

From technology access to digital marketing readiness: evidence from TVET students in Ghana

Higher Education,
Skills and Work-
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Abstract

Purpose – This study investigates the role of access to technology and digital skills in shaping technical and vocational education and training (TVET) students’ attitudes toward digital marketing in Ghana. It also examines the mediating role of digital skills and the moderating influence of motivation to learn digital marketing.

Design/methodology/approach – The study employed a cross-sectional, quantitative research design using structured questionnaires administered to 587 students from secondary and tertiary TVET institutions across three regions of Ghana. Structural equation modeling (SEM) was used to test direct, mediated, and moderated effects within the proposed conceptual model. Constructs were validated through confirmatory factor analysis, and key assumptions were assessed to ensure robustness.

Findings – The results confirm that access to technology significantly influences both students’ digital skills and their attitudes toward digital marketing. Digital skills, in turn, positively affect attitudes and partially mediate the relationship between access and attitude. Motivation to learn digital marketing significantly moderates the access–attitude relationship, strengthening it among highly motivated students.

Research limitations/implications – The use of cross-sectional data limits the ability to infer long-term causal effects. Additionally, the study was limited to Ghanaian institutions, which may affect generalizability to other cultural or regional contexts. Future research could incorporate longitudinal designs or comparative cross-country analyses.

Practical implications – For educators and policymakers, the findings underscore the importance of investing not only in digital infrastructure but also in skill development programs and motivational learning environments. Policies aimed at expanding access to technology should be complemented by initiatives that enhance students’ competencies and engagement with digital tools.

Social implications – The study offers insights for national strategies targeting youth employment and entrepreneurship through digital skills. By identifying the mechanisms through which access, skills, and motivation interact, the research contributes to more inclusive digital transformation policies in the Global South.

Originality/value – While policy initiatives across the Global South emphasize digital infrastructure expansion, there is limited empirical evidence clarifying the mechanisms through which access becomes meaningful for learners. By integrating digital skills as a mediating mechanism and motivation to learn as a boundary condition, this study provides actionable insights for educators, policymakers, and development partners seeking to design more effective digital education and youth employment interventions in emerging economies.

Keywords Digital skills, Digital marketing attitudes, Technical and vocational education and training, TVET, Technology access, Motivation

Paper type Research article

1. Introduction

In today’s digitally-driven economy, digital marketing has emerged as a cornerstone for business success, and the need for technologically competent youth who can navigate this



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landscape is more pressing than ever. Technical and Vocational Education and Training (TVET) institutions play a pivotal role in equipping students with practical and industry-relevant skills. In Ghana, where the youth unemployment rate remains persistently high despite a burgeoning digital economy, the strategic development of digital competencies among TVET students is not just beneficial but essential (Ghana Statistical Service, 2024). As digital technologies continue to reshape global industries, there is an urgent need to understand how access to technology and digital skills influence TVET students' attitudes toward digital marketing, an increasingly important skillset for entrepreneurial and employment success.

Although several studies have explored digital readiness and skills acquisition in higher education, few have critically examined the intersection between technology access, digital competencies, and attitudes toward digital marketing among TVET students in the Global South (Mensah *et al.*, 2025). This gap is particularly concerning given that TVET students are expected to transition quickly into the workforce or start their own enterprises upon graduation. In Ghana, the Ministry of Education has placed renewed emphasis on enhancing digital literacy within TVET curricula (Ministry of Education, 2024). However, the mere availability of digital tools does not automatically translate into effective digital engagement or positive attitudes toward digital marketing. This underscores the need for empirical research that explores how access to technology impacts students' attitudes, the role of digital skills in mediating this relationship, and how intrinsic motivation to learn further influences these dynamics.

Existing studies on digital readiness and technology adoption in education have largely emphasized access to infrastructure as a primary determinant of digital outcomes (Gyamfi and Amoako, 2024; Mensah *et al.*, 2025). However, influential work increasingly questions the assumption that access alone is sufficient, arguing instead that *capability development* and *learner agency* are decisive in shaping meaningful digital engagement (Buabeng-Andoh, 2025; Asare *et al.*, 2025). While some studies identify digital skills as outcomes of access, fewer empirically test their role as explanatory mechanisms linking access to attitudinal or career-related outcomes, particularly within TVET contexts in the Global South. Moreover, motivational factors are often treated as direct predictors rather than as boundary conditions that shape how learners convert technological resources into positive career orientations (Owusu and Antwi, 2024; Arthur *et al.*, 2022a). This study situates itself within this emerging discourse by shifting attention from access alone to the *processes and conditions* through which access influences attitudes toward digital marketing.

Despite increased investments in ICT infrastructure within Ghanaian educational institutions, many TVET students still face significant barriers in leveraging these resources effectively. A recent nationwide audit by the Ghana Education Service revealed that over 40% of public TVET institutions lack stable internet access, and more than 30% of students do not own a personal digital device (Ghana Education Service, 2024). This disparity creates an uneven playing field that hinders the development of critical digital marketing skills, which are vital for modern-day employment and entrepreneurship. Furthermore, while digital skills are often assumed to naturally develop alongside technology access, there is limited evidence supporting this assumption within the Ghanaian TVET context. Moreover, current literature often neglects the psychological dimension of learning digital tools, particularly the role of students' attitudes and motivation (Arthur *et al.*, 2026). Attitudes toward digital marketing are shaped not just by skills and access, but also by students' willingness to engage, experiment, and adopt new technologies (Asiedu and Tetteh, 2025). There is a significant theoretical and practical gap in understanding how these constructs interact to influence learning outcomes. The current study addresses this by investigating a moderated-mediation model, which not only examines direct and indirect effects but also integrates the motivational component as a moderating factor.

This study is grounded in an integrated theoretical framework that combines Social Cognitive Theory ([SCT] Bandura, 1986), Digital Human Capital Theory (van Dijk, 2020), and Self-Determination Theory ([SDT] Deci and Ryan, 1985; Ryan and Deci, 2020).

Together, these theoretical perspectives provide a robust foundation for examining the hypotheses that guide this study, which collectively explore direct, mediated, and moderated relationships between technology access, digital skills, motivation, and career attitudes.

