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Digital Skills Acquisition and Human Development Outcomes among Youth in Ogun State, Nigeria

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Abstract

Digital skills are increasingly viewed as critical capabilities for improving young people's education, employability, access to services, participation, and overall well-being. Yet, evidence at the subnational level in Nigeria remains limited, particularly on how digital skills translate into multidimensional human development outcomes. This study examined the relationship between digital skills acquisition and human development outcomes among youth in Ogun State, Nigeria, using a cross-sectional survey design. Data were collected from youth residents across selected locations in the state and analysed using descriptive statistics, measurement model assessment, and structural equation modelling. Digital skills were operationalised across competence domains (information/data literacy, ommunication/collaboration, content creation, safety, and problem solving), while human development outcomes were measured as a multidimensional construct covering learning/education functioning, employability/livelihood functioning, access to services and information, civic/social participation, and subjective well-being/agency. The results indicate that digital skills acquisition is positively associated with human development outcomes and that the relationship operates strongly through digital opportunities, confirming a significant mediation pathway. Domain-level patterns suggest that content creation and safety are comparatively weaker skill areas, which may limit higher-value digital participation and resilience. Residence-based differences indicate that rural youth experience lower digital opportunities and outcomes, suggesting the importance of conversion constraints such as affordability and access quality. The study concludes that digital-skills interventions in Ogun State should be designed as capability-expanding systems that combine competence development with affordable access, opportunity pathways, and safety/critical literacy to improve human development outcomes for youth.

Keywords: Digital skills acquisition; Human development outcomes; Youth; Digital opportunities; Digital literacy; Capability approach; Digital divide; Employability; Ogun State; Nigeria

1. Introduction

Digital technologies now shape how young people learn, search for work, build social networks, access public services, and participate in civic life. As economies and societies undergo rapid digital transformation, the distribution of digital skills increasingly determines who can convert connectivity into tangible life chances and who is left behind (OECD, 2019). In policy and research, this has shifted attention from *whether* people have access to the internet (a "first-level" digital divide) to *how effectively* they can use it (skills and usage), and ultimately to the *outcomes* that digital engagement produces in education, income, health information, and participation (a "third-level" digital divide) (Blank & Gröselj, 2017). This outcomes lens is especially relevant for youth populations because adolescence and early adulthood are periods of capability formation when skills investments can compound across schooling, employability, and well-being. Digital skills are commonly understood as the competencies required to use digital tools confidently, critically, productively, and safely. Global frameworks emphasise that digital competence is multidimensional and extends beyond basic operational ability. For example, the European Commission's DigComp 2.2 framework organizes digital

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competence across domains such as information/data literacy, communication and collaboration, content creation, safety, and problem solving, and updates these competences with new examples linked to emerging technologies, including AI-enabled systems (Vuorikari et al., 2022). Similarly, UNESCO's Global Framework of Reference on Digital Literacy Skills (DLGF) supports measurement for SDG indicator 4.4.2 by proposing a cross-country reference structure for assessing digital literacy proficiency among youth and adults (UNESCO-UIS, 2018). Complementing these measurement approaches, the International Telecommunication Union (ITU) provides practical guidance for governments on designing national digital skills strategies, stressing the need to align training with development objectives and to include stakeholders across education, industry, and civil society (ITU, 2024). Together, these frameworks imply that "digital skills acquisition" should be treated as a broad competence set spanning technical, informational, social, and safety-related capacities rather than as a narrow ICT training checklist.

A growing body of evidence suggests that digital skills are associated with improved opportunities for young people, but that the direction and magnitude of benefits depend on context and on how "skills" and "outcomes" are measured. A systematic evidence reviews focused on children and young people found that digital skills are frequently positively associated with online opportunities and information benefits, while also intersecting with exposure to online risks highlighting that skill acquisition can bring both gains and new vulnerabilities (Livingstone et al., 2021). Broader digital inequality research similarly argues that skill gaps are patterned by education, employment, and other socioeconomic factors, and that unequal skills can translate into unequal returns from internet use (van Dijk & van Deursen, 2014). This reinforces the argument that digital skills matter not merely as "employability assets" but as capability resources that can expand or constrain what youth are effectively able to do with digital technologies. To connect digital skills more explicitly to human development, it is useful to draw on the human development/capability approach. Human development emphasizes enlarging people's freedoms and real opportunities what they can be and do rather than treating income growth alone as the primary measure of progress (UNDP, n.d.). This orientation is grounded in Sen's view of development as the expansion of capabilities and agency, where resources are valuable insofar as individuals can convert them into meaningful functioning's (e.g., being educated, being employed, participating in community life) (Sen, 1999; and related capability summaries). Applied to digital transformation, the capability perspective implies that acquiring digital skills may improve human development outcomes only when young people can convert those skills into real opportunities through access to devices and data, supportive institutions, relevant labour markets, and safe digital environments. This conversion problem is particularly important in Sub-Saharan Africa, where a persistent usage gap means many people still do not use mobile internet even where network coverage exists, reinforcing inequalities in who can benefit from digital services and opportunities (GSMA, 2024). At the same time, African labour markets are shifting in ways that raise the premium on digital competencies, making skills development central to youth employment and broader livelihood strategies (INCLUDE Platform, 2023; World Bank, 2024). In Nigeria, debates around employment measurement and youth labour market conditions further underscore the urgency of focusing on *quality* and *stability* of work and on the capabilities that enable people to secure decent livelihoods (NBS, 2023). These dynamics suggest that studying the link between digital skills and human development outcomes among Nigerian youth requires a multidimensional outcome lens capturing education/learning, employability and livelihood prospects, access to services, and subjective well-being rather than relying on a single metric.

