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IMPACT OF SOCIAL MEDIA USE ON DIGITAL INEQUALITY AMONG STUDENTS: A CASE STUDY**Nana Owusua Aboage-Darko¹, Ntise Hendrick Manchidi^{2*}**^{1,2*}University of South AfricaE-mails: ¹ 10212515@mylife.unisa.ac.za; ^{2*} manchnh@unisa.ac.za (Corresponding author)

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Abstract. This study investigates how bridging social capital shapes digital inequality among undergraduate students at the University of Professional Studies, Accra (UPSA), Ghana. It examines whether diverse inter-group networks predict digital access, skills, and purposive digital use. A quantitative cross-sectional survey of 412 stratified, randomly sampled UPSA undergraduates was conducted. Bridging social capital was measured using Williams's (2006) Internet Social Capital Scale and an adapted resource generator. Digital inequality was operationalised across three dimensions. Structural equation modelling with SmartPLS 4.0 and bootstrapped mediation analysis were applied. Bridging social capital significantly predicted digital skills ($\beta = 0.341$, $p < 0.001$) and purposive digital use ($\beta = 0.297$, $p < 0.001$), but not physical access. Digital skills mediated 63.7% of the total effect on purposive use. Income remained the dominant predictor of access-level inequality. The cross-sectional, single-institution design limits causal inference. Institutions should invest in peer mentoring and cross-departmental communities as cost-effective mechanisms for bridging digital skill gaps. This study provides original empirical evidence from sub-Saharan Africa, extending digital capital theory by positioning bridging social capital as an antecedent to digital capital accumulation in resource-constrained higher education settings.

Keywords: social capital; social media; Accra; University of Professional Studies; digital inequality; digital capital; higher education; Ghana, sub-Saharan Africa; digital skills; students; social media

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1. Introduction

The proliferation of digital technologies has fundamentally reconfigured how knowledge is produced, transmitted, and consumed within contemporary higher education sector. Across the Global South, tertiary institutions increasingly rely on digital platforms to facilitate activities such as course delivery, assessment, research collaboration, and administrative communication. However, this shift towards digitally mediated learning has not occurred on a level playing field. There are still many students who lack adequate devices, reliable internet access, and sufficient digital competencies who are systematically disadvantaged in their academic pursuits. For example, within Ghana's rapidly expanding higher education sector, these disparities are acutely shaped by uneven infrastructure development, pronounced socioeconomic stratification, and persistent urban disparities in ICT penetration. The University of Professional Studies, Accra (UPSA), as one of Ghana's leading public universities with a professionally oriented student body, presents a compelling and underexplored context for examining digital inequality. Unlike elite research universities with well-endowed ICT infrastructure, UPSA caters predominantly to students from lower and middle-income backgrounds who navigate digital learning environments under significant resource constraints. Understanding the mechanisms through which some students overcome these constraints while others remain digitally disadvantaged is therefore both theoretically significant and practically urgent.

Existing studies on digital inequality have largely focused on material factors such as household income, geographic location, and institutional resources as primary determinants of differential digital access and competence (van Deursen & van Dijk, 2019; Ragnedda & Ruiu, 2020). However, a growing body of work suggests that social network characteristics, specifically the nature of interpersonal connections beyond one's immediate social group, play a critical though underappreciated role in shaping individuals' digital trajectories (Kozová et. Al., 2025; Bačík et al., 2025; Nyusani & Mabungela, 2025).

Bridging social capital, conceptualised by Putnam (2000) as the resources embedded in weak, cross-cutting ties that connect socially heterogeneous groups, has been theorised as a mechanism through which individuals can access information, skills, and opportunities otherwise unavailable within their own networks. Yet empirical examinations of how bridging social capital specifically shapes digital inequality in university settings, particularly in African higher education contexts, remain sparse.

This study addresses that gap by asking: to what extent does bridging social capital reduce digital inequality among undergraduate students at UPSA? Drawing on Bourdieu (1986) capital theory, Putnam (2000) bonding-bridging distinction as well as Ragnedda and Ruiu (2020) digital capital framework, this paper develops and tests a structural model in which bridging social capital is hypothesised to positively influence digital access, digital skills, and purposive digital use. The analysis further investigates whether digital skills mediate the effect of bridging networks on higher-order digital outcomes, thereby clarifying the precise pathways through which social connectivity converts into digital capital.