The findings of this study have critical implications not only for Ghana but for other developing countries facing similar infrastructural and educational challenges. In Ghana, where over 65% of the population is under the age of 35 and digital entrepreneurship is being touted as a key solution to youth unemployment, understanding how to cultivate positive digital marketing attitudes among TVET students is vital (World Bank, 2024a). A nuanced understanding of how technology access and digital skills interact within the Ghanaian context will enable policymakers, educators, and development partners to implement more targeted interventions. The urgency of this study is further reinforced by Ghana's digital economy policy (Ministry of Communications and Digitalization, 2025), which highlights the need for inclusive digital transformation and the role of human capital development. Yet, most policy prescriptions remain silent on the unique challenges faced by TVET students who are often located in resource-constrained environments. By foregrounding the voices and experiences of TVET students, this research contributes to a more equitable and context-specific understanding of digital skills development.

In sum, this study seeks to fill a significant gap in the literature by empirically testing a model that links access to technology, digital skills, and attitudes toward digital marketing among TVET students in Ghana, with a focus on mediating and moderating effects. Guided by these gaps, the study pursues the following research objectives: (1) to examine the effect of access to technology on TVET students' attitudes toward digital marketing; (2) to assess the influence of access to technology on students' digital skills; (3) to determine the effect of digital skills on attitudes toward digital marketing; (4) to test the mediating role of digital skills in the access–attitude relationship; and (5) to examine whether motivation to learn digital marketing moderates the relationship between access to technology and students' attitudes toward digital marketing.

2. Literature and theoretical review

2.1 Theoretical review

The study was founded on three theories, namely, Bandura's Social Cognitive Theory (SCT), Digital Human Capital Theory, and Self-Determination Theory (SDT). Bandura's Social Cognitive Theory (SCT) emphasizes that learning and behavioral change are influenced by the dynamic interaction between personal, environmental, and behavioral factors (Bandura, 1986). This theory supports the idea that access to technology (environmental factor) can influence attitudes toward digital marketing (personal factor) through digital skills acquisition (behavioral factor). Observational learning and self-efficacy, central concepts in SCT, suggest that when TVET students observe others effectively using digital tools and successfully apply those tools themselves, their confidence and attitude toward such tools improve (Schunk and DiBenedetto, 2020). In applying Social Cognitive Theory, this study specifically draws on the concepts of *environmental influence* and *behavioral capability* to explain how access to technology (environment) shapes digital skills (capability), which in turn influence attitudes toward digital marketing. Although SCT also emphasizes observational learning and reciprocal determinism, these elements were not explicitly modeled due to the cross-sectional design and the absence of peer-interaction measures. Focusing on capability development allows for a parsimonious and contextually appropriate application of SCT within the TVET setting (Schunk and DiBenedetto, 2024).

Digital Human Capital Theory posits that digital competencies are a form of capital that enhance individuals' productivity and adaptability in modern economies (van Dijk, 2020). In the context of TVET students, access to technology provides the foundational infrastructure to accumulate digital skills, which constitute digital human capital. These skills are valuable for engaging with digital platforms and marketing practices. For example, "digital human capital"

has been defined as the IT and computer skills individuals acquire through education and training. Increased access enables learners to accumulate this capital (digital skills). According to this theory, more digital human capital should translate into better outcomes or attitudes. The study adopts the premise that digital skills constitute productive assets that enhance individuals’ readiness for digital work and entrepreneurship. The analysis centers on *skills accumulation* as the primary form of capital, rather than labor market returns such as wages or employment outcomes, which were beyond the scope of the student sample. This selective focus aligns with recent calls to examine human capital formation processes prior to labor market entry (Brynjolfsson and McAfee, 2024).

Self-Determination Theory (SDT), developed by Deci and Ryan (1985), explains that motivation—particularly intrinsic motivation driven by autonomy, competence, and relatedness—enhances learning outcomes and engagement. When TVET students are intrinsically motivated to learn digital marketing, they are more likely to explore technology resources deeply and develop positive attitudes toward their use. Drawing on Self-Determination Theory, the study operationalizes *intrinsic motivation* as a moderating condition influencing how access to technology translates into attitudes. While SDT also includes autonomy, competence, and relatedness as distinct psychological needs, these were not modeled separately to avoid construct redundancy with digital skills and attitudinal measures. Recent studies suggest that motivation operates effectively as a boundary condition in technology-enabled learning environments (Arthur et al., 2022a, 2026; Ryan and Deci, 2020; Owusu and Antwi, 2024).

2.2 TVET education and digital skills development in Ghana

Ghana’s TVET system has undergone significant reforms aimed at aligning vocational education with labor market demands and national digitalization agendas. Despite policy commitments under the TVET Transformation Agenda and the Digital Economy Policy, empirical evidence suggests persistent disparities in digital infrastructure, instructional capacity, and curriculum implementation across institutions (Ministry of Education, 2024; Ghana Education Service, 2024).

Recent Ghana-based studies indicate that while access to digital tools has improved in urban and tertiary TVET institutions, secondary-level and rural schools continue to face constraints that limit effective digital skills development (Gyamfi and Amoako, 2024; Mensah et al., 2025). Moreover, existing research has largely focused on general ICT literacy, with limited attention to *applied digital marketing competencies* or students’ attitudinal readiness to engage in digital entrepreneurial activities. By focusing explicitly on digital marketing attitudes within the Ghanaian TVET system, this study addresses a critical contextual and empirical gap.

2.3 Conceptual framework and hypotheses

Figure 1 presents the conceptual framework underpinning the hypothesized relationships.

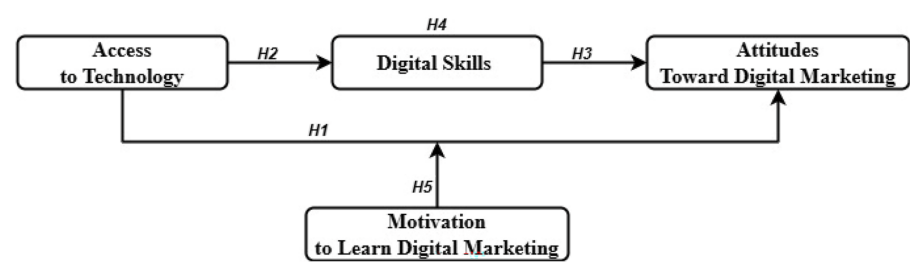


Figure 1. Conceptual framework Source: Authors’ construct (2025)

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- | | |
|--|---|
| H1. Access to technology has a significant positive effect on TVET students' attitude towards digital marketing. | Higher Education,
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| H2. Access to technology has a significant positive effect on digital skills of TVET students. | |
| H3. Digital skills have a significant positive effect on TVET students' attitude towards digital marketing. | |
| H4. Digital skills mediate the relationship between access to technology and TVET students' attitude towards digital marketing. | |
| H5. Motivation to learn digital marketing moderates the relationship between access to technology and TVET students' attitude towards digital marketing. | |
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3. Methods

3.1 Research design

The study adopted cross-sectional research design, as the data was gathered from a particular point in time (Saunders *et al.*, 2015). Quantitative research design approach was used, by gathering data using structured questionnaire. An explanatory research strategy was used for the study, by conducting a cause-and-effect analysis using Structural Equation Modeling (SEM) technique.