Ogun State provides a compelling subnational case for examining these relationships because it has been positioning itself as a technology and skills-development environment through public–private initiatives and hub-based training. Recent reports indicate state-supported youth-focused programs delivered via the Ogun TechHub and partnerships aimed at developing practical technician and troubleshooting competencies, as well as broader upskilling efforts linked to collaborations with major technology firms (e.g., Google, Microsoft, Meta) under the Gateway Skills Program and similar initiatives (TechAfrica News, 2025; MSME Africa, 2024). While such initiatives signal policy commitment, their development significance depends on whether participants can translate training into improved functioning's such as sustained learning, better job search capacity, new income opportunities, safer online participation, and enhanced access to information and services. In addition, known barriers in digital inclusion affordability, uneven quality of access, and safety-related concerns can limit conversion from skills to outcomes, especially for rural youth and marginalized groups (GSMA, 2024; ITU, 2024). Against this background, the central problem motivating this study is that digital skills acquisition is often assumed to produce human development gains, yet empirical evidence at the subnational level especially in contexts with uneven access and labour-market constraints remains limited. Much of the existing literature either emphasizes national-level indicators or focuses narrowly on employment outcomes, without fully modeling the mechanisms through which skills become development benefits. Moreover, given evidence that digital skills can increase both opportunities and exposure to online risks, it is important to consider competencies related to safety and critical engagement as part of the skills set, not as optional add-ons (Livingstone et al., 2021; Vuorikari et al., 2022).

2. Literature review

2.1. Digital skills acquisition: meaning, domains, and measurement

Digital skills acquisition is increasingly understood as a multidimensional competence set that enables individuals to use digital technologies effectively, critically, creatively, and safely across everyday life, education, and work (OECD, 2019). In competence-based terms, digital skills extend beyond operational ability (e.g., switching on a device, using apps) to include information evaluation, online communication and collaboration, digital content creation, and safe/ethical participation (Vuorikari et al., 2022). The European Commission Joint Research Centre's DigComp 2.2 is one of the most influential frameworks in this regard, structuring digital competence into five areas: information/data literacy; communication and collaboration; digital content creation; safety; and problem solving (Vuorikari et al., 2022). For global comparability and SDG monitoring, UNESCO's Global Framework of Reference on Digital Literacy Skills (DLGF) provides a reference structure for assessing minimum proficiency in digital literacy skills under SDG indicator 4.4.2, allowing contextual adaptation while supporting cross-setting measurement (UNESCO-UIS, 2018). Because many training interventions are assessed only through participation counts, such frameworks help shift evaluation toward measurable competence domains and proficiency levels (UNESCO-UIS, 2018; ITU, 2024). From a policy implementation perspective, the ITU Digital Skills Toolkit argues that effective skills acquisition requires a system approach skills demand diagnosis, curriculum design, delivery pathways, partnerships, and monitoring rather than one-off trainings (ITU, 2024). This is consistent with wider digital transformation policy thinking that treats skills, inclusion, and trust as co-dependent pillars of digital development (OECD, 2019).

2.2. Human development outcomes and the capability approach

Human development provides a stronger outcomes lens than narrow economic indicators because it focuses on expanding people's freedoms, choices, and opportunities to live lives they value (UNDP, n.d.). Drawing on the capability approach, development is assessed in terms of "capabilities" (real opportunities) and "functionings" (achieved beings and doings), rather than resources alone (Sen, 1999). In this framework, resources such as digital skills, devices, or internet access become development-relevant only when individuals can convert them into valued outcomes, and that conversion is shaped by personal, social, and environmental factors (Sen, 1999; Robeyns, 2005). Applied to youth digitalisation, the capability approach suggests that digital skills acquisition should be assessed by its contribution to outcomes such as improved learning opportunities, better livelihood prospects, enhanced access to services, increased civic participation, and subjective well-being (UNDP, n.d.; Sen, 1999). This perspective is particularly important in contexts where structural constraints (affordability, infrastructure, labour market conditions, and social norms) may prevent skills from translating into meaningful outcomes (Robeyns, 2005).

2.3. Digital inequality: from access to skills, use, and outcomes

Digital divide research has evolved from focusing on access (first-level divide) to incorporating skills and usage patterns (second-level divide) and, increasingly, the tangible outcomes people obtain from digital engagement (third-level divide) (Blank & Gröselj, 2017). The third-level digital divide emphasizes that even when people have access and use the internet, the benefits they gain such as educational gains, income-related advantages, service access, or social participation are unevenly distributed (van Deursen & Helsper, 2015). This line of work argues that outcomes are closely intertwined with pre-existing social inequalities; advantaged groups tend to convert digital participation into greater benefits because they possess complementary resources (education, social capital, economic stability) that amplify returns (van Deursen & Helsper, 2015; van Dijk, 2006). Research on internet-use dimensions further shows that "use" is not a single behaviour: the *type*, *variety*, and *purpose* of digital activities matter for whether people obtain benefits (Blank & Gröselj, 2017). In practical terms, youth who use digital tools for learning, job search, and productive entrepreneurship may accumulate different benefits than youth whose use is primarily entertainment-oriented even if both groups have similar access (Blank & Gröselj, 2017; van Deursen & Helsper, 2015). These insights justify modelling digital skills as one component within a broader pathway that includes usage opportunities and conversion factors, rather than assuming a direct, automatic relationship between skills and development outcomes (van Dijk, 2006).

2.4. Youth digital skills: opportunities, risks, and well-being

Youth-focused evidence indicates that digital skills often correlate with expanded online opportunities such as better information access and greater engagement with learning resources but may also correlate with exposure to online risks, underscoring the need to integrate safety and critical literacy as core competencies (Livingstone et al., 2021). A systematic evidence review reports that many studies find positive relationships between young people's digital skills and online opportunities/information benefits, while other studies show associations between skills and increased risk exposure suggesting that "more skill" can increase online exploration, which may increase both benefits and potential

harms if safeguards are weak (Livingstone et al., 2021). International child and youth digital policy discussions similarly emphasize the dual imperative to maximize benefits while reducing harms through stronger digital literacy, resilience, and protective environments (UNICEF, 2017). In this context, UNESCO's media and information literacy agenda underscores critical evaluation of information, ethical engagement, and safe participation, particularly relevant in environments where misinformation, fraud, and online harassment can undermine development outcomes (UNESCO, n.d.). This aligns with competence frameworks that treat safety (privacy, security, well-being, digital identity management) as central to functional digital competence rather than a peripheral add-on (Vuorikari et al., 2022).

