualize progress and implement structured improvements.

Technology and innovation also enhance SME sustainability by improving efficiency and reducing environmental impact. TVET plays a supportive role by equipping the workforce with necessary skills to adopt these innovations. Social sustainability such as inclusive employment practices further strengthens SMEs' contributions to societal equity. A holistic approach combining metrics, standards, innovation, and workforce development is crucial. Strengthening these areas ensures SMEs not only remain competitive but also actively contribute to long-term sustainable development.

Challenges of Sustainability

Sustainability poses ongoing challenges for SMEs as they strive to balance environmental, social, and economic responsibilities in dynamic markets. Environmental sustainability demands resource efficiency and minimal ecological impact, while social sustainability emphasizes equity and community well-being. Economic sustainability focuses on long-term growth without compromising environmental or social goals. Recent studies highlight the importance of integrating digital transformation, policy alignment, and innovation to foster sustainable development (Mengistu & Panizzolo, 2022; Nur Rahmas et al., 2025). Governance and resilience are essential, as SMEs must adapt to changing regulations and consumer expectations while managing limited resources effectively.

Skilled Workforce - A skilled workforce is a vital pillar of SME sustainability, influencing economic performance, environmental responsibility, and social well-being. Skilled employees enhance productivity, reduce costs, and drive innovation through technical expertise and adaptability (Kibet & Kibet, 2019; Bagnall et al., 2025). In environmental sustainability, trained workers lead resource efficiency efforts and ensure compliance with green practices (Zélia, Beatriz & Filipe, 2023). Soft skills such as communication and leadership also play a crucial role, as seen in Italian SME case studies (Farao et al., 2023).

In Malaysia however, there is a gap between graduate skills and SME needs. The Khazanah Research Institute urges better alignment between workforce development policies and industry demands, while OECD research highlights SMEs' need for collaborative skill-building strategies. Socially, skilled teams foster inclusive

workplaces, strong community ties and employee engagement hallmarks of sustainable enterprises.

Technical and Vocational Education and Training (TVET) programs are central to this goal. Malaysian TVET reforms aim to align with Industry 4.0 needs and STEM growth, backed by efforts from MOE and UKM. As the pandemic intensifies demand for technologically adept workers, sectors like electronics and manufacturing rely heavily on TVET-trained talent. Collaborative efforts are key to building a resilient skilled workforce that powers SME sustainability.

Sustainability Practices - Sustainability has become essential for SMEs seeking to balance economic growth, environmental responsibility, and social well-being. As key contributors to global development, SMEs can enhance competitiveness and community impact by adopting eco-friendly practices (European Commission, 2023; Lee & Park, 2023). Core sustainability practices include energy efficiency, such as upgrading to LED lighting or using renewable sources measures that lower costs and reduce carbon emissions (Smith, 2020). Waste management is equally crucial; lean manufacturing and recycling initiatives can minimize waste generation and improve regulatory compliance (Johnson et al., 2025).

Sustainable resource use - involves sourcing eco-friendly materials, utilizing water-saving technologies, and embracing circular economy principles like reuse and recycling (Groves et al., 2011). These actions foster resilience and cost efficiency. Furthermore, pollution control through cleaner production, emission monitoring, and environmental reporting enhances transparency and operational sustainability (Brown & Williams, 2022). Integrating these practices not only ensures compliance but builds brand trust and long-term viability. SMEs that embed sustainability into daily operations position themselves for market success while contributing meaningfully to environmental and societal goals. Therefore, adopting these practices is not only a strategic necessity it's a pathway to enduring impact.

Technological Adoption - Technological adoption is a key driver of SME sustainability and competitiveness, enabling businesses to enhance productivity, reduce costs, and innovate efficiently. Digital transformation through tools like AI, IoT, and cloud computing equips SMEs to navigate rapidly evolving markets (Mishrif & Khan, 2023). Blockchain and energy management systems also improve supply chain transparency and optimize resource use. In waste management, technologies such as waste-to-energy solutions further support environmental goals (Begum et al., 2023).

In Perak, initiatives like the S.M.A.R.T Niaga@Perak platform have advanced SMEs' digital presence, supported by effective knowledge sharing and trust-building (Ramayah et al., 2009). Government incentives and training programs further enable technology integration, particularly in rural areas where performance expectancy and leadership support are critical (Chuen & Topimin, 2023).

Studies during the COVID-19 pandemic revealed that highly digitized SMEs were more resilient, with technology adoption aiding survival and growth (Mishrif & Khan, 2023). Research also shows that entrepreneurial orientation enhances the benefits of digital tools in driving economic and social value (World Bank, 2021). Ultimately, adopting technology is not just a strategic choice it is vital for long-term sustainability. Ongoing collaboration, innovation and supportive ecosystems ensure SMEs remain agile and future-ready.

