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# The Impact of Digital Skills on Economic Independence among Technical and Vocational Education and Training (TVET) Graduates in Delta State, Nigeria

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## *Abstract*

This study investigated the impact of digital skills on economic independence among TVET graduates in Delta State, Nigeria, and whether reliable internet access moderates these relationships. A cross-sectional quantitative survey involved 506 TVET graduates that are currently running a postgraduate programme (PGD, master's, PhD) across public and private institutions, recruited via WhatsApp groups using random sampling. A structured questionnaire measured proficiency in ten digital-skill domains (5-point Likert), binary entrepreneurial engagement, six-month income ranges, and internet reliability. Descriptive statistics profiled skill levels. Binary logistic regression tested digital-skills' effect on business ownership, and OLS regression assessed impacts on income. Interaction terms between digital skills and internet reliability examined moderation. Model fit was confirmed with Hosmer–Lemeshow tests and VIF checks. Graduates scored highest in online research and information evaluation (mean = 4.10) and lowest in data analytics (2.30) and basic coding (2.21). A one-unit increase in digital skills raised entrepreneurship odds ($\beta = 0.56$, $p < .001$) and increased monthly income by ₦24,130.51 on average ($\beta = 0.78$, $p < .001$). Reliable internet directly boosted entrepreneurship ($\beta = 0.45$, $p < .001$) and income ($\beta = 0.65$, $p < .001$) and significantly amplified digital-skills' benefits (interaction $\beta = 0.85$ for entrepreneurship; $\beta = 0.89$ for income; $p < .001$). Economic independence among TVET graduates depends on both the depth of digital competencies and the quality of internet connectivity that enables their application. Delta State Government and the Nigeria Communications Commission should urgently invest in affordable broadband and stable power around TVET campuses.

**Keywords:** Digital Skills, Economic Independence, Technical and Vocational Education and Training (TVET), TVET Graduates, Delta State.

# Introduction

The rapid shift toward a knowledge-driven global economy has rendered digital competence indispensable for employability, particularly among Technical and Vocational Education and Training (TVET) graduates whose role is to supply industry with job-ready talent (Grech & Camilleri, 2020; Mata, 2015; Papier, 2021). Digital skills encompass a spectrum from basic e-literacy such as keyboard use, file management, online safety to advanced proficiencies in data analytics, coding, and platform-based entrepreneurship (Grech & Camilleri, 2020). These competencies underpin productivity across manufacturing (via Industry 4.0 tools), service sectors (through e-commerce and digital marketing), and lifelong learning ecosystems that demand continuous upskilling (Papier, 2021). Empirical studies link the depth and diversity of digital skills to better academic performance and economic outcomes for TVET graduates (Mbambo & du Plessis, 2025), validating the imperative to weave both foundational and specialist digital modules into TVET curricula.

Yet the translation of digital training into economic independence remains uneven. Economic independence meeting personal needs through self-generated income rather than external transfers (Levy Institute, 2024) is typically gauged by metrics such as self-employment rates, financial-inclusion scores, and venture performance (World Bank, 2023; Heritage Foundation, 2025; Mbambo & du Plessis, 2025). Despite TVET reforms and donor-funded ICT labs, fewer than 18 percent of polytechnic leavers in Nigeria feel confident handling e-commerce or data-analytics tasks, and under 10 percent monetise social-media marketing within six months (Joseph & Ogedengbe, 2020). Structural barriers intermittent broadband, high data costs, scant incubation finance further stifle the conversion of classroom learning into sustainable earnings (Tondi, 2023). States that integrate curriculum reform with network expansion and enterprise support, however, see sharper declines in youth unemployment (National Bureau of Statistics, 2024), underscoring the need for a holistic, systems-level approach.

Delta State exemplifies this disconnect. Hosting six public TVET colleges and numerous private institutions including Bellarks Polytechnic, Calvary Polytechnic, Evans Light Technical College, All Nations Institute of Marine & Technology, and Conarina Maritime Academy the state nevertheless, endures youth unemployment rates above the national average and high start-up failure within 24 months (Ministry of Economic Planning, 2024). Although most graduates receive some ICT exposure, only a minority translate these skills into viable ventures, citing unstable internet, limited digital-marketing expertise, and inadequate mentorship as primary bottlenecks (Joseph & Ogedengbe, 2020; Tondi, 2023; Abd Karim & Mustapha, 2022)

Comparative research in Oyo State shows

that without deliberate cultivation of entrepreneurial digital skills creativity, ICT proficiency, and online marketing self-reliance remains elusive (Araoye et al., 2024), while a Kenyan audit warns that pedagogical and infrastructural gaps can neutralise even the best-designed digital curricula (Mutembei, 2024).

