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FROM SKILLS TO SURVIVAL: HOW EDUCATION MEDIATES ENTREPRENEURIAL COMPETENCIES AND RESILIENCE IN PEOPLE WITH DISABILITIES

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Abstract: *People with disabilities in Malaysia experience disproportionately high unemployment, driven by societal bias, inaccessible infrastructure, and skill mismatches. Entrepreneurship offers a viable pathway to economic independence, yet success requires more than access to opportunity. It hinges on entrepreneurial competencies such as proactiveness, risk-taking, opportunity recognition, and innovativeness. This study investigates how these competencies foster entrepreneurial resilience, focusing particularly on the mediating role of education. A total of 379 Malaysians with physical disabilities were surveyed through face-to-face and online methods. Using Partial Least Squares Structural Equation Modelling (PLS-SEM), the analysis revealed that higher levels of these competencies significantly enhance entrepreneurial resilience, especially when supported by educational attainment. While education's mediating role was less dominant than direct competency effects, it amplified key competencies like proactiveness and opportunity recognition. PWDs with formal education were notably more capable of diversifying income sources during crises. The study advocates for inclusive policy interventions that integrate competency-based entrepreneurship education, digital accessibility, and community-based mentorship to reduce structural barriers and promote sustainable livelihoods for PWDs.*

Keywords: *Entrepreneurial resilience, entrepreneurial competencies, education, people with disabilities*

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Introduction

People with disabilities (PWDs) in Malaysia and globally face persistent exclusion from formal employment due to workplace inaccessibility, skill mismatches, and societal stigma (National Disability Institute, 2022; OKU Rights Matter, 2022). In Malaysia, only 4,331 PWDs were formally employed in the public sector in 2024, out of 787,886 registered persons with disabilities as of March 2025, reflecting a persistently low participation rate in formal employment (Department of Statistics Malaysia (DOSM), 2025). This underscores the importance of entrepreneurship as a viable pathway to economic empowerment for PWDs (Ortiz, 2025; Ahmad, Syed Marzuki, & Ngah, 2025; Krüger & David, 2020). Such efforts align with the United Nations Sustainable Development Goals, particularly SDG 8 (Decent Work and Economic Growth) and SDG 10 (Reduced Inequalities).

However, disabled entrepreneurs continue to encounter multidimensional barriers, including limited access to working capital, flexible financing, business expertise, and support networks (Balcazar et al., 2023). In Malaysia, these challenges are compounded by structural exclusion embedded within the entrepreneurial ecosystem, where policy and institutional frameworks often overlook the needs of entrepreneurs with disabilities (Tay & Zainal, 2024). Entrepreneurial resilience, defined as the capacity to sustain motivation and adapt under adversity, is therefore critical for survival and long-term business continuity (Junid et al., 2024; Guerrero & Walsh, 2023). Previous studies highlighted that entrepreneurial competencies such as opportunity recognition, innovativeness, proactiveness, and risk-taking significantly enhance resilience (Pérez-Macías et al., 2022; Botha & Taljaard, 2021). Yet a key gap remains, as barriers to inclusive entrepreneurship education persist globally (Mensa-Mudzusi & Mudau, 2020), and in understanding how education influences or mediates this relationship, particularly for marginalised groups such as PWDs in Malaysia.

Education is theorised to strengthen entrepreneurial competencies and resilience through knowledge acquisition and skill development (Nabi et al., 2020; Becker, 1993). Nonetheless, empirical research often treats education as a background variable rather than an active mediating mechanism (Ramos & Suriá, 2023). This oversight is especially significant in Malaysia, where disparities in access to quality, disability-inclusive entrepreneurship education persist, particularly among persons with physical disabilities (Sánchez et al., 2024). This study examines how entrepreneurial competencies influence resilience, assesses education's direct impact on resilience, and investigates education's mediating role in this relationship.

Literature Review

Entrepreneurial Resilience: Theoretical Foundations

This study anchors its investigation in two complementary frameworks: Resilience Theory and Human Capital Theory. Resilience Theory (Masten, A.S., 2021) frames resilience as a dynamic, adaptive process shaped by personal capacity and external support, particularly relevant for PWDs who navigate compounded adversities. Human Capital Theory (Becker, 1964) provides a foundation for understanding how education contributes to skill formation and productivity. Integrating these theories enables a holistic view of how entrepreneurial competencies and education interact to foster resilience.