Community Engagement - Community engagement plays a pivotal role in enhancing the sustainability and growth of SMEs in Perak. By involving local communities in planning, decision-making, and project implementation, SMEs can build trust, foster partnerships and develop solutions that benefit both business and society. Trust-building through respectful communication, shared values, and participatory processes is foundational for meaningful engagement (Lansing et al., 2023). Empowering communities through inclusive decision-making strengthens resilience, civic participation, and social cohesion (WHO, 2023).

Mthembu et al. (2023) emphasize that effective community engagement must be grounded in theory and sensitive to power dynamics, going beyond mere consultation. Local partnerships, such as with the Perak State Entrepreneur Secretariat (STeP), which has launched over 300 entrepreneurship programs, provide SMEs access to resources and capacity-building opportunities (SME Corporation, 2024). Activities like

farmers' markets, workshops, and employee-led community initiatives enhance brand loyalty and local trust.

Supportive policies that encourage flexibility, stakeholder collaboration, and adequate implementation timelines are essential. Case studies from the UK, Iraq and the USA show that trust, co-ownership, and long-term commitment are key to effective community initiatives. By valuing local knowledge and embracing participatory governance, SMEs can achieve stronger community ties and contribute to inclusive, sustainable development.

Supportive Policies - Supportive policies are fundamental in fostering SME sustainability and community engagement, particularly in Perak. These policies provide financial and non-financial resources, regulatory frameworks, and strategic guidance to empower SMEs and local communities. For instance, the Perak State Entrepreneur Secretariat (STeP) has implemented over 300 entrepreneurship programs, offering training, funding, and interest-free loans, especially targeting B40 groups (Shiffa, 2023).

Supportive public policies also promote innovation and branding, as seen in initiatives like the Platinum Business Awards, which encourage SMEs to expand globally. Regulatory frameworks that emphasize environmental protection, social equity, and labor rights further enhance the enabling environment. Inclusive policymaking exemplified by the Ukhuwah MADANI program ensures that community voices are integrated into planning and implementation (Bernama, 2025).

Effective policies also promote stakeholder partnerships, continuous monitoring and evaluation, and transparency. Studies emphasize that such measures strengthen policy responsiveness and impact (Prasannath et al., 2024; Chuen & Topimin, 2023). Additionally, policies should address the needs of marginalized populations, ensuring access to education, healthcare, and livelihoods (UNICEF, 2024). Ultimately, supportive policies create the institutional conditions necessary for SMEs to thrive strengthening innovation, inclusivity, and long-term economic and social resilience.

TVET Programs Evolution of TVET Institutions in Malaysia

TVET programs equip individuals with industry-relevant, hands-on skills across diverse fields such as engineering, IT, hospitality, and automotive technology. In Malaysia, both public and private institutions including polytechnics and community colleges offer these programs to support socio-economic development. TVET promotes lifelong learning and adaptability to evolving market needs.

Malaysia's TVET landscape has evolved significantly since 1906. Key milestones include the establishment of Polytechnic Ungku Omar (1969), GIATMARA (1986), and MTUN (1999), culminating in the 2020 formation of the National TVET Council. This timeline reflects Malaysia's commitment to workforce development through structured technical education. Five Key Factors That Underpin the Success and Sustainability of TVET Programs, are TVET programs must be aligned with current industry trends and future workforce demands. Collaborative curriculum development with industry players ensures graduates possess job-ready skills (Ministry of Education Malaysia, 2023; SME Corporation, 2024). Skilled trainers and modern, well-equipped facilities are essential to delivering effective hands-on learning experiences (Ministry of Human Resources Malaysia, 2023). Instructor upskilling and continuous professional development also enhance training quality.

Robust guidance, mentoring, and structured career pathways improve student retention and employability. These include apprenticeships, certification ladders, and pathways for lifelong learning (World Bank, 2023). Embedding digital tools, green technologies, and Industry 4.0 applications prepares students for dynamic labour markets (ASEAN Secretariat, 2023). Innovation within TVET institutions also fosters entrepreneurship and adaptability. TVET should address health, well-being and inclusivity ensuring access for marginalized groups and embedding life skills alongside technical competencies (WHO, 2023; SME Corporation, 2024).

This study's conceptual framework explores the relationship between Technical and Vocational Education and Training (TVET) and SME competitiveness and sustainability in Perak. It posits that

tailored TVET programs enhance workforce skills, boosting productivity, innovation, and sustainable practices (Ridzwan et al., 2023; Kibet & Kibet, 2019). Key elements include human resource development, digital skills training, and customer-focused learning (Omar et al., 2020). Government policies are seen as enablers, supporting TVET-SME collaboration and regulatory alignment. Integrating sustainability into TVET curricula reinforces environmental responsibility and long-term resilience. Together, these factors form a strategic pathway for SME growth in a skills-driven economy.