These observations reveal a pressing research gap: the specific digital skill clusters that most strongly predict entrepreneurial engagement and income, and the degree to which reliable internet access modulates this relationship, have not been established for resource-constrained Nigerian contexts. While broad cross-country studies map digital literacy trends (Vejayaratnam et al., 2019; Araoye et al., 2024), and frameworks on employability (Mata, 2015), talent strategies (Tahir & Abdullah, 2024), and TVET digitisation (Grech & Camilleri, 2020) offer valuable insights, they stop short of delivering context-responsive empirical evidence. By operationalising economic independence through entrepreneurial engagement and average monthly income, this study aims to pinpoint which digital competencies and under what connectivity conditions unlock real pathways to self-reliance for TVET graduates in Delta State. Its findings will equip curriculum designers, broadband planners, and entrepreneurship-support agencies with targeted data to maximize socio-economic impact.

**Objectives of the Study**

1. To identify the most common digital skills possessed by TVET graduates in Delta State.
2. To determine the impact of digital skills on TVET graduates' economic independence (entrepreneurship engagement and average monthly income).
3. To examine whether access to reliable internet moderates the relationship between digital skills and entrepreneurship success.

**Theoretical Framework**

This study is anchored on Human Capital Theory and the Capability Approach to explain how digital skills may influence the economic independence of TVET graduates. Human Capital Theory holds that education, training, and skills acquisition are productive investments that improve individuals' efficiency, employability, and earning potential (Schultz, 1961; Becker, 1964). Within the context of TVET, this perspective is relevant because digital competence can be understood as a form of human capital that increases graduates' capacity to participate in modern labour markets, create digital enterprises, and respond to changing workplace demands (Mata, 2015; Grech & Camilleri, 2020). From this standpoint, graduates who possess stronger digital skills, such as online communication, e-commerce operations, data handling, and digital marketing, are more likely to convert training into entrepreneurial engagement and improved monthly income (Papier, 2021; Mbambo & du Plessis, 2025). The theory therefore helps explain the expected positive relationship between digital skill acquisition and economic independence.

However, Human Capital Theory alone does not fully explain why individuals with similar training may experience different outcomes. For this reason, the Capability Approach provides an important complementary lens. The Capability Approach emphasizes not only the possession of skills, but also the real freedom and opportunity to use those skills to achieve valued outcomes (Sen, 1999; Nussbaum, 2000). In this study, reliable internet access represents a key enabling condition that can expand or constrain what TVET graduates are practically able to do with their digital knowledge (Tondi, 2023; Abd Karim & Mustapha, 2022). A graduate may possess digital skills, yet still be unable to translate them into income if internet access is unstable, unaffordable, or unavailable (Joseph & Ogedengbe, 2020). Thus, skills alone are insufficient unless supportive conditions exist for those skills to become economically meaningful.

Together, these two perspectives provide a clear analytical foundation for the study. Human Capital Theory explains why digital skills matter, while the Capability Approach explains the conditions under which those skills can produce real economic independence among TVET graduates in Delta State (Sen, 1999; Becker, 1964).

**Materials and Methods**

A cross-sectional quantitative design was employed. Data were obtained through a structured questionnaire administered to 506 TVET graduates enrolled in postgraduate programmes (PGD, master's, or PhD) in public and private higher institutions across Delta State. Participants were recruited through verified alumni WhatsApp groups of bona fide postgraduate TVET graduates. Although this approach enabled broad reach, rapid circulation, and cost-efficient participation across the state, it is more appropriately classified as a non-probability convenience sampling strategy rather than true random sampling. To improve coverage, the sample was stratified by major TVET fields, namely ICT, technical trades, hospitality, and service-trade programmes. The focus on postgraduate students was considered appropriate because they had completed prior degrees, were more likely to have work or entrepreneurial exposure, and possessed the literacy required for accurate self-reporting.