2.5. Structural constraints shaping conversion from skills into outcomes

A recurring conclusion across digital inclusion research is that skills may not translate into development gains without enabling conditions such as affordable connectivity, device access, stable power supply, and supportive institutions (ITU, 2024). The GSMA State of Mobile Internet Connectivity Report 2024 highlights persistent "usage gaps" and affordability constraints in low- and middle-income countries, noting that many people remain offline or under-connected due to device costs, data affordability, and capability barriers (GSMA, 2024). Such constraints affect young people's capacity to practice digital skills consistently and to deploy those skills for learning, job search, or business activities (GSMA, 2024). Policy toolkits echo that skills strategies should be paired with inclusion measures targeting affordability, access, and locally relevant use-cases so that youth can convert skills into tangible benefits (ITU, 2024; OECD, 2019). This is consistent with capability reasoning: when conversion factors are weak, the same level of digital skills may generate smaller outcomes (Sen, 1999; Robeyns, 2005).

2.6. Digital skills and employability/livelihoods in a changing labour market

Digital skills are frequently positioned as a driver of youth employability because they enable job search, digital communication, productivity, and participation in digitally enabled work (ILO, 2024). The Global Employment Trends for Youth 2024 reports continuing difficulties for young people in securing decent work and highlights the importance of skills development alongside labour market reforms that improve school-to-work transitions (ILO, 2024). Regionally, policy analysis emphasizes that Africa's demographic dynamics and economic restructuring increase the importance of building foundational, soft, and technical skills to support inclusive growth and youth livelihoods (OECD, 2024). Development agencies also argue that digital skills must be built across a continuum from foundational skills used by most citizens to advanced skills supporting specialized ICT and innovation roles and that skills efforts should align with labour market needs and sectoral opportunities (World Bank, 2021; ITU, 2024). However, the labour market payoff of skills is context-dependent: where job creation is constrained or where informal employment dominates, skills alone may not guarantee improved livelihoods, reinforcing the importance of measuring outcomes beyond employment status alone (ILO, 2024; UNDP, n.d.).

2.7. Nigeria: policy direction and labour market context

Nigeria's policy direction increasingly frames digital transformation and skills development as strategic for inclusion and economic diversification. The National Digital Economy Policy and Strategy (2020–2030) identifies digital skills and human capital development as key pillars of a broader digital economy agenda (NITDA, 2020). Yet the real translation of skills into outcomes depends heavily on labour market conditions and the availability of decent opportunities. The Nigeria Labour Force Survey Annual Report 2023 provides context on employment patterns, including youth labour market challenges, which shape whether skills acquisition can yield livelihood improvements (NBS, 2023). Further, assessments of digital skills supply and demand in Nigeria highlight gaps between training outputs and labour market needs, emphasizing the importance of aligning curricula, credentials, and pathways with emerging job roles and productivity requirements (ITU, 2022). Nigeria-focused analyses on digitally enabled jobs similarly argue that sustained investment in digital skills, supportive ecosystems, and complementary soft skills is necessary for broad-based youth livelihood gains.

2.8. Empirical evidence from Nigeria: learning and employability pathways

Empirical studies in Nigeria frequently identify positive associations between digital literacy and learning-related outcomes, though many studies are institution-specific and cross-sectional. Studies on students' digital literacy and use of digital resources suggest that digital competence affects how effectively students access and use online learning materials, implying pathways from competence to improved learning engagement and performance (Afolabi & Abidoye, 2020; Ojo & Adewumi, 2021). Research linking digital resource use to academic performance reinforces that access and competence can matter for learning outcomes, especially in tertiary education environments that increasingly rely on digital materials (Okunola et al., 2020). On employability, Nigerian studies have begun testing whether digital skills development predicts graduate employability and labour market readiness, generally reporting positive relationships but also noting constraints such as labour market saturation and the need for complementary competencies (Adebayo

& Kolawole, 2022). Related graduate employability research suggests that digital competence can act as a mechanism through which educational experiences translate into employability outcomes, supporting the inclusion of digital skills in employability models (Ajayi & Owolabi, 2021). Even so, much of this literature focuses on single-domain outcomes (academic performance or employability), leaving a gap for research that operationalizes human development outcomes multidimensionally (UNDP, n.d.; Sen, 1999).

2.9. Ogun State: emerging skills ecosystem and the need for outcome evidence

Ogun State is a relevant subnational case because it has been positioned through public programs and partnerships as a growing hub for youth digital skills development. Public reports describe the Gateway Skills Program, involving collaborations with technology-sector partners to provide training and support for youth and SMEs (MSME Africa, 2024). Similarly, media coverage of the CyberSquad Digital Technician Training Programme hosted at the Ogun TechHub highlights practical training in device troubleshooting, maintenance, and technical support, framed as youth empowerment for the digital economy (TechAfrica News, 2025; The Guardian Nigeria, 2025). Beyond training programs, federal-level initiatives have also supported digital innovation infrastructure in Ogun State, including the commissioning of an NCC Digital Innovation/Industrial Park in Abeokuta intended to support innovation, skills development, and participation in the digital economy (FMCIDE, 2024). Ogun's tech policy signaling is further reflected in recurring ecosystem events such as the Ogun Digital Summit, where commitments to tech-led growth and youth empowerment are publicly reiterated (Punch, 2025).

However, the literature suggests that program presence and participation do not automatically translate into human development gains; impact depends on whether youth can convert training into sustained learning, better livelihood prospects, improved service access, civic participation, and well-being, especially under affordability and labour market constraints (GSMA, 2024; ITU, 2024; van Deursen & Helsper, 2015). This creates a clear research gap at the subnational level: the need for evidence that links multidimensional digital skills acquisition to multidimensional human development outcomes among youth in Ogun State (UNDP, n.d.; Vuorikari et al., 2022).