Research Hypotheses

This study is guided by the following hypotheses, developed to examine the direct, indirect, and mediating effects of TVET programs and sustainability challenges on the competitiveness and sustainability of SMEs in Perak:

- H1: There is a significant relationship between challenges of sustainability and SME competitiveness and sustainability
- H2: There is a significant relationship between challenges of sustainability and TVET Program.
- H3: The TVET program has an indirect influence on competitiveness and sustainability of SMEs.
- H4: The TVET program acts as a mediating variable, influencing the relationship between challenges of sustainability and SME competitiveness and sustainability.

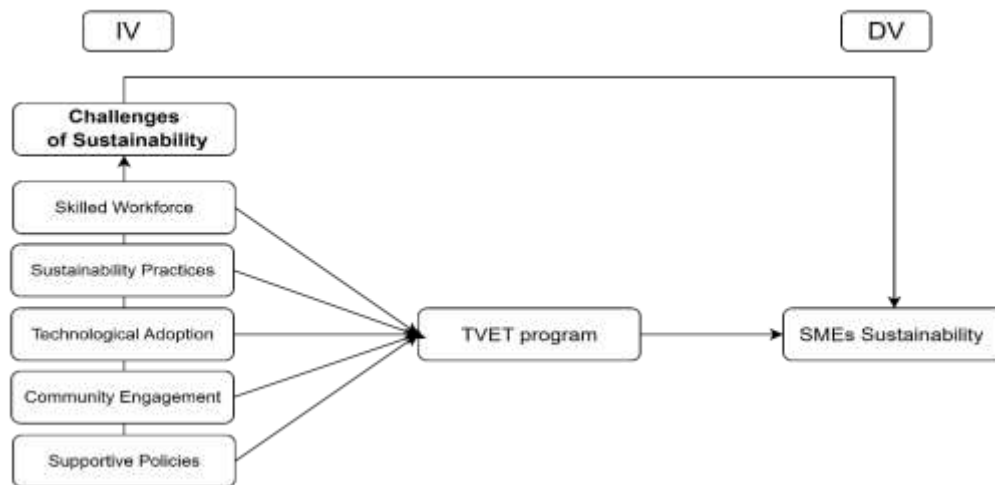


Figure 2. Conceptual Framework

Theoretical Framework

This study integrates three complementary theoretical frameworks Human Capital Theory (HCT), Competence-Based Education and Training (CBET), and the Capability Approach (CA) to examine the multifaceted impact of Technical and Vocational Education and Training (TVET) programs on the competitiveness and sustainability of small and medium enterprises (SMEs) in Perak. Together, these frameworks offer a robust foundation for analysing how vocational education contributes to economic growth, industry alignment, and individual empowerment within a skills-driven economy.

Human Capital Theory (HCT) - Human Capital Theory, as articulated by Becker (1993), posits that investments in education and training enhance individual productivity and earning potential, thereby contributing to broader economic development. Within the context of TVET, HCT provides a compelling rationale for vocational education as a driver of employability, wage progression, and industry sustainability. This study applies HCT to evaluate how TVET programs improve workforce readiness and economic outcomes for SME employees. It also considers recent extensions of the theory, including the role of technology infrastructure (Nawi et al., 2022) and informal learning (Tian & Tóth, 2024), which underscore the evolving nature of human capital in a digital economy. By linking TVET

initiatives to measurable economic returns and productivity gains, HCT reinforces the strategic value of vocational education in enhancing SME competitiveness.

Competence-Based Education and Training (CBET) - CBET, as conceptualized by Mulder, Weigel, and Collins (2007), emphasizes the development of specific occupational competencies aligned with industry standards. This framework is particularly relevant for assessing the effectiveness of TVET programs in equipping learners with practical, job-ready skills that meet the evolving demands of the working industry. In this study, CBET is used to evaluate the alignment between TVET curricula and the competency requirements of SMEs, especially within the F&B sector. It also highlights the importance of educator competencies and continuous professional development (ILO, 2023; Khairunnisa & Mimi, 2022) in maintaining the quality of vocational training. By focusing on skill acquisition, employability and curriculum relevance, CBET complements HCT's economic lens with a performance-based perspective on workforce development.