Ethical approval was obtained from the university review board, and informed consent was secured from all respondents before data collection. The instrument contained two sections. Section A captured demographic and control variables, including age, gender, programme of study, and institution. These variables were entered as controls in the regression models to account for potential confounding effects on entrepreneurial engagement and income. Section B measured digital-skills proficiency using a 10-item index rated on a 5-point Likert scale (1 = not at all to 5 = proficient). Items covered competencies in Microsoft Office applications, graphic design tools, and social media management. The questionnaire also measured entrepreneurial engagement through a binary indicator of business ownership and venture characteristics, average monthly income using categorical ranges for the previous six months, and internet reliability through items assessing consistency and speed of access.

Content validity was established through expert review, while pilot testing with 30 respondents produced Cronbach's alpha coefficients above 0.80 for all multi-item scales, indicating satisfactory internal consistency (Borowska, 2020). Data were collected over three months using both online (Google Forms) and paper-based formats. Responses were coded and analysed in SPSS version 26 using established procedures for transparent and reproducible data management (Dayal, 2020). Missing data, which accounted for less than 2% of responses, were handled through mean imputation.

Prior to regression analysis, key assumptions were assessed. Normality was examined using residual distribution checks, homoscedasticity was evaluated through residual plots (*figure 1*), and independence of errors was considered during model specification. Multicollinearity among predictors and control variables was tested using Variance Inflation Factors (VIFs), with results indicating acceptable thresholds. For the logistic regression model predicting entrepreneurial engagement, the Hosmer-Lemeshow goodness-of-fit test was used to assess model adequacy. The inclusion of these diagnostic procedures strengthens the methodological rigor of the study and supports the credibility of the reported findings. Data analysis procedures for each research objective are summarised in Table 1.

**Table 1: Summary of methodology applied in addressing each objective**

| Objective | Variable(s) | Model & Rationale |
|---|---|---|
| **Obj 1** | Ten 5-point items | Descriptive statistics (frequencies, means ± SD) |
| **Obj 2** | a) DS index (continuous, z-scored); EE (0 = no business, 1 = owns business)<br>b) DS index; AMI (mid-point of category, log-transformed) | **Binary logistic regression** $logit(EE) = \beta_0 + \beta_1 DS + \Sigma\beta_k Controls$<br>**OLS regression** $ln(AMI) = \beta_0 + \beta_1 DS + \Sigma\beta_k Controls$ |
| **Obj 3** | Same predictors + Internet Reliability (IR, z-scored) + interaction term | **Hierarchical regression** Step 1: main effects DS & IR Step 2: DS × IRSeparate models for EE (logistic) and AMI (OLS) |

## Results

**Table 2: Percentage and mean analysis of the digital skills possessed by TVET graduates in Delta State**

| | (n=506) Digital-skill domain | Not at all (%) | Beginner (%) | Intermediate n (%) | Advanced (%) | Proficient (%) | Mean |
|---|---|---|---|---|---|---|---|
| **1** | Computer & mobile basics | 45 (8.9 %) | 112 (22.1 %) | 113 (22.3 %) | 137 (27.1 %) | 99 (19.6 %) | 3.26 |
| **2** | Online research & information evaluation | 0 (0.0 %) | 25 (4.9 %) | 88 (17.4 %) | 206 (40.7 %) | 187 (37.0 %) | 4.10 |
| **3** | Word-processing & spreadsheets | 82 (16.2 %) | 99 (19.6 %) | 197 (38.9 %) | 103 (20.4 %) | 25 (4.9 %) | 2.78 |
| **4** | Graphic design / Canva | 115 (22.7 %) | 119 (23.5 %) | 123 (24.3 %) | 66 (13.0 %) | 83 (16.4 %) | 2.77 |
| **5** | Social-media marketing & scheduling | 58 (11.5 %) | 77 (15.2 %) | 145 (28.7 %) | 132 (26.1 %) | 94 (18.6 %) | 3.25 |
| **6** | E-commerce set-up & fulfilment | 69 (13.6 %) | 104 (20.6 %) | 135 (26.7 %) | 122 (24.1 %) | 76 (15.0 %) | 3.06 |
| **7** | Mobile/online payments & bookkeeping | 109 (21.5 %) | 122 (24.1 %) | 132 (26.1 %) | 82 (16.2 %) | 61 (12.1 %) | 2.73 |
| **8** | Website or app creation | 141 (27.9 %) | 121 (23.9 %) | 129 (25.5 %) | 93 (18.4 %) | 22 (4.3 %) | 2.47 |
| **9** | Data-analytics | 196 (38.7 %) | 141 (27.9 %) | 47 (9.3 %) | 63 (12.5 %) | 59 (11.7 %) | 2.30 |
| **10** | Basic coding / automation | 200 (39.5 %) | 152 (30.0 %) | 47 (9.3 %) | 63 (12.5 %) | 44 (8.7 %) | 2.21 |