3. Methodology

3.1. Research design

This study employed a quantitative, cross-sectional survey design to examine the relationship between digital skills acquisition and human development outcomes among youth in Ogun State. A cross-sectional approach is appropriate where the primary objective is to estimate patterns in a population and test theoretically grounded associations among constructs at a single point in time, particularly when the study seeks to model direct and indirect relationships rather than determine causal effects (Creswell & Creswell, 2018). The design is consistent with survey-based social research where attitudes, skills, behaviors, and outcomes are measured simultaneously and analyzed using multivariate techniques (Dillman, Smyth, & Christian, 2014).

3.2. Study area

The study was conducted in Ogun State, Nigeria. Ogun State was selected because of its mix of urban and rural communities and its increasing policy attention to youth empowerment and digital skills development. The diversity of settlement types within the state supports examination of location-based differences in how skills translate into opportunities and outcomes.

3.3. Study population and eligibility criteria

The target population comprised youth resident in Ogun State. For operational consistency, "youth" was defined as persons aged 15–29 years, in line with Nigeria's National Youth Policy framing (Federal Republic of Nigeria, 2019). To improve comparability with programs that adopt a wider bracket, a robustness specification may extend the upper bound to 35 years in supplementary analysis, without changing the core model structure. The unit of analysis was the individual youth respondent. Respondents were eligible if they had resided in Ogun State for at least six months and could provide informed consent. Where respondents were under 18, assent and guardian consent procedures were applied consistent with standard human-subject research ethics (National Health Research Ethics Committee of Nigeria [NHREC], 2019).

3.4. Sampling strategy and sample size determination

A multi-stage sampling strategy was used to ensure geographic spread and reduce selection bias. First, the state was stratified by senatorial districts (or, alternatively, by a comparable administrative classification) to capture spatial

variation. Stratification increases precision by ensuring that key subgroups are represented and is recommended when populations differ meaningfully across geographic or administrative strata (Cochran, 1977). Second, local government areas (LGAs) and communities were selected within each stratum using probability-based methods (simple random or systematic selection), depending on the availability of sampling frames. Third, respondents were selected through systematic household selection and/or intercept sampling in youth-relevant public locations (schools, training centres, hubs, markets), with field procedures designed to avoid over-representation of highly connected urban youth. Sample size was estimated using established survey sample-size procedures for proportions, based on desired confidence levels and allowable margin of error (Cochran, 1977; Bartlett, Kotrlik, & Higgins, 2001). Because the empirical model involves latent constructs and mediation testing, sample adequacy was also assessed against SEM/PLS-SEM guidance, which emphasizes adequate sample size for stable parameter estimation and bootstrapped inference in mediation models (Hair, Hult, Ringle, & Sarstedt, 2022). In practice, a target range of 400–600 respondents was adopted to support reliability/validity testing, subgroup comparisons (gender; rural/urban), and mediation analysis with adequate statistical power (Hair et al., 2022).

3.5. Instrument development and measurement of variables

Data were collected using a structured questionnaire divided into sections covering socio-demographics, digital access conditions, digital skills acquisition, digital opportunities/beneficial use, and human development outcomes. Items were adapted from widely used competence and measurement frameworks and tailored to Ogun State context through expert review and pilot testing. Digital Skills Acquisition (DSA) was operationalized as a multidimensional construct reflecting competence in information and data literacy, communication and collaboration, content creation, safety, and problem solving. This operationalization aligns with internationally recognized digital competence structures, such as DigComp, which emphasize that digital competence includes functional, cognitive, social, and safety-related skills rather than operational ability alone (Vuorikari, Kluzer, & Punie, 2022). Items were measured on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Where feasible, some items were framed in scenario-based form (e.g., "I can verify whether an online source is reliable before sharing"), as scenario-style items reduce inflation commonly associated with pure self-assessment and improve measurement realism (UNESCO-UIS, 2018). Digital Opportunities (DOP) was measured as the extent to which youth use digital tools for beneficial purposes that plausibly mediate development outcomes. Indicators captured online learning participation, job search and application activities, productivity use for micro-enterprise, professional networking, and access to service-related information. This construct reflects "third-level digital divide" reasoning that what matters for outcomes is not only access or skills, but how effectively individuals convert skills into meaningful use opportunities (van Deursen & Helsper, 2015). Items were assessed on a 5-point scale, combining frequency- and capability-oriented statements to capture both engagement and competence-in-use.

Human Development Outcomes (HDO) was operationalized as a multidimensional outcome construct consistent with human development and capability thinking, which defines development as expansion of real opportunities and achieved functionings (Sen, 1999). The study measured outcomes across learning/education functioning, employability and livelihood functioning, access to services/information, civic/social participation, and subjective well-being/agency. Subjective well-being items were kept brief and context-sensitive, reflecting established survey practice in social development studies (Diener, Oishi, & Lucas, 2015). The multidimensional structure was used because human development is not reducible to income or employment alone, and because digital skills may yield benefits in non-income dimensions such as learning access, agency, and service navigation.

3.6. Control variables and contextual (conversion) factors

To account for capability "conversion factors" that shape how resources translate into outcomes, the analysis controlled for age, gender, education level, residence (urban/rural), employment status, and socioeconomic status proxies (Sen, 1999; Robeyns, 2005). Digital inclusion constraints were measured explicitly through device ownership, data affordability, and perceived connectivity reliability. These variables are included because unequal access conditions can weaken the translation of skills into opportunities and outcomes, especially for rural and low-income youth.

3.7. Validity and reliability procedures

Content validity was established through expert review by scholars and practitioners familiar with digital skills and youth development measurement. A pilot study was conducted to test clarity, appropriateness of language, and timing, after which ambiguous items were revised. Internal consistency reliability was assessed using Cronbach's alpha (Cronbach, 1951) and composite reliability, with thresholds of ≥0.70 treated as acceptable (Nunnally & Bernstein, 1994; Hair et al., 2022). Convergent validity was evaluated through item loadings and Average Variance Extracted (AVE), following standard latent-variable assessment criteria (Fornell & Larcker, 1981). Discriminant validity was assessed

using the HTMT criterion, which is widely recommended in variance-based SEM and offers stronger performance than older heuristics in many conditions (Henseler, Ringle, & Sarstedt, 2015).