Beyond its empirical contributions, this study advances the theoretical conversation on digital capital by contextualising Lybeck et al. (2024) bridge capital argument within a sub-Saharan African higher education setting. The study also responds to calls by Clamor and Saloma (2023) for more empirically grounded accounts of how structural social inequalities are mediated by digital capital in Global South university settings.

The remaining sections of this paper are structured as follows. Section 2 reviews the theoretical underpinnings and relevant empirical literature on digital inequality and social capital in higher education. Section 3 details the research methodology, including sampling procedures, measurement instruments, and analytical approach. Section 4 presents and discusses the findings. Section 5 concludes with policy recommendations and directions for future inquiry.

2. Literature Review

2.1 Theoretical Framework

The theoretical architecture of this study draws on three interrelated conceptual traditions: Bourdieu's general theory of capital, Putnam (2000) social capital typology, and Ragnedda (2018) digital capital framework. Together, these traditions offer a layered explanation for how structural social positions, network configurations, and digital resource accumulation interact to produce and sustain digital inequalities in university settings.

Bourdieu (1986) conceived capital as accumulated labour, whether in material or incorporated form, that agents deploy within social fields to maintain or improve their positions. Social capital, in Bourdieu's formulation, refers to the aggregate of actual or potential resources accessible through durable networks of mutual acquaintance and recognition. What matters is not merely the possession of social ties but the quality and composition of those ties, and crucially, the capital, whether economic, cultural, or symbolic, that can be accessed through them. This formulation implies that social networks are not uniformly beneficial; their value depends on who is in the network and what resources those members possess and are willing to share. Coleman (1988) further developed this understanding by emphasising the role of closure, trustworthiness, and information channels within networks

as facilitators of human capital formation, a perspective directly relevant to educational contexts where peers transmit knowledge and competencies through informal interaction.

Putnam (2000) refines the understanding of social capital by distinguishing between bonding social capital, which resides in dense, homogeneous, and emotionally close networks, and bridging social capital, which emerges from looser, more heterogeneous connections that span social cleavages. Bonding ties reinforce group solidarity and provide reliable emotional support, but they tend to circulate redundant information within closed groups. Bridging ties, by contrast, serve as conduits for novel information, diverse perspectives, and resources that are unavailable within one's primary network. In the context of digital inequality, this distinction is consequential: students embedded in socially heterogeneous networks are more likely to encounter peers with greater digital competence, access to devices, and experience with productive digital practices. These encounters can trigger informal learning processes and facilitate access to resources that directly reduce digital disadvantage.

Ragnedda (2018) as well as Ragnedda and Ruii (2020) built on Bourdieu (1986) framework to theorise digital capital as a distinct form of capital comprising of both material resources, such as digital devices and connectivity, and embodied competencies, including digital skills and digital literacy. Their formulation situates digital capital at the intersection of the digital divide literature and Bourdieusian capital theory, framing digital inequality not as a binary of access versus non-access but as a multidimensional stratification across levels of access, skill, and use. Lybeck et al. (2024) extends this argument by demonstrating empirically that digital capital functions as a bridge capital between cultural capital and political engagement, and that education as a source of cultural capital is transformed into digital capital primarily through the mediating role of operational digital skills. This paper extends this logic by proposing that bridging social capital itself serves as an antecedent condition for digital capital accumulation, particularly in settings where formal educational resources are insufficient to independently generate digital competence.

The integrative framework guiding this study, therefore, posits a multilevel model of digital inequality in which students' structural positions, specifically income and institutional affiliation, determine baseline access to digital resources; bridging social capital moderates' inequalities at the skill and use levels; and digital skills mediate the relationship between bridging networks and purposive digital engagement. This model addresses a gap identified by Gentry et al. (2025), who observes that social capital research in higher education has inadequately been engaged with digital dimensions of students' capital endowments. In addition, Clamor and Saloma (2023) calls for further studies that can empirically model the indirect pathways through which capital accumulation influences academic belonging and engagement.