The data in table 2 above reveals that TVET graduates in Delta State rate "Online research & information evaluation" highest (mean = 4.10), with 78 % at advanced or proficient levels. "Computer & mobile basics" (mean = 3.26; 46.7 % advanced/proficient) and "Social-media marketing & scheduling" (mean = 3.25; 44.7 % advanced/proficient) follow closely. "E-commerce set-up & fulfilment" also shows moderate mastery (mean = 3.06; 39.1 % advanced/proficient). In contrast, specialized skills such as "Data-analytics" (mean = 2.30) and "Basic coding/automation" (mean = 2.21) are least possessed, with under 25 % at advanced or proficient levels. These results established that the core digital competencies of TVET graduates in Delta State are online search and information evaluation, basic ICT, social-media marketing and e-commerce which are thus the most common digital skills.

**Table 3: Summary of Logistic regression to establish the impact of Digital skills on economic independence**

| Model | Outcome | β | t | F | p-val |
|---|---|---|---|---|---|
| **2a** | Entrepreneurship Engagement (EE) | 0.56 | 7.50 | 13.431 | .001 |
| **2b** | Average monthly Income (AMI) | 0.78 | 12.50 | 22.123 | .001 |

**predictor: digital skill (DS) at 0.05 alpha level*

Table 3's regression summary demonstrates a statistically significant effect of the composite Digital Skills Index on both entrepreneurship engagement and average monthly income. In Model 2a, a one-unit increase in digital skills is associated with a 0.56-unit rise in the log-odds of running a business (t = 7.50, F = 13.43, p = .001). Model 2b indicates that each additional skill-point yields an average monthly income increase of ₦ 24,130.51 (t = 12.50, F = 22.12, p = .001). These findings confirm that stronger digital proficiency significantly enhances both the likelihood of entrepreneurial engagement and the income graduates generate.

**Table 4: Summary of Logistic regression to establish the moderating effects of Assess to reliable Internet Network on the impact of Digital skills on economic independence**

| Model | Outcome | β | t | F | p-value |
|---|---|---|---|---|---|
| **3a** | EE | 0.56 | 7.50 | 13.431 | .001 |
| | ARIN | 0.45 | 3.46 | 83.11 | .001 |
| | DS*ARIN | 0.85 | 10.25 | 16.04 | .000 |
| **3b** | AMI | 0.78 | 12.50 | 22.123 | .001 |
| | ARIN | 0.65 | 7.03 | 15.21 | .001 |
| | Interaction (DS*ARIN) | 0.89 | 21.84 | 44.43 | .000 |

*predictor: digital skill (DS) at 0.05 alpha level

* Moderator: Access to Reliable Internet Network (ARIN)

The moderation analysis in Table 4 shows that Access to Reliable Internet Network (ARIN) not only exerts a positive main effect—β = 0.45 on engagement (t = 3.46, F = 83.11, p = .001) and β = 0.65 on income (t = 7.03, F = 15.21, p = .001)—but also significantly interacts with

digital skills. The interaction terms (DSI×ARIN) are highly significant for both engagement ($\beta = 0.85$, $t = 10.25$, $F = 16.04$, $p < .001$) and income ($\beta = 0.89$, $t = 21.84$, $F = 44.43$, $p < .001$), indicating that the positive impact of digital skills on entrepreneurship success is amplified when graduates have reliable internet access.