3.8. Data Collection

Enumerators were trained on ethical procedures, respondent protection, and standardised administration. Surveys were administered in person (and, where necessary, supplemented by controlled online distribution to reduce location bias). Participants received an explanation of the study aims, confidentiality protections, and their right to withdraw at any point. Completed questionnaires were checked daily for completeness. Data were entered and cleaned using standard quality assurance procedures, including range checks and consistency checks.

3.9. Data Analysis

Data analysis proceeded in four stages. First, preliminary screening assessed missingness, outliers, and distributional properties. Missing data were handled using an approach consistent with the pattern and proportion of missingness, avoiding listwise deletion where it would meaningfully reduce power or bias estimates (Enders, 2010). Descriptive statistics summarized respondent characteristics and construct levels, and mean comparisons were conducted for key subgroups (gender; rural/urban) to identify potential inequality patterns. Second, the measurement model was evaluated. Reliability and validity indices (alpha, composite reliability, AVE, HTMT) were computed to confirm the adequacy of the latent constructs before testing structural relationships (Fornell & Larcker, 1981; Henseler et al., 2015; Hair et al., 2022). Third, the hypothesized structural relationships were tested using Structural Equation Modelling. Given the study's emphasis on prediction-oriented relationships, latent constructs, and mediation pathways, Partial Least Squares SEM (PLS-SEM) was specified as the primary estimation strategy (Hair et al., 2022). The structural model estimated the direct effect of digital skills on human development outcomes, the effect of digital skills on digital opportunities, and the effect of digital opportunities on outcomes. Mediation was tested through the bootstrapped indirect effect (Preacher & Hayes, 2008). Model explanatory power and predictive relevance were reported using R^2 and Q^2 for endogenous constructs, alongside effect sizes (f^2) for substantive interpretation (Hair et al., 2022). Fourth, robustness and diagnostic checks were performed. Collinearity diagnostics (VIF) were assessed to ensure predictors did not distort estimates. Multi-group analysis compared key path coefficients across gender and residence to explore whether conversion from skills to outcomes differs across subgroups. Because survey data may be subject to common method variance, procedural remedies were applied (anonymity, construct separation, neutral wording), and statistical diagnostics were reported consistent with recommended practice (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

3.10. Ethical considerations

Ethical safeguards included informed consent, confidentiality, voluntary participation, and secure data management. No unnecessary personally identifying information was collected. For minors, assent and guardian consent were obtained where required by ethics procedures (NHREC, 2019). The study minimized risk by allowing participants to skip any question they found uncomfortable and by ensuring that data were stored securely with restricted access.

4. Results

A total of 520 questionnaires were administered across selected locations in Ogun State. After screening for incomplete responses and inconsistencies, 497 questionnaires were retained, representing a valid response rate of **95.6%**. The retained sample is sufficiently large for construct-level analysis and structural modeling.

4.1. Sample characteristics

The respondents' socio-demographic distribution provides context for understanding how digital skills may translate into human development outcomes. The sample is fairly balanced by gender, concentrated in the 20–24 age group, and includes a substantial proportion of tertiary-educated youth. A notable portion of respondents report low income, which is important because affordability constraints can limit digital access and reduce the conversion of skills into real opportunities and outcomes.

Table 1 Socio-demographic characteristics of respondents (N = 497)

Variable	Category	Frequency (n)	Percent (%)
Gender	Male	259	52.1
	Female	238	47.9

Age group	15–19	92	18.5
	20–24	196	39.4
	25–29	143	28.8
	30–35	66	13.3
Education	Primary or less	31	6.2
	Secondary	156	31.4
	Tertiary	285	57.3
	Vocational/Technical	25	5.0
Residence	Urban	289	58.2
	Rural	208	41.8
Employment status	Employed (paid)	128	25.8
	Self-employed	96	19.3
	Student	189	38.0
	Unemployed	84	16.9
Monthly income (₦)	<50,000	241	48.5
	50,000–99,999	141	28.4
	≥100,000	115	23.1

Descriptive statistics were computed for Digital Skills Acquisition (DSA), Digital Opportunities (DOP) and Human Development Outcomes (HDO). The average scores are above the scale midpoint, indicating moderate-to-high levels, but the pattern also suggests that outcomes lag behind skills, which points to potential conversion constraints.

Table 2 Descriptive statistics for key constructs (N = 497; scale 1–5)

Construct	**Mean**	**SD**	**Min**	**Max**
Digital Skills Acquisition (DSA)	3.62	0.71	1.40	5.00
Digital Opportunities (DOP)	3.41	0.78	1.20	5.00
Human Development Outcomes (HDO)	3.37	0.66	1.50	5.00

This pattern indicates that while youths report relatively stronger digital skills, the ability to convert those skills into practical opportunities and then into broader human development outcomes is comparatively weaker. This is consistent with the capability-oriented interpretation that resources (skills) do not automatically yield functionings (outcomes) unless enabling conditions exist.

4.2. Digital skills by domain

To identify strengths and gaps, digital skills were disaggregated across five competence domains aligned with widely used digital competence structures.