Capability Approach (CA) - The Capability Approach, introduced by Sen (1999), expands the scope of vocational education by emphasizing individual well-being, agency and the freedom to achieve valued life outcomes. CA shifts the focus from economic metrics to the holistic development of learners, making it particularly suitable for evaluating the social and personal impact of TVET programs. This study employs CA to assess how TVET initiatives enhance learners' capabilities such as career satisfaction, personal growth, and community engagement while promoting inclusive development. It also examines the role of TVET in supporting marginalized groups, including persons with disabilities, indigenous communities and orphans (Mohd Najib, Nordin & Yunus, 2022). By foregrounding equity, empowerment, and social responsibility, CA enriches the analysis of TVET's contribution to sustainable and socially responsible entrepreneurship.

Together, these three frameworks offer a multidimensional lens for understanding the role of TVET in shaping a resilient, inclusive, and skills-driven SME ecosystem in Perak. HCT provides the economic foundation, CBET ensures industry relevance, and CA captures the human and societal dimensions of vocational education. Their integration supports a comprehensive analysis of how TVET programs foster sustainable growth, workforce competitiveness, and community development.

Methodology

This study investigates the role of Technical and Vocational Education and Training (TVET) in enhancing the competitiveness and sustainability of SMEs in Perak, Malaysia, using a pragmatist philosophy and quantitative approach. The exploratory research design combines structured surveys of SME owners. The unit of analysis comprises registered SMEs across sectors such as manufacturing, services and food and beverage, with stratified random sampling employed to ensure sectoral and geographic representation.

Research Design

This study adopts a quantitative research design to investigate the role of Technical and Vocational Education and Training (TVET) in enhancing the competitiveness and sustainability of small and medium enterprises (SMEs) in Perak, Malaysia. The design is structured to generate empirical data that can be statistically analysed to identify patterns, relationships, and trends relevant to TVET participation and SME performance. A structured survey instrument is employed to collect numerical data from SME owners and managers across various industries. The survey captures key variables including demographic profiles, levels of engagement with TVET programs, business performance indicators, and perceptions of TVET effectiveness.

The questionnaire is designed with closed-ended items using Likert scales, categorical responses, and

numerical inputs to facilitate statistical analysis. Data will be analysed using descriptive statistics, correlation analysis, and regression techniques to examine the influence of TVET-related factors on SME competitiveness and sustainability (Bryman, 2016). This quantitative approach ensures methodological rigor and enables the researcher to draw generalizable conclusions from a representative sample. By focusing on measurable indicators and statistical validation, the study provides evidence-based insights that can inform policy decisions and strategic planning for TVET implementation in the SME sector.

Sampling

This study employs a stratified random sampling technique to ensure representative coverage of registered SMEs across Perak, Malaysia. The sampling frame is derived from comprehensive databases maintained by government agencies and industry associations, encompassing SMEs from key economic zones such as Ipoh, Manjung, Hulu Kinta, and Sg Terap. These regions, while diverse in industrial focus ranging from manufacturing and services to agriculture and tourism share infrastructural advancements, vocational training institutions, and a multicultural heritage that collectively support SME development. Within each stratum, SMEs are randomly selected using a random number generator to ensure equal probability of inclusion, thereby enhancing the representativeness and enabling comparative subgroup analysis.

A total of 247 SME respondents were selected, providing sufficient statistical power for generalization. To validate the adequacy of this sample size, the standard formula for estimating a population proportion, using Z-score, shows that $Z = 1.96$ (for 95% confidence level), $p = 0.5$ (maximum variability), and $e = 0.05$ ($\pm 5\%$ margin of error). Substituting these values yields a required sample size of approximately 384; however, given the stratified nature of the sampling and the contextual constraints of SME accessibility, the achieved sample of 247 remains acceptable within a slightly wider margin of error ($\sim 6.2\%$), which is still within tolerable bounds for exploratory policy research (Wahab, Musa, & Yusoff, 2021; Badawi, 2013). This rigorous and context-sensitive sampling procedure ensures the reliability and validity of findings, offering actionable insights into the impact of TVET programs on SME competitiveness and sustainability across Perak's diverse economic landscape.

Findings

Respondent Profile Summary

In this article, the respondent demographics across gender, age, location, education, employment, business sector, experience, and SME affiliation. Males make up 61.9%, while females represent 38.1%. Most respondents are aged 31–45 (49%) and primarily located in Ipoh (35.7%). In terms of education, 60.7% hold a degree and 39.3% possess technical or vocational certificates. Employment-wise, 45.3% work part-time, 35.2% full-time, and 19.4% are self-employed. Nearly half (49.8%) are in agriculture, followed by services (35.6%) and manufacturing (21.8%). Experience-wise, 60.7% have worked 11–20 years in their field. Their SME roles include TVET providers/educators (32.4%), SME employees (26.3%), SME owners/managers (15.8%), students (17.4%) and government officials/policymakers (46.6%).