**Diagnostics Analysis**

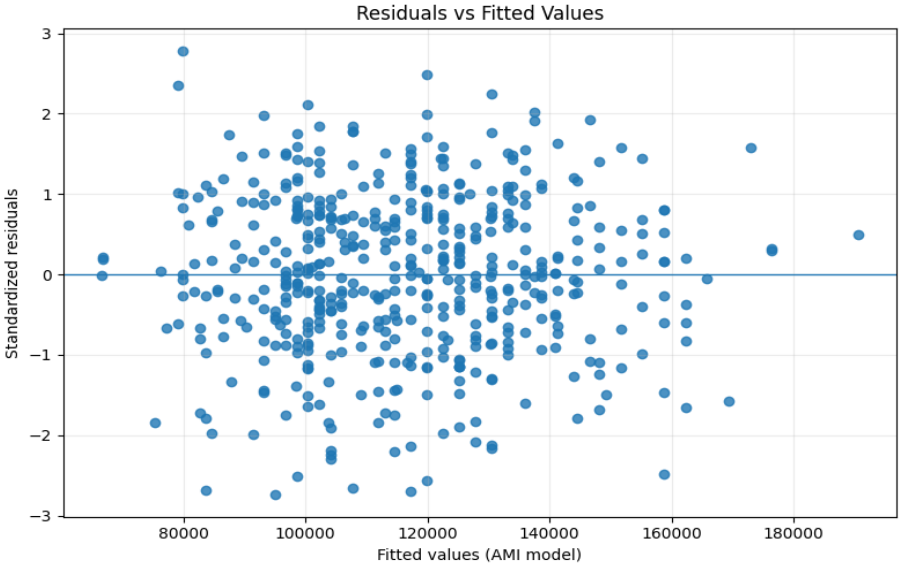



**Figure 1: Residuals versus fitted values for the regression model predicting average monthly income**

Figure 1 showed that the standardized residuals are fairly randomly dispersed around the horizontal zero line across the range of fitted values, which suggests that the linear regression model is reasonably appropriate for predicting average monthly income. The absence of a strong curved pattern indicates that the assumption of linearity is largely satisfied, while the relatively even spread of points across the plot suggests that homoscedasticity is not seriously violated. Although there are slight variations in the spread of residuals at some fitted values, these do not appear substantial enough to indicate severe heteroscedasticity. In addition, most of the residuals fall within the acceptable range of approximately -2 to +2, with only a few values approaching the outer limits, suggesting that extreme outliers are minimal. Overall, as shown in Figure 1, the residual pattern provides reasonable support for the adequacy of the regression model and indicates that the model's predictions are broadly stable and reliable.

**Table 5: Hosmer–Lemeshow test**

| | Value |
|---|---|
| **Hosmer–Lemeshow Chi-square** | 13.52 |
| **Degrees of freedom** | 8 |
| **p-value** | 0.097 |

*A non-significant p-value (> .05) indicates good model fit.*

**Table 6: variance inflation factors test**

| Variable | VIF |
|---|---|
| **Digital Skills (DS)** | 8.70 |
| **Access to Reliable Internet Network (ARIN)** | 9.73 |
| **DS*ARIN** | 9.86 |

*VIFs above 10 suggest multicollinearity concerns.*

Data results in table 5 and 6 showed the diagnostics analysis to establish the model fitness. The Hosmer–Lemeshow test ($\chi^2 = 13.52$, df = 8, p = .097) shows the logistic model fits the data well, as the p-value exceeds .05. Variance inflation factors for Digital Skills (8.70), Reliable Internet (9.73) and their interaction (9.86) all remain below the critical threshold of 10, indicating only moderate collinearity. Thus, predictor estimates are reliable, and multicollinearity is not severe enough to invalidate the regression coefficients.

**Discussion of Findings**

The findings indicate that digital skills significantly improve the economic independence of TVET graduates in Delta State, particularly where competencies are concentrated in information evaluation, social-media marketing, e-commerce, and basic ICT. This supports evidence from Kenya, where digital-platform competencies were associated with stronger entrepreneurial adaptation and business resilience (Odondi, Arisa, & Wangari, 2022), and from Ghana, where digitally capable graduates reported better enterprise performance and improved revenue outcomes (Charles et al., 2025). Similar patterns are reported in South Africa, where specialized ICT training was linked to stronger start-up survival among graduates (Mbambo & du Plessis, 2025). In the present study, the positive coefficients for digital skills across entrepreneurial engagement and income suggest that digital competence is not merely an employability asset, but also a productive resource for self-employment and micro-enterprise development. This reinforces the argument that in contemporary TVET systems, digital literacy has shifted from being a supplementary skill to becoming a core economic capability that shapes whether graduates can participate meaningfully in platform-based and small-scale entrepreneurial markets (Grech & Camilleri, 2020; Papier, 2021).