3.2 Data collection

The study focused on three (3) universities and ten (10) senior high schools from Ashanti, Central and Upper East regions of Ghana. The selected students offered various TVET programs. Data was gathered over a period of 3 months (February to April, 2025), with the help of a local coordinator in each region. Prior to the data collection, ethical approval was sought from the Research and Ethics Committee of the University of Skills Training and Entrepreneurial Development, Ghana.

Two non-probability sampling techniques were used. Firstly, purposive sampling technique was used to target TVET students. Secondly, convenience sampling technique to select students who were readily available in class, during the data collection. The data was gathered in-person using printed questionnaire. A total of 607 questionnaires were received, however, 587 were considered usable, after the data entry.

The study controlled for the level of education (be at tertiary or secondary), year (1st to 4th year in school), gender, and age. The adapted measurement items for the main constructs (variables) were responded to on a 5-point Likert scale of 1-strongly disagree to 5-strongly agree.

The use of non-probability sampling techniques introduces limitations related to selection bias and restricts the generalizability of the findings beyond the sampled institutions. However, such approaches are commonly employed in educational research involving hard-to-access student populations and are considered appropriate for theory testing using SEM (Hair *et al.*, 2024). The sample size of 587 exceeds minimum recommendations for covariance-based SEM and provides sufficient statistical power for detecting moderated mediation effects. Control variables—including level of education, year of study, gender, and age—were included because prior research demonstrates their influence on digital skill acquisition and technology-related attitudes among youth and TVET learners (Afeti, 2024; Asare *et al.*, 2025).

3.3 Research instrument

The study employed a structured questionnaire comprising four multi-item constructs: access to technology, digital skills, motivation to learn digital marketing, and attitude toward digital

marketing. All items were measured using five-point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to finalizing the questionnaire for the data collection, the items were pilot tested on 25 respondents, where ambiguous and redundant items were refined.

Access to technology was measured using four items adapted from [Gyamfi and Amoako \(2024\)](#), capturing students’ access to devices, internet connectivity, and program-specific digital tools. Digital skills were assessed using three items adapted from [Adusei and Nyarko \(2025\)](#), focusing on communication tools, troubleshooting, and online research capabilities. Motivation to learn digital marketing was measured with five items adapted from [Owusu and Antwi \(2024\)](#), capturing intrinsic interest, perceived value, and future application intentions. Attitude toward digital marketing was measured using three items adapted from [Asare and Boakye \(2025\)](#), reflecting confidence, comfort, and perceived ease of application.

The alignment between measurement items and theoretical constructs was ensured by mapping each scale explicitly to the underlying theory (e.g. access to technology as environmental input under Social Cognitive Theory, and digital skills as digital human capital). Similar scale adaptation approaches have been validated in recent TVET and digital education research in developing contexts ([Castaño-Muñoz et al., 2024](#); [Adusei and Nyarko, 2025](#)). All scales were subjected to confirmatory factor analysis to assess reliability and validity prior to hypothesis testing.

3.4 Sample characteristics

The study surveyed a total of 587 TVET students from both secondary and tertiary institutions across Ghana. [Table 1](#) presents the statistics on the demographics of the respondents. Regarding educational level, the majority of the respondents were from the secondary level, constituting 85.5% ($n = 502$) of the sample. Tertiary-level participants were represented by 6.1% ($n = 36$) pursuing diploma programs and 8.3% ($n = 49$) enrolled in degree programs. This distribution reflects the predominantly secondary-level focus of TVET in the Ghanaian educational landscape, while still acknowledging the emerging integration of TVET into higher education curricula.

Table 1. Demographics of respondents

Variables	Freq. (N)	Perc. (%)
Level	587	100.0
Secondary	502	85.5
Diploma	36	6.1
Degree	49	8.3
Year	587	100.0
1st year	106	18.1
2nd year	192	32.7
3rd year	268	45.7
4th year	21	3.6
Gender	587	100.0
Male	364	62.0
Female	223	38.0
Age	587	100.0
13–17 years	237	40.4
18–21 years	285	48.6
Above 21 years	65	11.1

Source(s): Field Data (2025)

In terms of academic year, the largest proportion of students were in their third year of study (45.7%, $n = 268$), followed by second-year students (32.7%, $n = 192$). First-year students comprised 18.1% ($n = 106$) of the sample, and those in their fourth year accounted for only 3.6% ($n = 21$). This suggests a well-distributed representation across different stages of academic progression, although slightly skewed towards more advanced students.

The gender distribution of the sample revealed a higher proportion of male participants, with males constituting 62.0% ($n = 364$) and females accounting for 38.0% ($n = 223$). This imbalance is consistent with broader trends in TVET programs in Ghana and across Sub-Saharan Africa, where male dominance persists in technical and vocational fields (Afeti, 2024).

The age distribution showed that the majority of respondents were between 18 and 21 years old (48.6%, $n = 285$), followed by 40.4% ($n = 237$) who were between 13 and 17 years, indicating a substantial portion of the sample comprised of younger secondary-level students. Participants aged above 21 years represented the smallest category at 11.1% ($n = 65$), aligning with expectations for more advanced or tertiary-level learners.

3.5 Confirmatory factor analysis

To evaluate the reliability and validity of the latent constructs, a confirmatory factor analysis (CFA) was conducted using AMOS (v.23), with results presented as Table 2 and Figure 2. The results demonstrate that the measurement model provides a good fit to the data, as evidenced by several widely accepted fit indices. The chi-square value (CMIN) was 194.863 with 84 degrees of freedom, yielding a CMIN/DF ratio of 2.320, which falls within the acceptable range of 1–3, indicating an acceptable level of model parsimony (Arthur *et al.*, 2022b; Byrne, 2016).