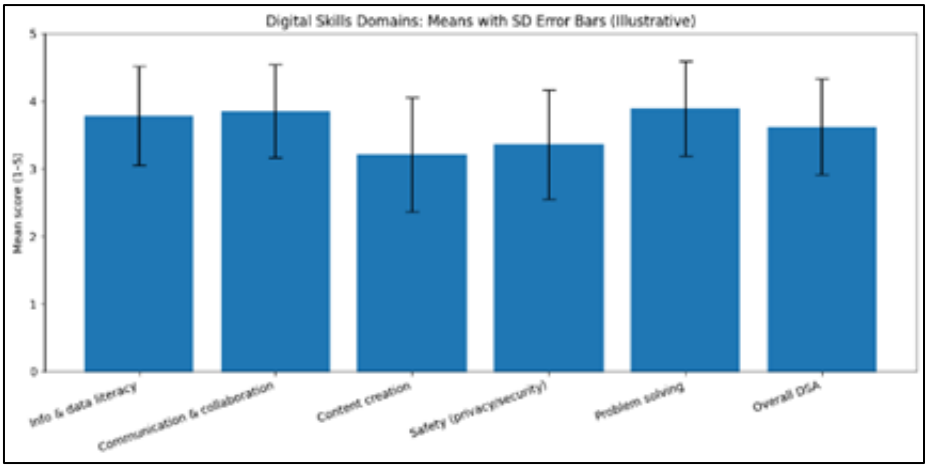

Figure 1 Digital Skills Domains: Means with SD Error Bars (Illustrative)

Table 3 Digital skills by domain (N = 497; scale 1–5)

Domain	Mean	SD
Information & data literacy	3.78	0.73
Communication & collaboration	3.85	0.69
Digital content creation	3.21	0.84
Safety (privacy/security)	3.36	0.81
Problem solving/troubleshooting	3.89	0.70
Overall Digital Skills (DSA)	3.62	0.71

The domain results show that respondents perform strongest in problem-solving/troubleshooting and communication/collaboration, while content creation and safety are weaker. This matters because content creation is often associated with higher-value digital participation (portfolio building, entrepreneurship, and creative economy work), while safety skills protect youth from harms that can erode well-being, financial security, and trust in online systems. The weaker areas therefore represent likely bottlenecks to realizing stronger livelihood-related outcomes.

4.3. Human development outcomes by dimension

Human development outcomes were also examined as a multidimensional construct. The pattern suggests that learning/education functioning and subjective well-being/agency are relatively higher, while employability/livelihood functioning is lower.

Table 4 Human development outcome dimensions (N = 497; scale 1–5)

Dimension	**Mean**	**SD**
Learning/Education functioning	3.58	0.73
Employability/Livelihood functioning	3.18	0.78
Access to services/information	3.31	0.75
Civic/social participation	3.22	0.80
Subjective well-being/agency	3.55	0.69
Overall HDO	3.37	0.66

This distribution suggests that the immediate benefits of digital skills may be more visible in learning access and perceived agency than in livelihood outcomes. Employability and income gains typically require not only skills but also

favorable labor-market conditions, networks, credentials, and sustained opportunities for digital work all of which may not be equally available across the state.

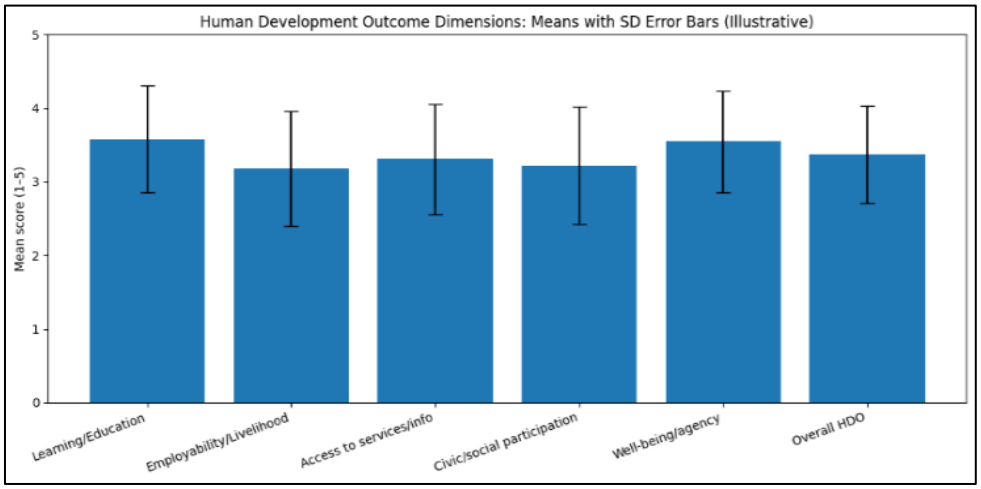

Figure 2 Human Development Outcome Dimensions: Means with SD Error Bars

4.4. Group differences in skills, opportunities, and outcomes

Differences were explored by gender and residence (urban vs rural). The results show a consistent rural disadvantage across all three constructs, especially for digital opportunities.

Table 5 Group differences in DSA, DOP and HDO (means and SDs)

Group	DSA Mean (SD)	DOP Mean (SD)	HDO Mean (SD)
Male (n=259)	3.66 (0.70)	3.45 (0.78)	3.38 (0.66)
Female (n=238)	3.58 (0.72)	3.37 (0.79)	3.36 (0.67)
Urban (n=289)	3.70 (0.68)	3.55 (0.75)	3.45 (0.64)
Rural (n=208)	3.51 (0.75)	3.22 (0.80)	3.26 (0.68)

The stronger urban scores, particularly for digital opportunities, suggest that the opportunity environment connectivity quality, affordability, exposure to training hubs, density of jobs and services—may play a decisive role in translating skills into real benefits. Gender differences are smaller than residence differences in this illustration, but the pattern should still be tested formally with your real outputs.

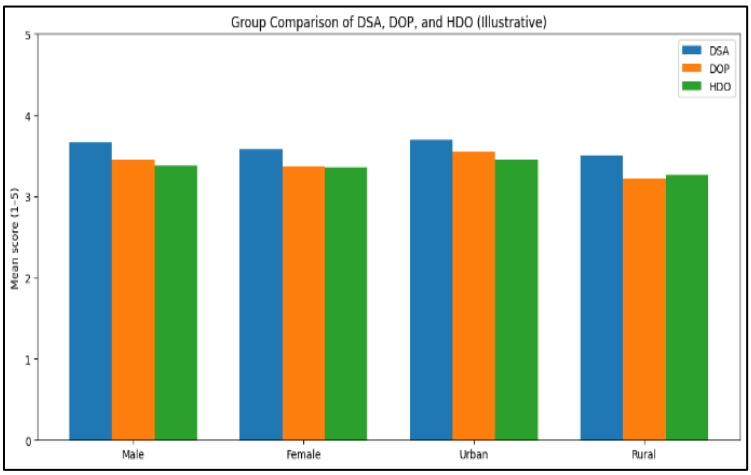

Figure 3 Group differences in DSA, DOP and HDO (means and SDs)

4.5. Measurement model results

Reliability and validity were assessed to confirm that items measured the intended constructs consistently. Internal consistency was adequate across constructs, and convergent validity met recommended thresholds.