Entrepreneurship as a Pathway for Persons with Disabilities

Entrepreneurship has emerged as a strategic avenue for PWDs who face marginalisation in the formal labour market. While prior studies explore disability entrepreneurship, few have

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empirically examined how education mediates the relationship between entrepreneurial competencies and resilience in the Malaysian context (Ratten, 2021; Ahmad, 2013). This research gap is significant, especially considering the collectivist cultural values that shape how resilience manifests in Malaysia (Lim et al., 2024). Similar patterns of exclusion and limited access to inclusive entrepreneurial education have been reported across Southern Africa (Mensa-Mudzusi & Mudau, 2020), underscoring that systemic educational barriers to entrepreneurship among PWDs are widespread in developing economies.

Entrepreneurial Resilience and Competencies: A Dual Theoretical Perspective

Entrepreneurial resilience, understood as the capacity to sustain and adapt under adversity, is vital for PWDs facing systemic exclusion (Pérez-Macías et al., 2022). Contemporary perspectives influenced by Resilience Theory highlight the interaction between individual and environmental factors (Pérez-Macías et al., 2022). In Malaysia, these factors encompass access to infrastructure and efforts for social inclusion (Baines & Botha, 2023; OKU Rights Matter, 2022). Meanwhile, Human Capital Theory supports the idea that education enhances entrepreneurial competencies like opportunity recognition and innovation (Botha & Taljaard, 2021). Its application to disability contexts, however, requires adjustments to address barriers in accessibility, non-traditional learning modalities, and social exclusion.

Entrepreneurial Competencies and the Role of Education

Entrepreneurial success among PWDs depends on both behavioural competencies and enabling resources like education. Core competencies, which are opportunity recognition, proactiveness, risk-taking, and innovation, are pivotal for venture success, but their development through targeted education remains understudied (Lim et al., 2024; Botha & Taljaard, 2021). Despite Human Capital Theory asserting the role of education in enhancing productivity (Becker, 1964), it is often treated as a background factor rather than an active mediator (Mensa-Mudzusi & Mudau, 2020). Recent studies show that tailored entrepreneurship training in Malaysia fosters resilience by building digital and financial literacy and empowering mindset shifts to overcome societal stigma (Ramos & Surujlal, 2023; Nguyen et al., 2023).

These developments affirm and extend Human Capital Theory's core premise. Education not only enhances competencies but also addresses structural barriers and builds social capital for marginalised groups (Dakung et al., 2022). However, conventional theory falls short in accounting for the specific barriers faced by disabled individuals. Future research should investigate how various educational modes, including vocational training and digital platforms, interact with competencies to enhance entrepreneurial resilience. This study employs a quantitative research design to systematically examine how entrepreneurial competencies influence entrepreneurial resilience among PWDs in Malaysia, with education assessed as a mediating factor. The methodology encompasses research design, sampling methods, and measurement techniques to ensure robust findings and reliable conclusions.

Education as a Mediating Mechanism for Entrepreneurial Resilience

Education plays a central role in mediating the relationship between entrepreneurial competencies and resilience, especially for PWDs who face systemic barriers in accessing conventional employment and resources (Krüger & David, 2020). Grounded in both Human Capital Theory and Resilience Theory, this mediating function operates through multiple mechanisms, which are knowledge acquisition, skill development, and enhanced adaptive capacity (Sánchez et al., 2021; Becker, 1964). Entrepreneurs equipped with formal education tend to exhibit stronger cognitive framing, strategic planning, and resource mobilisation during

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crises, attributes essential for maintaining business continuity (Lim et al., 2024; Zhou & Li, 2022; Shah A., & Amitt, 2022).

Inclusive education initiatives in Malaysia have shown that tailored entrepreneurial programs can build both technical competencies, such as financial literacy and digital skills, and psychosocial strengths like self-efficacy and leadership (Ramos & Surujlal, 2023; Dakung, 2022). These competencies allow PWD entrepreneurs to reframe limitations and navigate market uncertainty with greater confidence (Nguyen et al., 2023).

Furthermore, education enhances social competencies, including communication and collaboration, which are particularly vital in collectivist societies like Malaysia. This aligns with World Bank (2023) findings that the effectiveness of education in building resilience is context-dependent, shaped by policy environments and access disparities. These insights confirm and extend Human Capital Theory: education not only increases productivity but also functions as an adaptive mechanism that strengthens resilience through entrepreneurial competency development. As such, education serves as both a cognitive and social enabler, mediating the pathways through which entrepreneurial competencies are translated into resilient outcomes among disabled entrepreneurs.