Table 2. Confirmatory factor analysis (CFA)

Model-fit summary CMIN = 194.863; DF = 84; CMIN/DF = 2.320; GFI = 0.958; PClose = 0.673; TLI = 0.941; CFI = 0.953; RMSEA = 0.047; RMR = 0.067		Factor loading
<i>Access to Technology (ACCESS): CA = 0.843; CR = 0.831; AVE = 0.559</i>		
I have regular access to a computer or laptop for learning purposes (AT1)		0.883
I can easily access the internet for educational purposes (AT2)		0.638
I own a smartphone that I use for learning and accessing digital platforms (AT3)		0.856
I have access to digital tools or software specific to my TVET program (AT4)		0.564
<i>Digital Skills (SKILLS): CA = 0.819; CR = 0.781; AVE = 0.544</i>		
Email and Communication Tools (DSU1)		0.709
Troubleshooting technical issues with software/equipment (DSU2)		0.817
Online Research (e.g. Google, Technical Databases) (DSU3)		0.680
<i>Motivation to learn Digital Marketing (MOTI): CA = 0.862; CR = 0.849; AVE = 0.531</i>		
I am interested in learning digital marketing (MLD1)		0.735
I plan to apply digital marketing skills in my job or business (MLD2)		0.739
I am motivated to learn new tools and technologies related to digital marketing (MLD3)		0.691
I believe digital marketing is a valuable skill in today's economy (MLD4)		0.656
Digital media offer good opportunities for young people in TVET to be able to start and grow their business (MLD5)		0.814
<i>Attitude towards Digital Marketing (ATTITUDE): CA = 0.810; CR = 0.809; AVE = 0.589</i>		
I am comfortable learning digital tools and software (ATD1)		0.735
I think it will be easy to apply digital marketing concepts in practical scenarios (ATD2)		0.667
I feel confident that I can learn digital marketing skills (ATD3)		0.885
Note(s): CFI = Comparative fit index; CMIN/DF = Chi-square/degree of freedom; RMR = Root mean square residual; RMSEA = Root mean square error of approximation; TLI = Tukey-Lewis index		
Source(s): Field Data (2025)		

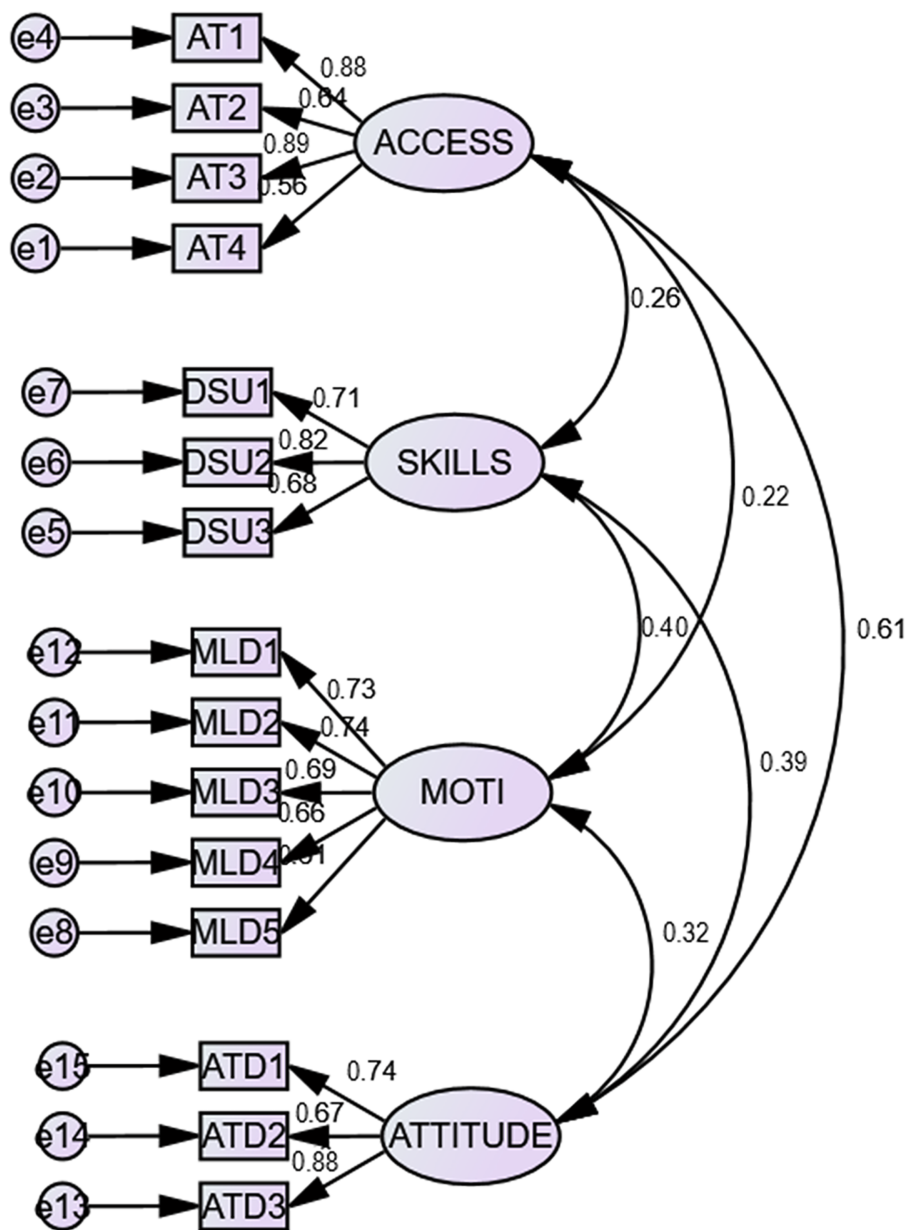


Figure 2. Confirmatory factor analysis Source: Field data (2025)

Additionally, the Goodness-of-Fit Index (GFI = 0.958), Comparative Fit Index (CFI = 0.953), and Tucker-Lewis Index (TLI = 0.941) all exceed the 0.90 threshold recommended by [Hu and Bentler \(1999\)](#). The Root Mean Square Error of Approximation (RMSEA = 0.047) and its PClose value (0.673) further confirm the model's adequate fit, as RMSEA values below 0.05

and non-significant PClose values (>0.05) are indicative of a well-fitting model. The Root Mean Square Residual ($RMR = 0.067$) also meets the suggested cutoff criteria.