2.2 Empirical Studies

Research on digital inequality in higher education has evolved considerably from early binary framings of the digital divide toward more nuanced, multi-level analyses. The earliest contributions to this literature, typified by Attewell (2001) and Katz and Aspden (1997), conceptualised the digital divide primarily as a gap in physical access to computing devices and internet connectivity, driven by socioeconomic disparities. While this first-level divide retains explanatory relevance, scholars including van Deursen and van Dijk (2014, 2019); Makhoba et al. (2026) have progressively demonstrated that even among those with physical access, significant variation in digital proficiency and purposive use persists, necessitating analysis at second and third levels of the divide.

Van Deursen and van Dijk (2014) establishes that differences in digital skills, rather than access alone, are the primary driver of unequal digital outcomes in contemporary societies. Their longitudinal work distinguishes between operational, information navigation, social, creative, and mobile skills, each with distinct sociodemographic predictors. Extending this framework, van Deursen and van Dijk (2019) further demonstrates that the first-level divide has shifted from inequalities in physical access to inequalities in material access,

encompassing the quality of devices and connectivity, with income and education as the strongest predictors. This multi-level understanding directly informs the operationalisation of digital inequality in the present study.

Clamor and Saloma (2023) conducted a landmark quantitative study across Philippine universities during the COVID-19 pandemic, demonstrating that family income ($\beta = 0.220$, $p < 0.001$), type of residence, and academic excellence criterion were the primary determinants of digital capital accumulation. Their structural equation model revealed that digital capital significantly predicted students' sense of belonging ($\beta = 0.576$, $p < 0.001$) and that digital capital mediated the effects of residence type and family income on belonging. By contrast, gender did not emerge as a significant predictor in the SEM results despite bivariate differences, a pattern replicated in the present study. Where Clamor and Saloma (2023) focused on belonging as the outcome, the present study extends their model by examining purposive digital use as an academic performance-related outcome and by introducing bridging social capital as a structural predictor alongside income and residence type.

Lybeck et al. (2024), drawing on a large representative Finnish survey of 3,724 adults, demonstrates that digital skills mediated over 80% of educational differences in online political participation. Their decomposition analysis identifies operational skills as the most powerful mediator, accounting for more of the indirect effect of education than informational, creative, or mobile skill dimensions. This finding contrasts somewhat with Park's (2017) argument that higher-order creative and strategic skills are the most consequential for deriving social benefits from digital engagement. The discrepancy is likely explained by the level of analysis for example, at the population level, basic operational competencies represent the binding constraint, whereas among those with already adequate operational skills, higher-order skills become differentiating. In a developing country context such as Ghana, where foundational digital access remains uneven, operational skills are plausibly the binding constraint which is consistent with Lybeck et al. (2024) population-level conclusion.

Ragnedda et al. (2020) empirically measures digital capital using a multi-dimensional instrument by combining the Digital Access and Digital Competence Index and finds that digital capital accumulation is significantly shaped by socioeconomic background, age, and educational attainment. Their findings from a multi-country study replicate and extend the earlier work by Ragnedda (2018), who theorises digital capital within a Weberian framework of life chances that position digital competencies within a new axis of social stratification. Crucially, they found that urban residence strongly predicted higher digital capital accumulation compared to rural residence, a pattern replicated in the present study's access-level findings. Where Ragnedda (2018) and colleagues measured digital capital as a composite of access and competence, the present study disaggregates these dimensions to enable more precise identification of where social capital effects operate most strongly.

Gentry et al. (2025) provides a systematic review of 93 quantitative social capital assessment studies in higher education, revealing that most instruments lack alignment with social capital theory and rely on indirect proxy measures or generic Likert scales that inadequately capture the resources embedded in social ties. Their review advocates for resource generators and position generators as more theoretically valid assessment methods, specifically because these instruments measure what one can access through networks rather than simply who one knows or how often one interacts. This methodological critique directly informed the measurement design of the present study, which combined Williams's (2006) Internet Social Capital Scale with an adapted resource generator.