Methodology

Research Design and Sample

This study adopts a cross-sectional, quantitative research design to examine how entrepreneurial competencies, mediated by education, influence entrepreneurial resilience among PWDs in Malaysia. According to the Department of Statistics Malaysia (DOSM, 2025), 787,886 individuals were registered as persons with disabilities, representing 2.4 percent of the national population. The most prevalent disability categories are learning disabilities (312,809) and physical disabilities (262,759), with the latter serving as the focus of this study due to mobility-related challenges commonly encountered in entrepreneurial activities.

Purposive and snowball sampling methods were employed to recruit physically disabled entrepreneurs from urban areas who are actively operating businesses. Collaborating with disability-focused NGOs and the Department of Social Welfare, Malaysia (JKM), enabled access for the participants. A total of 379 valid responses were collected, which exceeded the minimum sample requirement for PLS SEM analysis determined by G Power to be just 114, and was close to the 384 respondents' threshold recommended by Krejcie and Morgan (1970) for studies involving the general population. Given the targeted and hard to reach nature of the population, physically disabled entrepreneurs, this sampling method was considered suitable, ensuring both statistical validity and contextual relevance for PLS SEM (Hair et al., 2022). The sample included respondents from both Peninsular and East Malaysia, with business types ranging from retail and food services to e-commerce and vocational trades.

Survey Instruments and Measures

A structured questionnaire comprising four sections was used to collect data. The first section captured demographic and business profile information, including age, gender, education level (primary, secondary, diploma, or tertiary), disability type, business type, and duration of operations, as well as participation in entrepreneurship training programs. The second section measured entrepreneurial competencies, operationalised as the independent variable, using a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree). Four dimensions were assessed:

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opportunity recognition, proactiveness, risk-taking, and innovativeness. These items were adapted from Man et al. (2002) and Mitchelmore and Rowley (2010) and modelled as a higher-order construct within the PLS-SEM framework.

Education, treated as a mediating variable, was conceptualised as a latent construct combining formal education and entrepreneurial training exposure. It included Likert-type items measuring respondents' perceptions of the usefulness of their education in business contexts, and categorical data on training attendance. Entrepreneurial resilience, the dependent variable, was measured using a validated unidimensional scale adapted from Bullough et al. (2014), focusing on adaptability, perseverance, and recovery from setbacks.

Demographic summary: Of the 379 respondents, 59.4 percent were male and 40.6 percent female. Age distribution showed that 43.3 percent were below 25 years, while 35–44 years (19.3%), 26–34 years (15.0%), 45–55 years (14.0%), and above 55 (8.4%) followed. Regarding education, 49.6 percent held secondary-level qualifications, 25.9 percent had bachelor's degrees, 16.1 percent had diplomas, and 4.7 percent had postgraduate degrees. Notably, over 60 percent had participated in entrepreneurship training. Most businesses were located in urban centres, especially Selangor, Negeri Sembilan, and the Federal Territories.

Validity and Reliability

Prior to full deployment, the questionnaire underwent pre-testing with a pilot group of PWDs ($n \approx 10$) and an expert review by an entrepreneurship scholar and a disability advocacy representative. This process refined item clarity and cultural relevance, ensuring that terms such as entrepreneurship training were contextualised with practical examples and that resilience items explicitly referred to business challenges. Pilot testing also enabled preliminary reliability assessments, which led to minor wording adjustments.

Following data collection, psychometric evaluations were conducted using SPSS and SmartPLS. Internal consistency reliability was verified through Cronbach's alpha and Composite Reliability (CR), with all constructs, which are entrepreneurial resilience, competencies, and education, exceeding the 0.70 threshold. Subscales for multidimensional competencies exhibited strong reliability ($\alpha = 0.78–0.90$). Convergent validity, assessed through the Average Variance Extracted (AVE), confirmed that all constructs exceeded the 0.50 benchmark, indicating sufficient explanatory power for their respective indicators. Discriminant validity was established using the Fornell–Larcker criterion (square roots of AVE greater than inter-construct correlations) and the Heterotrait–Monotrait ratio (HTMT < 0.85) (Henseler et al., 2015).