Construct reliability and convergent validity were also assessed using Cronbach's Alpha (CA), Composite Reliability (CR), and Average Variance Extracted (AVE). All four latent variables demonstrated satisfactory internal consistency, with Cronbach's alpha values ranging from 0.810 (attitude) to 0.862 (motivation), exceeding the acceptable threshold of 0.70 (Nunnally and Bernstein, 1994). Composite reliability values similarly surpassed the 0.70 benchmark, indicating strong construct reliability: ACCESS (0.831), SKILLS (0.781), MOTI (0.849), and ATTITUDE (0.809). Convergent validity was confirmed as AVE values for all constructs exceeded the 0.50 threshold (Fornell and Larcker, 1981), with values ranging from 0.531 to 0.589.

Examining individual item loadings, all standardized factor loadings exceeded the minimum acceptable value of 0.50, ranging from 0.564 to 0.885. Notably, items for Access to Technology (e.g. $AT1 = 0.883$; $AT3 = 0.856$), Digital Skills ($DSU2 = 0.817$), and Attitude ($ATD3 = 0.885$) exhibited particularly strong loadings, reinforcing the robustness of the constructs. Although $AT4$ reported a relatively lower loading (0.564), it still meets the acceptable minimum and contributes to the content validity of the construct by capturing access to digital tools specific to TVET programs.

In conclusion, the CFA results confirm that the measurement model is both reliable and valid, providing strong support for the use of the latent constructs in the subsequent structural model analysis.

3.6 Descriptive statistics

To provide context for the structural equation modeling results, descriptive statistics were examined for the main study constructs. As shown in Table 3, mean scores were calculated on a five-point Likert scale. Access to technology recorded a mean score of 2.80 ($M = 2.796$), indicating relatively limited access to digital devices and internet resources among the sampled TVET students. Similarly, digital skills showed a moderate mean level ($M = 2.832$), suggesting that many students possess only basic or emerging digital competencies.

In contrast, motivation to learn digital marketing reported a comparatively high mean score ($M = 3.997$), indicating strong intrinsic interest and perceived value attached to digital marketing skills. Attitude toward digital marketing also recorded a moderately positive mean score ($M = 3.439$), reflecting a generally favorable disposition toward digital marketing despite constraints in access and skills.

This pattern of descriptive results provides important context for the subsequent SEM analysis. Specifically, the coexistence of high motivation with relatively lower levels of access and skills helps explain why motivation emerges as a significant moderator in the model. It also underscores the partial mediation observed for digital skills, suggesting that while students are highly motivated, structural and capability constraints may limit the full translation of access into positive attitudinal outcomes.

3.7 Normality, discriminant validity, and common method bias

Prior to testing the hypothesized structural relationships, the dataset was assessed for key statistical assumptions to ensure the robustness and credibility of the findings. These included tests for univariate normality, discriminant validity, and common method bias (CMB).

Univariate normality was evaluated using skewness and kurtosis statistics for all observed variables. Following the thresholds suggested by Kline (2015), skewness values within ± 3 and kurtosis values within ± 10 are considered acceptable for data to be normally distributed in SEM. The results presented in Table 3 confirm that all variables meet these criteria, with skewness ranging from -1.173 (motivation to learn digital marketing) to 1.406 (level of education), and kurtosis values ranging from -1.462 to 2.237 . This suggests that the data are sufficiently normal to proceed with covariance-based SEM estimation techniques.

Table 3. Descriptive statistics, normality and discriminant validity

Variables	Mean	SD	Skewness	Kurtosis	1	2	3	4	5	6	7	8
Level (1)	–	–	1.406	2.237	–							
Year (2)	–	–	–0.313	–0.813	0.034	–						
Gender (3)	–	–	0.567	–1.462	0.086*	–0.197**	–					
Age (4)	–	–	0.432	–0.585	0.512**	0.250**	0.019					
ACCESS (5)	2.796	1.042	0.056	–1.027	–0.023	0.061	–0.167**	0.018	<i>0.747</i>			
SKILLS (6)	2.832	1.196	0.029	–1.055	0.057	0.004	–0.023	0.028	0.256*	<i>0.738</i>		
MOTI (7)	3.997	0.868	–1.173	0.873	–0.039	0.004	0.087*	–0.074	0.220*	0.402**	<i>0.729</i>	
ATTITUDE (8)	3.439	1.074	–0.553	–0.645	0.142**	0.228**	–0.193**	0.085*	0.608**	0.391**	0.316**	<i>0.764</i>

Note(s): ** ~ Correlation is significant at the 0.01 level (2-tailed); * ~ Correlation is significant at the 0.05 level (2-tailed); $\sqrt{\text{AVE}}$ ~ Italics

Source(s): Field Data (2025)

To assess discriminant validity, the [Fornell and Larcker \(1981\)](#) criterion was employed. This approach involves comparing the square root of the average variance extracted ($\sqrt{\text{AVE}}$) for each construct (placed on the diagonal in [Table 2](#)) with the correlations between that construct and all others in the model. Discriminant validity is confirmed when the $\sqrt{\text{AVE}}$ exceeds the corresponding inter-construct correlations. In this study, all $\sqrt{\text{AVE}}$ values exceeded the correlations with other constructs: for instance, the $\sqrt{\text{AVE}}$ for access to technology (0.747) was greater than its correlation with any other variable (maximum $r = 0.608$ with attitude toward digital marketing). Similar patterns were observed for skills (0.738), motivation (0.729), and attitude (0.764). These results affirm that all latent constructs in the study are conceptually distinct and exhibit satisfactory discriminant validity.

To evaluate the potential presence of common method bias, the inter-variable correlation matrix was inspected. As recommended by [Podsakoff et al. \(2003\)](#), correlations below 0.90 indicate that CMB is unlikely to pose a serious threat to the validity of the findings. In the present dataset, all inter-construct correlations fall well below this threshold, with the highest being 0.608 between access to technology and attitude toward digital marketing. This indicates that the observed relationships are not likely artifacts of common method variance. Also, Harman's one factor test was conducted, and the results demonstrate that the first extracted component had a variable of 32.451%, lower than 50%. No single factor, therefore, explained the majority of the variance in the model, and was thus concluded that there was no CMB ([Podsakoff and Organ, 1986](#)).

In sum, the dataset meets the essential assumptions of normality, discriminant validity, and lack of common method bias, thereby providing a solid empirical foundation for the subsequent analysis of structural relationships among the study variables.