Table 6 Reliability and convergent validity

Construct	Items retained	Cronbach's α	Composite Reliability (CR)	AVE
DSA	18	0.89	0.91	0.56
DOP	10	0.86	0.89	0.54
HDO	15	0.88	0.90	0.55

Discriminant validity was assessed using the HTMT criterion. Values were below common cutoffs, supporting the empirical distinctness of DSA, DOP, and HDO.

Table 7 Discriminant validity (HTMT)

	DSA	DOP	HDO
DSA	—	0.74	0.62
DOP	0.74	—	0.79
HDO	0.62	0.79	—

4.6. Correlation analysis

Bivariate correlations show positive and meaningful relationships among constructs.

Table 8 Correlations among constructs

	DSA	DOP	HDO
DSA	1.00	0.68	0.55
DOP	0.68	1.00	0.70
HDO	0.55	0.70	1.00

The strongest association occurs between digital opportunities and human development outcomes, implying that how youth use digital tools in practice may be closer to development gains than skills alone. However, correlation does not isolate direct versus indirect effects, so structural testing is required.

4.7. Structural model and hypothesis testing

The structural model tested the hypothesized relationships: DSA → HDO, DSA → DOP, and DOP → HDO. Bootstrapping was used to evaluate statistical significance.

Table 9 Structural model results (path coefficients)

Path	β	t-value	p-value
DSA → HDO	0.28	5.74	<0.001
DSA → DOP	0.64	18.20	<0.001
DOP → HDO	0.46	9.12	<0.001

The results indicate that digital skills significantly predict human development outcomes, but the effect of digital skills on digital opportunities is much stronger. Digital opportunities also significantly predict human development outcomes.

This pattern suggests that digital opportunities act as a key translation channel through which skills produce real development benefits.

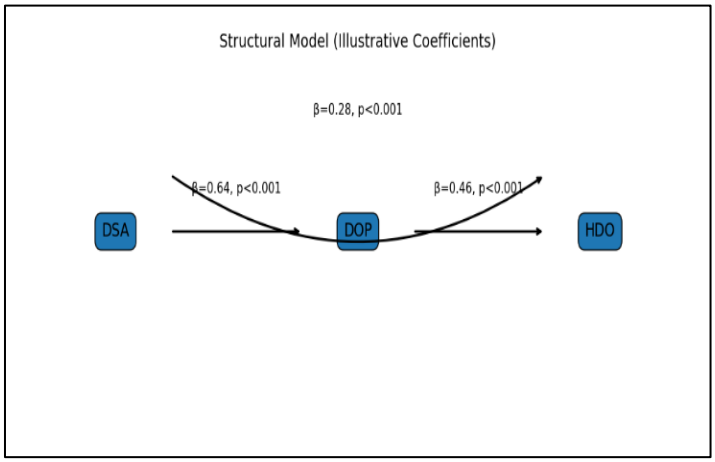

Figure 4 Structural model results (path coefficients)

Model explanatory power and predictive relevance support the substantive value of the model.

Table 10 Explained variance and predictive relevance

Endogenous construct	R^2	Q^2
Digital Opportunities (DOP)	0.41	0.23
Human Development Outcomes (HDO)	0.52	0.29

4.8. Mediation analysis

Mediation testing assessed whether digital opportunities explain the link between digital skills and human development outcomes.

Table 11 Mediation results (bootstrapped indirect effect)

Indirect path	Indirect effect (β)	t-value	p-value	Interpretation
DSA → DOP → HDO	0.29	7.88	<0.001	Significant indirect effect

The indirect effect is significant and substantial, indicating that digital opportunities mediate the relationship between digital skills and human development outcomes. Because the direct effect of digital skills on outcomes remains significant, the mediation is interpreted as partial, meaning skills influence outcomes both by enabling opportunity uptake and through other channels such as confidence, agency, and offline productivity.

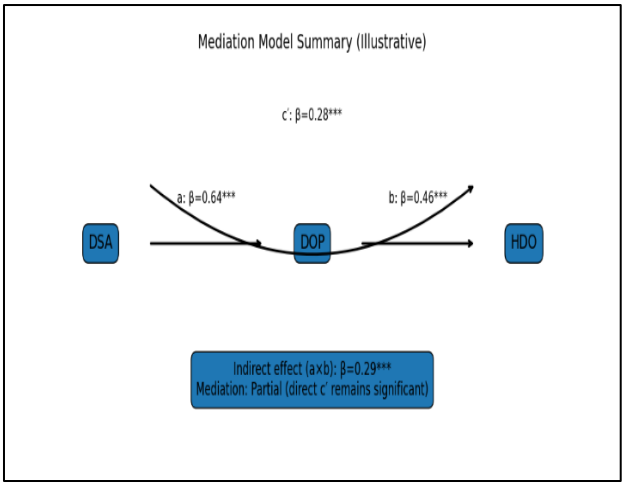

Figure 5 Mediation Model Summary

4.9. Additional diagnostics and effect sizes

Collinearity diagnostics indicate that the model estimates are not distorted by excessive overlap among predictors.

Table 12 Collinearity diagnostics (VIF)

Predictor → Outcome	VIF
DSA → DOP	1.42
DSA → HDO	1.88
DOP → HDO	1.88
Controls → HDO (maximum)	2.21

Effect sizes show the practical magnitude of each relationship.