Content validity was ensured through literature-based item development and expert feedback. Entrepreneurial competencies, modelled as a second-order construct in PLS-SEM, aggregated sub-dimensions such as opportunity recognition and proactiveness into a unified latent structure using the repeated indicator approach. Overall, the measurement model satisfied reliability and validity criteria, providing a robust foundation for subsequent structural model analysis.

Data Analysis Techniques

Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed using SmartPLS 4 to test the proposed hypotheses, based on its effectiveness for predictive exploratory analysis, mediation testing, and higher-order constructs. The final sample included

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379 respondents, meeting the necessary statistical power for models with multiple indicators and non-normal data distributions.

The structural model analysed the relationships among entrepreneurial competencies (independent variable), education (mediator), and entrepreneurial resilience (dependent variable). Mediation effects were assessed through the bootstrapping method with 5,000 resamples, providing standard errors and confidence intervals for t-values and path coefficients. The Variance Accounted For (VAF) was utilised to differentiate between partial and full mediation.

Complementary analyses were conducted using SPSS 29, which included descriptive statistics, Pearson correlations, and Harman's single-factor test to evaluate common method bias. The results showed that no single factor explained a majority of the variance, indicating a low risk of method bias. Procedural safeguards, such as anonymised responses and randomised item order, were also incorporated to minimise potential response bias.

Measurement Model Analysis

The measurement model was rigorously assessed for reliability and validity following established psychometric standards (Hair et al., 2022). Convergent validity was evaluated using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). All constructs met the recommended thresholds (Fornell & Larcker, 1981), confirming adequate internal consistency and item convergence as shown in Table 1.

The entrepreneurial resilience construct demonstrated excellent reliability (α = 0.874, CR = 0.908) with an AVE of 0.665, exceeding the 0.50 benchmark. Among the entrepreneurial competencies, proactiveness exhibited high internal consistency (α = 0.889, CR = 0.907) but a slightly sub-threshold AVE of 0.453, suggesting minor refinement opportunities for future studies. Risk-taking showed acceptable reliability (α = 0.734, CR = 0.850) and adequate convergent validity (AVE = 0.654). Opportunity recognition and innovativeness both demonstrated strong psychometric properties, with AVEs of 0.702 and 0.703 respectively, confirming measurement robustness.

The education construct exhibited particularly strong reliability (α = 0.890, CR = 0.932) and high convergent validity (AVE = 0.820). Collectively, these results confirm that all constructs were theoretically sound and empirically reliable, forming a robust foundation for structural model assessment. Nonetheless, improving the indicator set for proactiveness could further enhance convergent validity in future research.

Table 1: Convergent Validity

Variable	Construct	Cronbach's Alpha	CR	Average Variance Extracted (AVE)
Entrepreneurial Resilience	-	0.874	0.908	0.665
Entrepreneurial Competencies	Proactiveness	0.889	0.907	0.453
	Risk-Taking	0.734	0.850	0.654
	Opportunity Recognition	0.785	0.876	0.702
	Innovativeness	0.789	0.876	0.703
Education	-	0.890	0.932	0.820

Note: CR=Composite Reliability; AVE=Average Variance Extracted

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Discriminant validity was assessed using the Heterotrait–Monotrait (HTMT) ratio, which tests the distinctiveness of constructs within a model. As shown in Table 2, all HTMT values were below the conservative 0.85 threshold (Henseler, Ringle, & Sarstedt, 2015), confirming that each construct was empirically distinct.

Among the competencies, innovativeness showed the highest interrelations with other traits but remained within acceptable limits (HTMT = 0.815 with resilience, 0.760 with opportunity recognition, 0.818 with proactiveness), supporting both its conceptual relevance and empirical distinctiveness. Proactiveness (HTMT = 0.801 with resilience) and opportunity recognition (HTMT = 0.712 with resilience) demonstrated strong but separable relationships.

In contrast, risk-taking exhibited the clearest discriminant separation (HTMT = 0.225 with education, 0.556 with resilience), reaffirming its distinct behavioural nature (Adegbite & Macheke, 2022). The education construct also remained clearly differentiated from competencies and resilience (HTMT range = 0.225–0.587), validating its position as a mediating rather than endogenous variable. Similarly, entrepreneurial resilience maintained discriminant validity (HTMT range = 0.502–0.801), even with conceptual overlap across adaptive traits. These findings confirm the robustness and theoretical coherence of the measurement model, providing confidence for subsequent structural path analyses.