4. Results

The results of the study presented as [Table 4](#) and [Figures 3 and 4](#). Among the control variables, level of education ($\beta = 0.249$, CR = 5.015) and year of study ($\beta = 0.170$, CR = 4.784) are both significant predictors of attitude, suggesting that university students and students in higher academic years are more likely to develop positive attitudes toward digital marketing. Gender is negatively associated with attitude ($\beta = -0.170$, CR = -3.074), implying that female students may exhibit more favorable attitudes than male students—a gender gap that calls for inclusive policy interventions. Age, however, does not significantly predict attitude (CR = -1.372), indicating that age-related differences among TVET students may not play a significant role in shaping digital marketing attitudes.

Table 4. Path coefficients

Paths	Unstd. Estimates	S. E	C. R
Level → ATTITUDE	0.249	0.050	5.015**
Year → ATTITUDE	0.170	0.035	4.784**
Gender → ATTITUDE	-0.170	0.055	-3.074**
Age → ATTITUDE	-0.055	0.040	-1.372
ACCESS → ATTITUDE	0.464	0.065	7.095***
SKILLS → ATTITUDE	0.155	0.073	2.123*
MOTI → ATTITUDE	0.224	0.082	2.732*
AT_MLD → ATTITUDE	0.144	0.066	2.182*
ACCESS → SKILLS	0.318	0.071	4.469***
Indirect Effect		LBC	UBC
ACCESS → SKILLS → ATTITUDE	0.049	-0.023	0.055

Note(s): Bootstrap Bias-Corrected Confidence Interval at 95%; ***~Sig. at 1%; **~Sig. at 5%

Source(s): Field Data (2025)

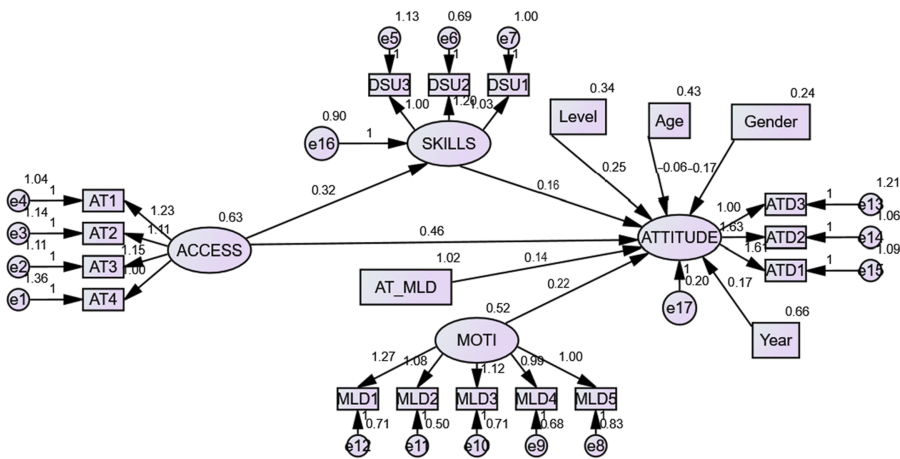


Figure 3. Structural equation model Source: Field data (2025)

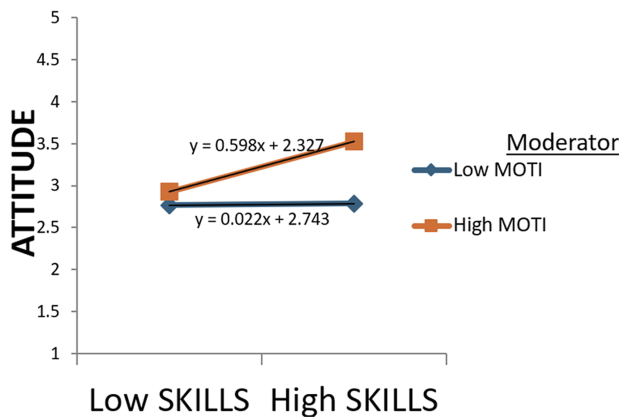


Figure 4. Interaction plot Source: Field data (2025)

The direct path from access to technology (ACCESS) to attitude toward digital marketing (ATTITUDE) is highly significant ($\beta = 0.464$, CR = 7.095), confirming [Hypothesis 1 \(H1\)](#). This indicates that TVET students with better access to digital technologies exhibit more favorable attitudes toward digital marketing. The path from access to technology to digital skills (ACCESS $\rightarrow$ SKILLS) is also significant ($\beta = 0.318$, CR = 4.469), supporting [Hypothesis 2 \(H2\)](#). This confirms that access to digital tools and platforms is a necessary enabler for skill acquisition among TVET students. The link between digital skills (SKILLS) and attitude toward digital marketing is statistically significant ($\beta = 0.155$, CR = 2.123), confirming [Hypothesis 3 \(H3\)](#). This suggests that as students acquire and improve their digital competencies, their disposition towards applying these skills in marketing contexts becomes more positive.

The indirect effect of access to technology on attitude through digital skills is 0.049, with a 95% bootstrap confidence interval ranging from -0.023 to 0.055 . Because this confidence

interval includes zero, the mediating effect is partial and marginal, rather than fully significant, providing limited support for [Hypothesis 4 \(H4\)](#). While digital skills partially mediate the effect of access to technology, the direct influence of access remains dominant. This finding highlights the importance of not only providing infrastructure but also actively enhancing students' ability to translate access into competence.

The interaction term (AT_MLD), representing the moderation of access to technology by motivation to learn digital marketing, is statistically significant ($\beta = 0.144$, $CR = 2.182$). This confirms [Hypothesis 5 \(H5\)](#) and emphasizes that students who are more motivated benefit more from their access to technology in developing a positive attitude toward digital marketing. As illustrated in [Figure 4](#), students with high motivation (High MOTI) demonstrated a steeper positive relationship between digital skills and attitude (slope = 0.598), suggesting that improvements in digital skills strongly enhanced their attitude towards digital marketing. In contrast, for students with low motivation (Low MOTI), the relationship was negligible (slope = 0.022), indicating that gains in digital skills did not significantly influence their attitude. These findings confirm that motivation significantly strengthens the impact of digital skill acquisition on students' attitudinal outcomes. Thus, motivation acts as a positive and significant moderator in this relationship, reinforcing the notion that internal drive is essential for translating skills into favorable perceptions and attitudes.