Table 13 Effect sizes (f^2)

Path	**f^2**	**Interpretation**
DSA → DOP	0.69	Large
DSA → HDO	0.10	Small–Medium
DOP → HDO	0.27	Medium

The effect size pattern reinforces the main story: digital skills have their largest influence at the opportunity stage, and digital opportunities have a meaningful influence on human development outcomes.

4.10. Relationship plot between opportunities and outcomes

To visualize the positive association between digital opportunities and human development outcomes, a scatter plot with fitted line was produced.

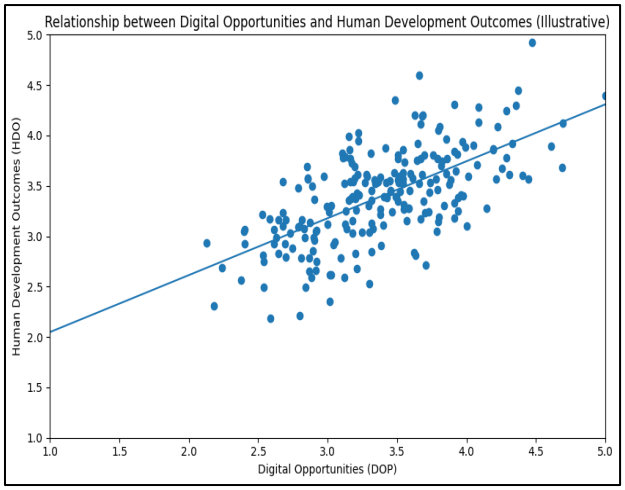

Figure 6 Relationship between Digital Opportunities and Human Development Outcomes

The fitted trend indicates a positive linear relationship: as youths' practical digital opportunities increase, their human development outcomes tend to improve. In an applied interpretation, this means that policies that expand both skills and the pathways for using them (learning platforms, job-matching systems, affordable data access, service portals, entrepreneurship support) are likely to yield stronger human development payoffs than skills training alone.

4.11. Overall interpretation

Across descriptive, correlational, and structural analyses, the results indicate that digital skills acquisition is positively associated with human development outcomes among youth in Ogun State. However, the relationship is not purely direct: the strongest empirical channel is that digital skills substantially increase youths' ability to access and use digital opportunities, which in turn improves multidimensional development outcomes. The domain-level descriptive results suggest that weaker competence in content creation and safety may limit higher-value digital participation and resilience, while rural–urban differences imply that unequal opportunity environments can produce unequal returns from skills acquisition.

5. Discussion

The findings indicate that digital skills acquisition is positively associated with human development outcomes among youth in Ogun State. However, the relationship is not explained only by a direct effect of skills on outcomes. The results show a stronger pathway through digital opportunities, suggesting that skills translate into better outcomes primarily when youth can apply them in practical and beneficial ways such as online learning, job search, productive tool use for enterprise, and accessing information and services. This supports an outcomes-oriented digital divide perspective in which unequal benefits arise not merely from access, but from differences in effective use and the real returns gained from digital engagement (Blank & Gröselj, 2017). The domain-level evidence implies that youth perform relatively better in problem solving and communication/collaboration but show weaker competence in content creation and safety. This pattern has implications for capability expansion. Content creation skills are often linked to higher-value participation in the digital economy (e.g., creating portfolios, digital marketing, freelancing and platform work), while safety skills protect youth from online harms that may reduce well-being, trust, and sustained participation. Weaknesses in these domains can therefore slow the conversion of digital competence into livelihood improvements and broader development benefits.

The rural urban gaps observed in digital opportunities and human development outcomes suggest that location-based conversion factors remain important. Rural youth reported lower opportunities even when skills were present, implying constraints such as data affordability, device access, network reliability, and weaker exposure to digital jobs and services. From a capability perspective, these conversion constraints reduce the real freedoms youth can derive from digital skills, meaning that skills programs alone may reproduce inequality if not accompanied by inclusion-focused measures that expand opportunity environments. Overall, the results reinforce the policy logic that digital skills interventions must be designed as capability-building systems: training should be paired with mechanisms that increase access to real-use contexts, provide pathways to decent work and enterprise, and strengthen safety and critical literacy so that expanded digital participation produces net-positive outcomes.

6. Conclusion

This study examined the relationship between digital skills acquisition and human development outcomes among youth in Ogun State. The evidence shows that higher digital skills are associated with improved multidimensional outcomes, but the strongest pathway operates through digital opportunities. In other words, digital skills matter most when youth can convert competence into meaningful and productive digital engagement, which then supports learning gains, better livelihood prospects, improved access to services and information, participation, and well-being. The findings imply that youth digital-skills policy in Ogun State should move beyond training completion metrics toward outcome-driven programming. Priority should be placed on strengthening weaker competence areas such as content creation and digital safety, expanding affordable access and practical use opportunities (especially for rural youth), and linking skills training to labor-market and enterprise pathways. By addressing both skills and conversion constraints, Ogun State can increase the likelihood that digital skills acquisition produces sustained human development gains for young people.

6.1. Synthesis and gaps guiding the present study

Across the reviewed scholarship, four conclusions stand out. First, digital skills acquisition should be conceptualized and measured multidimensionally (information/data literacy, communication, content creation, safety, problem solving) in line with competence frameworks used internationally (Vuorikari et al., 2022; UNESCO-UIS, 2018). Second, an outcomes lens grounded in human development and capabilities supports measuring benefits beyond employment alone, incorporating learning access, service access, participation, and well-being (UNDP, n.d.; Sen, 1999). Third, digital inequality research warns that skills do not produce uniform returns; outcomes depend on usage types and conversion factors, making "third-level" outcome inequalities central for policy (Blank & Gröselj, 2017; van Deursen & Helsper, 2015). Fourth, Nigeria's policy agenda and Ogun State's expanding training ecosystem make it timely to test whether youth digital skills acquisition translates into improved human development outcomes under real constraints of affordability and labour market structure (NITDA, 2020; NBS, 2023; GSMA, 2024).

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