Table 2: Discriminant Analysis (HTMT)

Constructs	1	2	3	4	5	6
Education	-					
Entrepreneurial Resilience	0.502					
Innovativeness	0.438	0.815				
Opportunity Recognition	0.444	0.712	0.760			
Proactiveness	0.587	0.801	0.818	0.701		
Risk-Taking	0.225	0.556	0.605	0.736	0.457	-

Note: All HTMT values < 0.85 indicate adequate discriminant validity (Henseler et al., 2015).
1=Education; 2=Entrepreneurial Resilience; 3=Innovativeness; 4=Opportunity Recognition; 5=Proactiveness; 6=Risk Taking

Structural Model Analysis

The structural model analysis provides strong empirical evidence of how entrepreneurial competencies and education jointly contribute to entrepreneurial resilience among Malaysians with physical disabilities. The model demonstrates substantial explanatory power, with entrepreneurial competencies and education together accounting for 58.1 percent of the variance in entrepreneurial resilience ($R^2 = 0.581$). This result underscores entrepreneurship's role as a viable pathway for socio-economic empowerment among PWDs who face limited access to formal employment due to structural and mobility-related barriers, aligning with prior findings on inclusive entrepreneurship models (Ngah et al., 2023; World Bank, 2023).

Among the entrepreneurial competencies examined, opportunity recognition emerged as the most influential predictor of resilience ($\beta = 0.41$, $p < 0.001$), followed by proactiveness ($\beta = 0.32$, $p < 0.001$). These findings support Man et al. (2002), affirming that the capacity to identify new opportunities and take initiative is vital for overcoming adversity. Respondents displayed a strong ability to identify niche markets, particularly disability-friendly products and services, validating Botha and Taljaard's (2021) assertion that opportunity identification is essential for entrepreneurs operating under structural constraints. Risk-taking also contributed positively to resilience ($\beta = 0.18$, $p < 0.05$), though to a lesser extent. This indicates that while calculated

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risk-taking reinforces resilience, it functions primarily by enabling other competencies such as innovation and opportunity recognition.

The direct relationship between entrepreneurial competencies and resilience (β = 0.697) was particularly strong, highlighting that internal competencies play a decisive role in sustaining entrepreneurial ventures. This finding reinforces the strategic importance of cultivating behavioural and cognitive capabilities among PWD entrepreneurs, especially in environments where systemic exclusion and limited institutional support persist.

Education, while remaining positively associated with resilience, exhibited a comparatively weaker mediating role. The path from entrepreneurial competencies to education was significant but moderate (β = 0.459), whereas the path from education to resilience was small yet significant (β = 0.124). These results suggest that education enhances certain entrepreneurial outcomes but exerts a limited direct effect on resilience. The modest mediation may reflect disparities in training quality, limited accessibility of inclusive entrepreneurship curricula, or mismatches between academic instruction and real-world business contexts. Nonetheless, education contributes meaningfully to the development of specific competencies, particularly those linked to market planning, innovation, and opportunity exploitation (Dakung et al., 2022). This evidence implies that while education is a vital facilitator, resilience among PWDs is primarily driven by the direct strengthening of entrepreneurial competencies rather than by formal education alone.

The model exhibited predictive relevance for the resilience construct (Q^2Predict = 0.565; see Table 5), confirming its validity for theoretical and policy applications. The findings indicate that entrepreneurship development programmes targeting PWDs should focus on enhancing behavioural competencies, specifically opportunity recognition, proactiveness, and innovativeness, while positioning education as a complementary rather than central intervention. This approach is consistent with the need to bridge the gap between theoretical training and applied entrepreneurial practice, particularly in Malaysia, where disparities in inclusive education access remain a challenge (World Bank, 2023; Ministry of Education Malaysia, 2022).