5. Discussions and contributions

5.1 Discussion of results

The findings of this study strongly support [Hypothesis 1 \(H1\)](#), confirming that access to technology significantly and positively affects TVET students' attitudes towards digital marketing. Students who reported higher levels of access to digital tools—such as computers, smartphones, internet connectivity, and educational platforms—demonstrated more favorable perceptions and openness toward engaging with digital marketing content. This result is consistent with findings from [Asare and Boakye \(2025\)](#). Also, recent evidence from Ghanaian educational institutions echoes this finding, with [Gyamfi and Amoako \(2024\)](#) reporting that students in tech-enabled environments were more likely to consider digital marketing a viable professional path. The implication here is that any strategy to promote digital marketing literacy among TVET students must start with ensuring equitable access to essential digital tools.

Support was also found for [Hypothesis 2 \(H2\)](#), which proposed that access to technology positively impacts the development of digital skills among TVET students. The analysis revealed that students with regular, reliable access to digital devices and internet services exhibited significantly higher proficiency in using digital platforms, tools, and applications relevant to marketing and entrepreneurship. These findings align with the experiential learning model, which emphasizes the importance of hands-on engagement in skill acquisition ([Kolb, 1984](#); [Adusei and Nyarko, 2025](#)). Importantly, this result highlights the interdependence of infrastructure and pedagogy, suggesting that without deliberate investment in technological infrastructure within TVET institutions—particularly in under-resourced or rural areas—students may fall behind in the development of critical digital competencies ([Nyamekye and Adjei, 2024](#)).

[Hypothesis 3 \(H3\)](#), which posited a significant positive relationship between digital skills and attitudes toward digital marketing, was also supported by the data. Students with higher levels of digital proficiency were more confident in navigating digital marketing tools and thus demonstrated greater enthusiasm and positive perceptions toward pursuing digital marketing as a professional path. This finding aligns with prior studies that emphasize the role of self-efficacy in shaping technology adoption behaviors ([Tetteh and Obeng, 2025](#); [Boateng and Darko, 2025](#)). The development of digital skills not only reduces technophobia but also provides students with a clearer understanding of the practical applications of digital

marketing in entrepreneurship. For TVET students—many of whom aspire to self-employment or SME development—digital fluency is both a tool and a motivator, enhancing their capacity to market products and services in a competitive digital landscape.

The mediation analysis provided partial support for [Hypothesis 4 \(H4\)](#), which proposed that digital skills mediate the relationship between access to technology and students' attitudes toward digital marketing. The results indicate that while access to technology does have a direct effect on attitudes, a significant portion of this effect operates through the development of digital skills. This partial mediation confirms theoretical propositions from Bandura's Social Cognitive Theory, which identifies skills and perceived competence as mechanisms through which environmental factors influence behavioral outcomes ([Bandura, 2001](#)). This is a particularly important insight for educators and policymakers: providing technology alone is insufficient. Without structured programs to build digital skills, much of the potential impact on student attitudes and engagement with digital marketing may be lost ([Naatu et al., 2025](#)). As such, integrated approaches that combine infrastructure with active digital pedagogy are crucial.

Finally, the findings fully support [Hypothesis 5 \(H5\)](#), demonstrating that motivation to learn digital marketing significantly moderates the relationship between access to technology and students' attitudes. Specifically, students who reported higher intrinsic motivation exhibited a stronger positive relationship between access to technology and favorable attitudes towards digital marketing. This finding resonates with Self-Determination Theory, which emphasizes the role of intrinsic motivation in driving engagement and performance ([Ryan and Deci, 2020](#)). [Owusu and Antwi \(2024\)](#) similarly found that motivation enhances the effectiveness of digital tools in learning environments. In the context of Ghanaian TVET education, this underscores the need not only to equip institutions with technology but also to foster a culture of curiosity, entrepreneurial ambition, and personal growth among students. Motivation acts as an amplifier, turning access into active engagement and facilitating meaningful learning outcomes.

Beyond confirming hypothesized relationships, the findings offer deeper insights into why technology-based interventions yield uneven outcomes in TVET education. The partial mediation effect of digital skills suggests that access to technology exerts both symbolic and functional influences on students' attitudes. Even when skills are underdeveloped, access alone may signal inclusion in the digital economy, thereby shaping attitudes independently. Additionally, the strong moderating role of motivation highlights that technological investments are most effective when learners perceive personal relevance and future value. This may explain why prior studies report inconsistent outcomes across similar digital education initiatives ([Goldin, 2025](#)). The results underscore the importance of coupling infrastructure expansion with pedagogical and motivational strategies to maximize impact.

The significant effects of demographic variables offer additional insights that extend the study's contribution. The positive influence of education level and year of study on attitudes toward digital marketing suggests that students closer to labor market entry perceive greater instrumental value in digital marketing skills. This aligns with human capital perspectives, which argue that perceived return on skills investment increases as individuals approach employment transitions ([Castaño-Muñoz et al., 2024](#)).

The negative coefficient for gender, indicating more favorable attitudes among female students, is particularly noteworthy in a TVET context traditionally dominated by males. This finding challenges prevailing assumptions about gendered technology orientations and suggests that digital marketing—unlike many technical trades—may be perceived as more accessible or compatible with female career aspirations ([Afeti, 2024](#); [Buabeng-Andoh, 2025](#)). The non-significant effect of age further implies that attitudinal differences are shaped more by institutional exposure and learning stage than by biological maturity, underscoring the importance of curriculum design over age-based targeting.

5.2 Theoretical contributions

This research makes some significant theoretical contributions that advance our understanding of digital skills development in vocational education contexts, particularly in emerging economies like Ghana. The study's findings extend and refine existing theoretical frameworks while introducing novel insights about the complex interplay between technological, cognitive, and motivational factors in career attitude formation.

Social Cognitive Theory (Bandura, 1986) posits that behavior, personal factors, and environmental influences interact in a process called *triadic reciprocal determinism*. The results of H1 and H3 support this view, showing that access to technology (an environmental factor) and digital skills (a personal capability) significantly influence students' attitudes towards digital marketing (behavioral outcome). Furthermore, the mediating effect of digital skills in H4 demonstrates the cognitive processing element in SCT—where skills acquired through access and interaction with digital tools influence one's motivation and behavioral intentions (Bandura, 2001).

Digital Human Capital Theory suggests that digital competencies are essential assets in today's labor market (Katz *et al.*, 2022). The confirmation of H2 and H4 contributes to this theory by providing empirical evidence that access to technology directly fosters the development of digital skills, which in turn shape positive work-related attitudes. These findings reinforce the notion that investing in digital infrastructure is crucial for cultivating economically relevant competencies among TVET students (Castaño-Muñoz *et al.*, 2023).