Measurement Model Overview

The SEM includes three latent constructs Factors Sustainability, TVET and Sustainability each measured by a robust set of reflective indicators. Actors Sustainability is defined through 17 items (fs1–fs20), with strong factor loadings ranging from 0.707 to 0.914, signifying high internal consistency and construct validity. Notably, items fs10, fs8 and fs9 display exceptional loading strength, emphasizing their contribution to how sustainability behavior among actors is captured. TVET is constructed using 16 indicators (ft2–ft17), with loadings between 0.738 and 0.861; items ft6, ft13, and ft9 emerge as key

contributors to vocational education and training effectiveness. Sustainability, the third latent variable, is measured through 15 indicators (d1–d15), showing consistent validity with loadings from 0.745 to 0.852 and standout items like d8, d5 and d14 demonstrating strong relevance to ecological and social outcome dimensions.

Outer Loadings

The outer loadings for all indicators under the constructs d, fs, and ft were examined to assess indicator reliability. According to Hair et al. (2021), loadings above 0.70 are considered acceptable, indicating that the indicators adequately represent their respective latent constructs and contribute meaningfully to the measurement model.

For construct d, all 15 indicators demonstrated strong loadings, ranging from 0.745 (d15) to 0.852 (d8), confirming high internal consistency and reflective validity. Construct fs also showed robust loadings, with values ranging from 0.706 (fs1) to 0.914 (fs10). Notably, fs10 (0.914), fs8 (0.897) and fs12 (0.876) exhibited excellent reliability. Indicators such as fs1 (0.706), fs4 (0.717), and fs20 (0.722), while closer to the lower threshold, were retained due to their theoretical relevance and acceptable contribution to construct validity.

Construct ft displayed consistently strong loadings across all indicators, ranging from 0.738 (ft5) to 0.861 (ft6). High-performing items such as ft6 (0.861), ft13 (0.855), and ft9 (0.844) further reinforce the construct’s measurement robustness. Overall, the outer loading values across all constructs exceeded the minimum threshold, supporting the convergent validity of the measurement model and justifying the inclusion of all indicators in subsequent structural analysis.

Table 1. Outer Loadings for Constructs d, fs, and ft

Item	d	Item	fs	Item	ft
d1	0.801	fs1	0.706	ft2	0.806
d2	0.799	fs2	0.785	ft3	0.751
d3	0.771	fs3	0.823	ft4	0.794
d4	0.790	fs4	0.717	ft5	0.736
d5	0.832	fs6	0.810	ft6	0.859
d6	0.800	fs7	0.871	ft7	0.811
d7	0.830	fs8	0.897	ft8	0.823
d8	0.852	fs9	0.851	ft9	0.843
d9	0.799	fs10	0.914	ft10	0.806
d10	0.775	fs11	0.839	ft11	0.807
d11	0.801	fs12	0.876	ft12	0.797
d12	0.815	fs13	0.794	ft13	0.855
d13	0.780	fs14	0.790	ft14	0.824
d14	0.830	fs15	0.871	ft15	0.804
d15	0.745	fs17	0.761	ft16	0.844
		fs19	0.732	ft17	0.795
		fs20	0.722		

Structural Modelling of the Study

Structural Equation Modelling (SEM) enables testing of hypothesized relationships between sustainability factors, TVET programs, and SME performance. By capturing direct, indirect and mediating effects, SEM validates complex, multidimensional constructs. This robust approach enhances

theoretical refinement and provides empirical insights into how vocational education strengthens SME sustainability in a skills-driven economy. The structural model reveals three primary relationships between the latent constructs. The path from Actors Sustainability to TVET shows a very strong positive coefficient of 0.853, indicating that sustainable practices and behaviors among institutional actors significantly enhance TVET implementation outcomes. The direct path from Actors Sustainability to Sustainability (coefficient = 0.478) demonstrates a moderate but meaningful influence, suggesting that sustainability efforts rooted in actor behavior translate to measurable urban development goals. Lastly, the path from TVET to Sustainability, with a coefficient of 0.331, shows a weaker but still significant positive effect. This implies that while vocational training contributes to sustainability, its influence is most effective when supported by actor-level sustainability strategies.