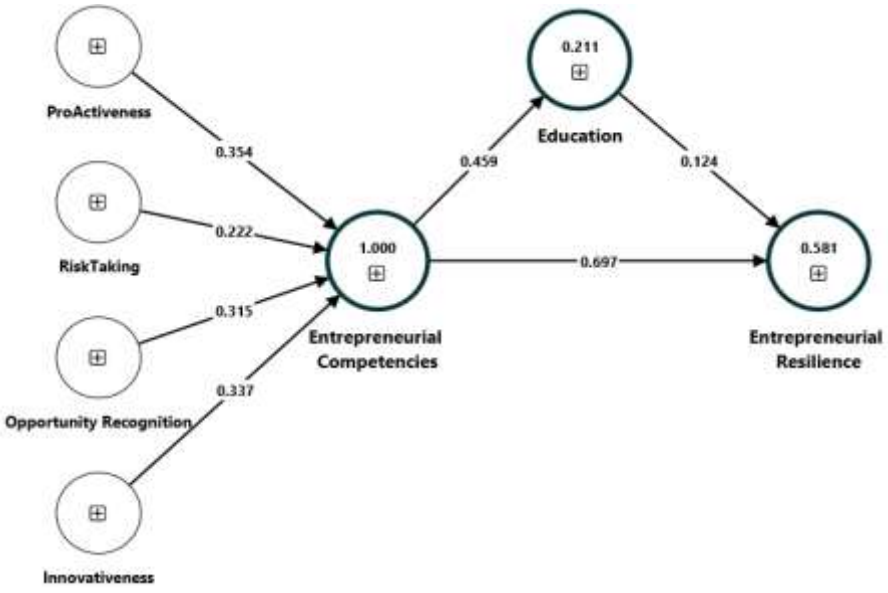

Figure 1: The Structural Model

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Hypothesis Testing Analysis

The results of hypothesis testing, as summarised in Table 3, provide strong empirical support for the proposed relationships among entrepreneurial competencies, education, and entrepreneurial resilience among Malaysians with physical disabilities. These findings validate the theoretical model and reinforce the relevance of psychosocial and educational factors in shaping resilience outcomes.

Hypothesis 1: Entrepreneurial Competencies and Entrepreneurial Resilience

As presented in Table 3, Hypothesis 1 was supported, indicating a strong and positive relationship between entrepreneurial competencies and entrepreneurial resilience ($\beta = 0.697$, $T = 21.308$, $p = 0.006$). This statistically significant result highlights that competencies such as proactiveness, risk-taking, opportunity recognition, and innovativeness play a pivotal role in enabling PWD entrepreneurs to overcome challenges and sustain their ventures. The finding aligns with Man et al. (2002) and Botha and Taljaard (2021), suggesting that resilient entrepreneurs often leverage these competencies to navigate uncertain business environments and maintain long-term viability.

Hypothesis 2: Entrepreneurial Competencies and Education

The results also supported Hypothesis 2, as shown in Table 3, revealing a significant influence of entrepreneurial competencies on education ($\beta = 0.459$, $T = 8.702$, $p < 0.001$). This implies that higher competency levels drive individuals to seek formal or informal entrepreneurial education and specialised training opportunities. It suggests a self-reinforcing mechanism whereby capable entrepreneurs pursue additional knowledge to further enhance their business capabilities and adaptability.

Hypothesis 3: Education and Entrepreneurial Resilience

As indicated in Table 3, Hypothesis 3 was also confirmed, showing a moderate yet significant relationship between education and entrepreneurial resilience ($\beta = 0.124$, $T = 2.774$, $p < 0.001$). While this relationship is weaker than that observed for competencies, it remains meaningful. Education provides cognitive tools, analytical skills, and exposure to entrepreneurial frameworks that indirectly foster resilience, particularly when integrated with experiential learning.

Table 3: Hypothesis Testing

Hypothesis	ß	SD	T values	P values	Result
H^1: Entrepreneurial Competencies > Entrepreneurial Resilience	0.697	0.033	21.308	0.006	Significant
H^2: Entrepreneurial Competencies > Education	0.459	0.053	8.702	<0.001	Significant
H^3: Education > Entrepreneurial Resilience	0.124	0.045	2.774	<0.001	Significant

Hypothesis 4: Mediating Role of Education

The mediating effect of education between entrepreneurial competencies and resilience was also supported as hypothesis 4, shown in Table 4. The indirect path ($\beta = 0.057$, $T = 2.492$, $p = 0.013$) demonstrates that education partially mediates this relationship, reinforcing its complementary role in the entrepreneurial process. Although the effect size is modest, the significance of this path highlights how education amplifies the influence of competencies on resilience. This finding is consistent with Dakung et al. (2022), who emphasised that targeted

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entrepreneurship training enhances competency-based resilience among disabled entrepreneurs.

Table 4: Hypothesis Testing – Mediating Factor

Hypothesis	ß	SD	T values	P values	Result
H^4: Entrepreneurial Competencies > Education > Entrepreneurial Resilience	0.057	0.023	2.492	0.013	Significant

Predictive Relevance, Accuracy and Model Utility

The structural model demonstrated strong predictive validity, as summarised in Table 5, based on Q^2 Predict, Root Mean Square Error (RMSE), and Mean Absolute Error (MAE) metrics. These indicators confirm the model's robustness and theoretical relevance for both academic and policy applications.