Self-Determination Theory (SDT), as developed by Deci and Ryan (1985), emphasizes the role of intrinsic motivation and psychological needs—autonomy, competence, and relatedness—in learning and behavior. The significant moderating effect of motivation (H5) aligns with SDT by illustrating that students' intrinsic desire to learn digital marketing enhances the influence of environmental resources (technology access) on their attitudes. This suggests that digital learning environments are more effective when learners are self-motivated (Ryan and Deci, 2020), adding to the theory's application in digital education contexts.

Beyond confirming established relationships, this study advances the literature in three important ways. First, rather than treating access to technology as a standalone predictor, the study empirically demonstrates *how* access translates into attitudinal outcomes through the intervening mechanism of digital skills. This addresses recent critiques that digital inclusion research often overemphasizes infrastructure while under-theorizing capability conversion processes (Goldin, 2025; World Bank, 2024b).

Second, the study introduces *motivation to learn digital marketing* as a boundary condition that shapes the effectiveness of technology access. While prior studies typically model motivation as a direct predictor, positioning it as a moderator reveals why similar levels of access yield divergent outcomes across learners. This moderated pathway extends Self-Determination Theory into TVET and digital marketing education contexts, which remain underexplored in the Global South (Ryan and Deci, 2020; Owusu and Antwi, 2024).

Third, the findings reveal meaningful demographic asymmetries—particularly across education level, year of study, and gender—that are rarely theorized in digital skills research. These patterns suggest that digital attitudes are shaped not only by resources and skills but also by students' institutional positioning and career proximity, offering a more nuanced understanding of digital readiness within vocational education systems.

6. Practical and policy implications

For educators and TVET institutions, the findings underscore the critical importance of integrating digital technologies into both the curriculum and the broader school environment. Practical, hands-on exposure to digital marketing tools—such as social media advertising platforms, email automation tools, content management systems, and data analytics software—should be embedded within learning activities to improve both skills and

attitudes. Teachers and facilitators must be upskilled to deliver digitally-oriented content in ways that enhance learners' motivation and confidence. The partial mediation effect of digital skills highlights that while access to technology is foundational, students need guided instruction to translate that access into practical competence and enthusiasm. Therefore, training programs must emphasize applied digital skill development, rather than passive technology use.

From the students' perspective, this study highlights the value of personal initiative and self-motivation. Since motivation significantly moderates the impact of technological access, students should be actively engaged through gamified learning, peer-led workshops, digital innovation competitions, and mentorship programs that connect theory with real-world marketing practices. School-based entrepreneurship clubs and innovation labs can be powerful platforms for nurturing motivation, offering students the opportunity to experiment with digital marketing strategies in safe and supportive environments.

At the policy level, the findings call for a dual-focus approach: infrastructure development and learner-centered pedagogy. First, Ghana's Ministry of Education, in collaboration with the Council for Technical and Vocational Education and Training (COTVET), should prioritize expanding access to digital technologies across all TVET institutions, with a particular emphasis on schools in rural and under-resourced areas. National strategies like the "ICT in Education Policy" must be revised and fully implemented to ensure that every TVET institution is equipped with functioning ICT laboratories, affordable internet, and modern devices.

Second, policies must be introduced or reinforced to mandate digital literacy and marketing modules in the core curriculum of secondary and tertiary TVET programs. This inclusion should be accompanied by training and professional development for educators to ensure they are adequately prepared to teach in a technology-enriched environment. In alignment with [Hypothesis 4](#), these curricular reforms should also adopt competency-based approaches that focus on building students' digital skills as pathways to influence their professional interests and attitudes toward digital marketing careers.

Finally, this study calls for inter-sectoral collaboration between education, private sector (especially tech firms and marketing agencies), and community organizations to create internship and apprenticeship programs. Such collaborations can ensure that TVET students transition from learning digital skills to applying them in practical, revenue-generating contexts. These partnerships can further act as pipelines for employment and self-employment opportunities, supporting national goals for youth employment and economic transformation.

The findings also carry broader societal implications for youth employment and digital inclusion. Evidence from Ghana and comparable economies shows that digitally skilled TVET graduates are more likely to engage in self-employment and micro-enterprise creation, particularly in online retail and service sectors ([World Bank, 2024b](#); [African Development Bank, 2025](#)). By identifying motivation as a critical amplifier of access, the study suggests that public investments in digital infrastructure should be complemented by behavioral and pedagogical interventions—such as mentorship, project-based learning, and exposure to real digital marketing campaigns—to maximize social returns. Such integrated approaches can contribute to reducing youth unemployment and fostering inclusive participation in the digital economy.

7. Conclusion

In conclusion, this study provides empirical evidence that access to technology and digital skills are critical enablers of positive attitudes toward digital marketing among TVET students in Ghana. The findings confirm that increased access to technological resources significantly enhances both students' digital competencies and their receptiveness to digital marketing practices. Moreover, digital skills not only exert a direct influence on students' attitudes but also partially mediate the relationship between access to technology and digital marketing attitudes. This partial mediation suggests that while access to technology independently shapes

attitudes, its full potential is realized when students are also equipped with the necessary digital skills. Equally compelling is the finding that motivation to learn digital marketing significantly moderates the relationship between access to technology and students' attitudes. This underscores the importance of intrinsic psychological factors in amplifying the benefits of external resources. These insights highlight the interconnectedness of infrastructure and capacity-building in preparing TVET students for active participation in the digital economy, underscoring the need for holistic interventions that address both access and skill acquisition to foster digital entrepreneurial readiness.

Although situated in Ghana, the findings contribute to broader international debates on digital skills development in vocational education systems across the Global South. Similar challenges related to unequal access, skill conversion, and learner motivation have been documented in other African and emerging economies (Castaño-Muñoz *et al.*, 2024; World Bank, 2024a). By empirically demonstrating how and when technology access translates into positive digital career attitudes, this study offers transferable insights for policymakers and educators seeking to design inclusive digital TVET reforms beyond the Ghanaian context.

8. Limitations and future research

While the study establishes clear technology-attitude linkages, two limitations merit attention. First, the observational nature of technology access metrics may overlook qualitative differences in usage patterns. Future studies should incorporate usage analytics. Second, the 3-month study period may not capture long-term attitude sustainability - longitudinal tracking is recommended.

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