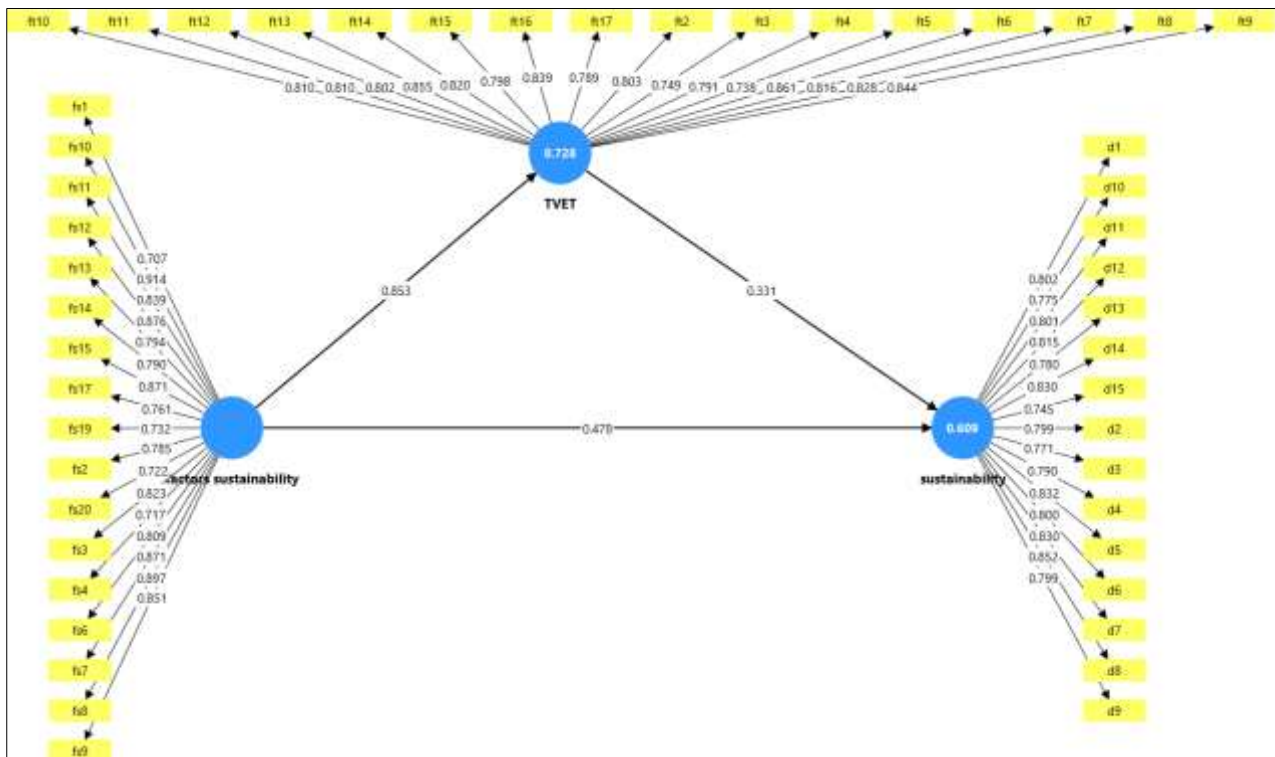


Figure 3. Structural Modelling of the study

Conceptual Interpretation and Mediation Insight

Taken together, the SEM diagram supports a partial mediation model in which TVET acts as a conduit between Actors Sustainability and overall Sustainability. The strongest impact originates from Actors Sustainability, both directly to Sustainability and indirectly through TVET. This structure reinforces the idea that empowered, sustainability-conscious actors are central to driving educational and developmental programs, which then collectively shape broader urban resilience and regenerative outcomes. The diagram reflects a well-structured and empirically supported framework for understanding how strategic education policies and behavioural alignment can jointly produce sustainable city transformations.

Path-Coefficient

Structural Equation Modelling (SEM) confirmed the significance of hypothesized paths linking Factors of Sustainability, TVET Program, and SME Sustainability. The path from Sustainability Factors to SME Sustainability was significant ($\beta = 0.407$, $t = 5.169$, $p = 0.000$), validating the direct role of internal

sustainability practices. A stronger path emerged from Sustainability Factors to the TVET Program ($\beta = 0.852$, $t = 34.248$), emphasizing innovation and human capital. TVET's impact on SME Sustainability ($\beta = 0.407$, $t = 5.255$, $p = 0.000$) affirms its mediating role. Together, these paths support a dual mechanism through which sustainability drivers influence SME resilience and performance.

Table 5. Structural Model Path Coefficients and Significance

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Factors of Sustainability → SME Sustainability	0.407	0.405	0.079	5.169	0.000
Factors of Sustainability → TVET PROGRAM	0.852	0.852	0.025	34.248	0.000
TVET PROGRAM → SME Sustainability	0.407	0.408	0.077	5.255	0.000

Total Effects

The structural model confirms strong, significant relationships among the constructs. The path from Factors of Sustainability to SME Sustainability ($\beta = 0.753$, $t = 20.473$, $p = 0.000$) highlights the powerful impact of internal drivers like strategic alignment and innovation. A robust link is observed between Factors of Sustainability and TVET Program ($\beta = 0.852$, $t = 34.248$), indicating sustainability priorities promote skills development. The TVET Program also significantly influences SME Sustainability ($\beta = 0.407$, $t = 5.255$), underscoring its mediating role. These findings validate the interconnected effects and affirm that holistic strategies are vital for SME resilience and long-term performance.