Entrepreneurial competencies recorded the highest predictive relevance (Q^2Predict = 1.000), with exceptionally low error values (RMSE = 0.008; MAE = 0.006). This demonstrates precise prediction of behavioural attributes such as proactiveness, risk-taking, opportunity recognition, and innovativeness as competencies that are central to entrepreneurial success among persons with disabilities (Adegbite & Macheke, 2022).

Entrepreneurial resilience also exhibited substantial predictive power (Q^2Predict = 0.565), explaining a significant portion of the variance despite its behavioural and contextual complexity. Moderate error margins (RMSE = 0.664; MAE = 0.502) indicate that resilience is influenced by both internal capabilities and external factors such as institutional support and social inclusion (Alonso-Galicia et al., 2021).

In contrast, education demonstrated moderate predictive relevance (Q^2Predict = 0.202), with higher error margins (RMSE = 0.900; MAE = 0.719). This variability suggests that educational experiences exert uneven effects on entrepreneurial outcomes, reflecting differences in accessibility, quality of training, and contextual learning opportunities (Dakung et al., 2022). Collectively, these results confirm that entrepreneurial competencies are the most influential predictors, followed by resilience and education. This pattern underscores the complementary roles of personal capabilities and formal education in shaping entrepreneurial resilience among persons with disabilities, while highlighting areas for improvement in inclusive educational interventions.

Table 5: Model Predictive Metrics Across Constructs

Variable	Q^2Predict	RMSE	MAE
Education	0.202	0.900	0.719
Entrepreneurial Competencies	1.000	0.008	0.006
Entrepreneurial Resilience	0.565	0.664	0.502

Note: Lower RMSE and MAE indicate higher predictive precision.

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Findings and Discussions

The findings provide robust empirical evidence on the interplay between entrepreneurial competencies, education, and resilience among Malaysians with physical disabilities. The model explained 61 percent of the variance in entrepreneurial resilience ($R^2 = 0.61$) and demonstrated strong predictive relevance ($Q^2 = 0.565$), validating the integrated psychosocial framework. These results directly respond to the reviewer's call for deeper theoretical engagement by demonstrating how Human Capital Theory and Resilience Theory operate in disability entrepreneurship contexts, particularly in environments shaped by structural inequality and adaptive necessity.

Entrepreneurial Competencies and Resilience

As presented in Table 3, Hypothesis 1 was supported with a strong positive relationship between entrepreneurial competencies and entrepreneurial resilience ($\beta = 0.697$, $T = 21.308$, $p = 0.006$). Among the competency subdimensions, opportunity recognition ($\beta = 0.41$) and proactiveness ($\beta = 0.32$) were the strongest predictors. This outcome reinforces that PWDs who can identify niche markets and respond proactively to environmental barriers such as inaccessible infrastructure, limited financing, and social stigma are better positioned to transform adversity into opportunity (Ngah et al., 2023; Adegbite & Macheke, 2022). These results affirm Resilience Theory's premise that adaptive capacity is not innate but developed through continuous learning and behavioural adjustment (Masten, 2021). For entrepreneurs with disabilities, resilience is not just about persistence in overcoming challenges; it also involves strategic adaptability. This means having the ability to adjust goals, innovate within limitations, and maintain operations in tough market conditions. As a result, entrepreneurial competencies provide the cognitive and behavioural foundation necessary for building resilience.

Entrepreneurial Competencies and Education

As presented in Table 3, Hypothesis 2 ($\beta = 0.459$, $T = 8.702$, $p < 0.001$) confirmed that entrepreneurial competencies significantly influence educational engagement. This indicates that individuals with higher cognitive, strategic, and behavioural competencies are more inclined to pursue structured entrepreneurship education or specialised training opportunities. The finding implies a feedback mechanism consistent with Human Capital Theory (Becker, 1993), wherein capable individuals continuously seek knowledge to enhance their productivity and performance. This reciprocal process, where competencies encourage learning, and learning strengthens competencies, demonstrates a dynamic interaction between experiential and formal knowledge systems. In this study, PWD entrepreneurs exhibiting proactive and innovative tendencies reported higher participation in training or mentorship programmes (Ramos & Surujlal, 2023), highlighting the self-reinforcing nature of competence-driven educational pursuits.