However, the relationship is neither automatic nor socially uniform, and this is where a more critical reading is necessary. Studies from Rwanda and across Sub-Saharan Africa show that digital competence does not always translate into viable livelihoods when wider ecosystem conditions are weak. Tondi (2023) found that even graduates with strong coding and networking skills struggled to monetize them in the absence of functional start-up support, while Langthaler and Bazafkan (2020) identify unstable electricity, high connectivity costs, and weak institutional support as persistent constraints on digital entrepreneurship. Mutembei (2024) likewise observed in Kenya that digital-literacy training improved employability more readily than self-employment where finance and mentorship systems were limited. These contrary findings help explain why the positive Delta State results should be interpreted cautiously. The moderating effect of reliable internet access in this study suggests that digital

skills generate stronger returns only when enabling infrastructure is present. Yet access to such infrastructure is rarely evenly distributed. Urban graduates are more likely to benefit from stable broadband, denser markets, and business networks than their rural counterparts, meaning that the apparent benefits of digital skills may partly reflect rural-urban inequalities in infrastructure and opportunity rather than skill alone (Langthaler & Bazafkan, 2020; Mutembei, 2024). In the same way, gender disparities may shape how these gains are realized, since women often face additional barriers in access to finance, devices, time, and mobility, which can reduce their ability to convert similar digital training into equivalent entrepreneurial outcomes (Sen, 1999; Tondi, 2023).

These patterns suggest that the study's contribution is strongest when interpreted through a broader structural lens rather than a purely skills-based one. Human Capital Theory remains useful because it explains why investment in digital competencies can raise productivity and income potential (Becker, 1964). Yet the findings also show the limits of that explanation when considered in isolation. Rogers' Diffusion of Innovations framework helps clarify why reliable internet accelerates the uptake and practical use of digital tools by lowering uncertainty and expanding access to digital networks (Rogers, 2003), while Sen's Capability Approach offers a stronger account of why some graduates convert skills into livelihoods and others do not, despite similar training. From this perspective, economic independence depends not only on possessing digital skills, but on having the real opportunity to use them under supportive social and infrastructural conditions (Sen, 1999). The policy implication is therefore clear: TVET reform in Delta State cannot stop at curriculum digitisation. To avoid reproducing digital exclusion, interventions must also address affordable broadband, rural connectivity gaps, inclusive incubation support, and barriers that disproportionately affect women and other digitally marginalised groups (Grech & Camilleri, 2020; Langthaler & Bazafkan, 2020; Charles et al., 2025). Only then can digital skills function as a genuinely inclusive pathway to self-reliance rather than a benefit captured mainly by already advantaged graduates.

**Conclusion**

This study investigated the impact of digital-skill including Microsoft Office, graphic design, online research and information evaluation, social-media marketing, e-commerce, mobile payments/bookkeeping, website/app creation, data analytics, and basic coding impacts economic independence among TVET graduates in Delta State. It found that proficiency in online research and information evaluation and basic ICT skills significantly increased both the odds of business ownership and average monthly income, while data analytics and coding remained weak areas. Reliable internet access not only directly boosted entrepreneurial engagement and earnings but also amplified the value of all digital competencies for entrepreneurship. These results highlight that economic independence hinges on both the breadth of graduates' digital skills and the quality of connectivity. Policymakers and educators must therefore treat digital-skill training and infrastructure provision as inseparable pillars of

youth-led enterprise development. As such, the following recommendation became imperative:

1. Delta State Government, through the Ministries of Communications & Digital Economy and Energy, in partnership with the NCC and local utilities, must urgently deliver affordable broadband and stable power around TVET campuses to enable graduates to commercialize their digital skills.
2. NBTE and the Delta State Ministry of Technical Education, with curriculum committees and industry experts, should integrate advanced modules data analytics, coding, and digital financial management across all TVET programmes to enhance graduates' innovative capacity.
3. TVET colleges, supported by the Delta State Entrepreneurship Development Agency, chambers of commerce, and private partners, must co-fund incubation hubs offering mentorship, seed funding, and market linkages to convert competencies into sustainable businesses.

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