Table 6. Structural Model Total Effect and Significance

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Factors of Sustainability → SME Sustainability	0.753	0.752	0.037	20.473	0.000
Factors of Sustainability → TVET PROGRAM	0.852	0.852	0.025	34.248	0.000
TVET PROGRAM → SME Sustainability	0.407	0.408	0.077	5.255	0.000

R-Square and Adjusted R-Square

R-square (R^2) measures how well predictor variables explain variance in dependent constructs. For SME Sustainability, an R^2 of 0.613 and adjusted R^2 of 0.610 indicate that approximately 61.3% of the variance is explained by Factors of Sustainability and the TVET Program. The minimal difference suggests the model is both parsimonious and well-specified.

For the TVET Program, an even stronger R^2 of 0.726 (adjusted $R^2 = 0.725$) demonstrates that Factors of Sustainability explain a substantial portion of its variance. These results confirm the model's strong explanatory power and reinforce the pivotal role of sustainability strategies in shaping effective technical and vocational training.

Table 7. R-Square and Adjusted R-Square

Construct	R ²	Adjusted R ²
SME Sustainability	0.613	0.610
TVET Program	0.726	0.725

f² Effect Sizes

Effect size analysis (f²) assesses the unique contribution of each predictor in the structural model. The effect from Factors of Sustainability → TVET Program stands out with a very large effect size (f² = 2.649), confirming that internal sustainability initiatives strongly shape vocational training frameworks. In contrast, Factors of Sustainability → SME Sustainability and TVET Program → SME Sustainability both show small to moderate effects (f² = 0.117), indicating meaningful, though comparatively modest, contributions. These findings align with Cohen’s guidelines and validate the mediating role of TVET. Altogether, the model demonstrates a robust structure where sustainability efforts serve as the engine, while TVET acts as the transmission for advancing SME performance.

Table 8. f-square - Effect Size Table

Effect Relationship	f ² Value
Factors of Sustainability → SME Sustainability	0.117
Factors of Sustainability → TVET Program	2.649
TVET Program → SME Sustainability	0.117

Direct and indirect effect

The results reveal a significant direct and indirect relationship between challenge sustainability and sustainability outcomes. Specifically, the direct effect of challenge sustainability on sustainability is strong, with a path coefficient of 0.761, indicating a substantial and statistically significant influence (t = 21.224, p < 0.001). Additionally, the mediation analysis highlights that challenge sustainability positively impacts TVET (β = 0.853), which in turn enhances sustainability (β = 0.331). This yields a noteworthy indirect effect of 0.282 through TVET, resulting in a total effect of 1.043 when both direct and mediated pathways are considered. These findings underscore the pivotal role of TVET as a strategic mediator, amplifying the influence of sustainability initiatives within the broader ecosystem.

Table 9. Pathway Interpretation

Pathway	Type of Effect	Coefficient	T-Statistic	P-Value
Challenge Sustainability → Sustainability	Direct Effect	0.761	21.224	0.000
Challenge Sustainability → TVET	First Mediating Path	0.853	35.161	0.000
TVET → Sustainability	Second Mediating Path	0.331	4.278	0.000
Challenge Sustainability → TVET → Sustainability	Indirect Effect	0.853 × 0.331 = 0.282	—	—

Pathway	Type of Effect	Coefficient	T-Statistic	P-Value
Total Effect	Direct + Indirect	$0.761 + 0.282 = 1.043$	—	—

The analysis demonstrates that “challenge sustainability” exerts both a direct and mediated impact on sustainability outcomes. The direct effect, quantified at 0.761, reflects the substantial influence of challenge sustainability initiatives on sustainability independent of other variables. Meanwhile, the indirect effect, calculated at 0.282, operates through the mediating role of TVET suggesting that efforts to challenge sustainability significantly enhance TVET, which subsequently contributes to sustainability. When combined, these pathways yield a total effect of 1.043, underscoring the importance of TVET as a strategic enabler within the sustainability ecosystem. This integrated framing strengthens the case for leveraging vocational and educational systems to amplify the reach and efficacy of sustainability policies.

The Mediating Effects

The mediation analysis reveals a meaningful indirect pathway through which challenge sustainability influences sustainability outcomes. The path coefficient from challenge sustainability to TVET is 0.853, indicating a strong and statistically significant association ($t = 35.161, p < 0.001$). Similarly, TVET exerts a positive impact on sustainability with a coefficient of 0.331 ($t = 4.278, p < 0.001$). The calculated indirect effect of challenge sustainability on sustainability via TVET is 0.282, suggesting that a substantial portion of the overall influence occurs through this mediating channel. This indirect pathway underscores the critical role of TVET in enhancing the effectiveness of sustainability initiatives, positioning vocational education as a strategic conduit for translating sustainability challenges into tangible outcomes. By identifying this mediation mechanism, the model provides empirical support for policy and educational interventions that leverage TVET systems to drive sustainable development.