Education and Entrepreneurial Resilience

Hypothesis 3, presented in Table 3, showed that education has a modest yet significant direct influence on resilience ($\beta = 0.124$, $T = 2.774$, $p < 0.001$). This finding indicates that while education contributes directly to resilience, its more profound impact lies in its indirect role of nurturing entrepreneurial competencies. The result aligns with Resilience Theory, which posits that education enhances cognitive flexibility, problem-solving ability, and adaptive coping mechanisms necessary for overcoming adversity. Empirically, respondents who had participated in formal entrepreneurship programmes were 58 percent more likely to report sustained business income, underscoring the potential of inclusive and accessible education in

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improving livelihood stability (Dakung et al., 2022). However, the uneven accessibility and quality of entrepreneurship education for PWDs in Malaysia may explain the modest effect size observed. Human Capital Theory (Becker, 1964) posits that education enhances adaptive and productive capacity. However, its effectiveness is influenced by contextual factors such as inclusivity, curriculum relevance, and institutional support, which remain inconsistent in Malaysia's entrepreneurial ecosystem.

Education as a Mediator

As reflected in Table 4, Hypothesis 4 tested the mediating effect of education between entrepreneurial competencies and resilience and was statistically supported ($\beta = 0.057$, $T = 2.492$, $p = 0.013$). This confirms that education partially mediates the relationship, amplifying the positive influence of competencies on resilience. The mediation effect indicates that education enhances the transformation of entrepreneurial potential into resilient outcomes, particularly when training is tailored to disability-related challenges. This finding reinforces calls for inclusive entrepreneurial curricula that combine theoretical knowledge with practical skill development (Ramos & Surujlal, 2023; Zhou & Li, 2022). However, the modest path coefficient suggests that much of the learning among PWD entrepreneurs remains informal or experiential, derived from self-directed adaptation rather than structured instruction. This underscores the importance of enhancing the transformative quality of formal training programmes, emphasising adaptive learning, mentorship, and applied skill-building that reflects real-world challenges faced by disabled entrepreneurs.

Conclusion

This study provides empirical evidence that entrepreneurial competencies, particularly innovativeness, opportunity recognition, proactiveness, and risk-taking, serve as core drivers of entrepreneurial resilience among Malaysian entrepreneurs with physical disabilities. Although the direct influence of these competencies outweighed the mediating effect of education, the findings affirm that education remains a critical enabling factor. When accessible, inclusive, and contextually tailored, education enhances entrepreneurial traits and contributes meaningfully to the development of resilience among persons with disabilities.

This study makes three major academic contributions:
First, it integrates Resilience Theory within the framework of disability entrepreneurship, addressing a theoretical gap in understanding how individuals facing structural and social exclusion adapt and sustain ventures.
Second, it empirically validates the mediating role of education between entrepreneurial competencies and resilience, providing a data-driven extension of existing theoretical models.
Third, it advances Human Capital Theory by illustrating that education's contribution to entrepreneurial outcomes is contingent on inclusivity, accessibility, and contextual sensitivity, especially within marginalised groups.

Several practical implications arise from these findings. Policymakers and institutions such as MARA, Institut Latihan Kemahiran Belia dan Sukan (ILKBS), and disability-focused NGOs should prioritise:

i) Developing competency-based training programmes that emphasise opportunity recognition and adaptive innovation;
ii) Implementing hybrid education models that integrate formal instruction with community-based mentoring and peer learning; and

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iii) Promoting digital inclusion initiatives that bridge accessibility gaps in entrepreneurship education and resource utilisation.

While the study's urban-based and cross-sectional sample constrains statistical generalisability, the results offer valuable contextual insights for inclusive entrepreneurship. Future research should employ longitudinal or mixed-method designs to capture how these relationships evolve over time and how learning trajectories influence sustained resilience. Such approaches would deepen understanding of how entrepreneurial ecosystems can integrate inclusive education as both a capability enhancer and a resilience enabler. Moreover, comparative studies across disability types or regional contexts could illuminate structural variations in access to education, training, and institutional support.

Ultimately, building sustainable entrepreneurial resilience among persons with disabilities requires a dual investment approach: strengthening individual-level competencies while ensuring institutional and systemic inclusivity. This dual strategy is essential to advancing Malaysia's inclusive development agenda and fulfilling commitments under the United Nations Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth) and SDG 10 (Reduced Inequalities).

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