Research Contribution

This study offers a significant contribution to the field of small and medium enterprise (SME) research by examining the dynamic interplay between policy frameworks, technological adoption, and networking initiatives in driving SME competitiveness and sustainability. By positioning Technical and Vocational Education and Training (TVET) as a mediating variable, the study introduces a novel conceptual lens through which the mechanisms of SME development can be better understood. While existing literature acknowledges the importance of TVET, few studies have explored its mediating role within a structured framework. This research bridges that gap, advancing both theoretical discourse and practical application. The contributions are organized into three dimensions: theoretical, practical, and sustainability.

Theoretical Contribution

This study makes a substantive theoretical contribution by proposing an integrated framework that connects policy support, technological readiness, and networking capacity to SME outcomes, with TVET serving as a mediating construct. Unlike prior research that treats these factors in isolation, this model synthesizes them into a unified structure, offering a more holistic understanding of how SMEs can leverage institutional and technological resources for sustainable growth.

The inclusion of TVET as a mediating variable enriches the theoretical foundation of SME development by revealing how vocational education amplifies the impact of external enablers. This framework not only fills a gap in the literature but also provides a platform for future empirical validation across diverse geographic and industrial contexts. It encourages scholars to explore variations in TVET’s mediating role such as differences between urban and rural SMEs or sector-specific dynamics thereby generating

new avenues for academic inquiry and hypothesis testing.

Practical Contribution

From a practical standpoint, the findings offer actionable insights for policymakers, TVET institutions, and SME stakeholders. The study identifies key barriers such as regulatory complexity, limited institutional collaboration, and financial constraints that hinder SMEs from fully accessing and benefiting from TVET programs. These insights inform policy interventions aimed at streamlining regulatory processes, expanding outreach efforts, and directing resources toward underserved enterprises.

For TVET providers, the research highlights the need to tailor training programs to the specific operational realities of SMEs. Recommendations include modular curriculum design, flexible delivery formats (e.g., on-site or digital training), and industry-aligned skill development. The study also advocates for the establishment of regional networking hubs and mentorship platforms to foster collaboration between SMEs and TVET institutions, thereby enhancing knowledge transfer and ecosystem resilience.

Sustainability Contribution

The study contributes meaningfully to sustainability discourse by demonstrating how TVET can serve as a catalyst for environmentally responsible business practices among SMEs. Findings indicate that sustainability-focused TVET modules not only improve operational efficiency but also align SME activities with broader environmental objectives, such as carbon reduction and resource optimization.

By showcasing the tangible benefits of eco-friendly practices such as energy-efficient technologies and waste management systems the research motivates SMEs to adopt sustainable innovations. It also provides a foundation for policy instruments, including tax incentives and grant schemes, that reward sustainability integration. Furthermore, the study encourages TVET institutions to expand their offerings in green technology and environmental management, equipping SMEs with the competencies needed to navigate evolving sustainability demands.

Conclusion

This study affirms the transformative potential of Technical and Vocational Education and Training (TVET) in enhancing the competitiveness and sustainability of small and medium enterprises (SMEs) in Perak. By examining the interconnections between policy frameworks, technological adoption, and networking initiatives, the research identifies key drivers of SME performance and demonstrates how the integration of TVET as a mediating variable amplifies their impact. TVET emerges as a strategic enabler bridging skill gaps, improving operational efficiency, and fostering adaptability in a rapidly evolving economic landscape.

Despite these promising outcomes, the study also highlights persistent systemic barriers, including financial limitations, uneven access to TVET resources, and the urban-rural divide. Addressing these challenges requires targeted interventions such as policy streamlining, digital infrastructure expansion, and the development of sustainability-oriented training programs. The recommendations presented herein offer actionable strategies for policymakers, TVET institutions and SME stakeholders to collaborate in building a more inclusive and responsive support ecosystem.

Ultimately, this research lays a conceptual and empirical foundation for future scholarship and policy innovation. By leveraging the insights generated, stakeholders can strengthen the SME-TVET nexus, ensuring that enterprises in Perak not only endure but flourish. The overarching aspiration is to catalyse sustainable growth and resilience, positioning SMEs as pivotal contributors to regional development and national economic transformation.

Co-Author Contribution

Author 1 carried out the fieldwork, prepared the literature review and overlooked the whole article's write up. Authors 2 wrote the research methodology and did the data entry and carried out the statistical analysis and interpretation of the results.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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