Williams (2006) develops and validates the Internet Social Capital Scale to capture both bridging and bonding capital in online contexts to distinguish between the two forms through items that reflect openness to diverse perspectives, exposure to new ideas, and interaction with people different from oneself. Several subsequent studies have employed what Williams (2006) refers to as a scale in educational settings. For instance, Trieu et al. (2019) finds that bridging capital scores positively predict individuals' willingness to form and maintain weak ties that provide novel information. Cheung and Liu (2017) similarly find that higher bridging capital among

university students is associated with greater volunteer participation and diverse social interactions. These findings collectively suggest that the scale by Williams (2006), though developed in a Western internet context, is responsive to a theoretical and meaningful variation in network heterogeneity which can be adapted for use in African university settings through appropriate recontextualisation.

Empirical studies which specifically examined social capital and digital outcomes in African higher education remain limited, but a small body of work has begun to emerge. Research by Mishra (2020) which draws on a systematic review of social capital studies that focuses on underrepresented students, finds that network diversity, especially access to cross-group institutional ties, consistently predict better information outcomes and access to academic resources.

The relationship between formal education and digital skill development has been examined in multiple national contexts. Blank and Groselj (2014) analyses data from Great Britain, finding that educational attainment is the most consistent predictor of both the breadth and quality of internet use, even after controlling for income, age, and employment status. Büchi et al. (2016) replicates this finding across five European countries, confirming that education predicts internet use variety and benefits at the third-level divide.

Clamor and Saloma (2023) finds that non-binary students at Philippine universities reported higher digital capital than binary-gendered students, a finding attributed to increased Lesbian, Gay, Bisexual, Transgender and Queer (LGBTQ) community engagement with digital tools and online civic spaces during the pandemic. The current study, conducted in a different cultural context and with a binary gender variable due to the institutional survey framework, finds no significant gender difference in digital skills at UPSA, broadly consistent with the trend toward gender convergence in foundational digital access identified in recent global evidence.

The mediating role of digital skills in converting social and educational resources into digital outcomes has been theorised and empirically tested across several studies. Scheerder et al. (2017) conducted a systematic review of second and third-level digital divide determinants, confirming that digital skills consistently mediate the relationship between socioeconomic variables and beneficial digital outcomes, including online civic participation, economic activity, and educational engagement. Their finding that information navigation and creative skills are particularly consequential for third-level outcomes is consistent with the present study's emphasis on purposive digital use as the key outcome variable.

Lin (2001), whose network theory of social capital provides the most precisely operationalised framework for empirical measurement, argued that the value of social capital lies not in the sheer size of one's network but in the diversity of resources accessible through network ties and the structural positions of those who provide them. This argument directly supports the present study's hypothesis that bridging, rather than bonding, capital is the form of social capital most likely to generate digital skill acquisition. Students with access to network members who occupy different structural positions, including senior students, faculty, and peers from technology-oriented disciplines, are better positioned to access diverse digital knowledge and resources than students confined to homogeneous peer clusters.

Timmis and Munoz-Chereau (2022) examined digital capital accumulation among underrepresented university students in the United Kingdom, finding that students from disadvantaged backgrounds developed digital improvisations, creative and adaptive uses of available technologies that partially compensated for structural disadvantages. Crucially, these digital improvisations emerged through social interactions with more digitally competent peers rather than through formal digital skills instruction, reinforcing the argument that bridging network access is a critical determinant of skill development in resource-constrained settings. Buzard et al. (2011) similarly finds that the pedagogical use of digital technologies in higher education classrooms increased student engagement and competence, but that these benefits were unevenly distributed, with more socially connected

students deriving greater gains from digital instruction. The empirical literature identifies a clear and consistent pattern that views digital inequality as a multi-level phenomenon shaped by structural socioeconomic factors at the access level and by skills, network, and motivational factors at higher levels. While prior studies have examined income, education, and geographic residence as the primary predictors of digital capital, this study introduces bridging social capital as a theoretically distinct and potentially more actionable predictor of second and third-level digital inequalities. The study builds on the methodological rigour advocated by Gentry et al. (2025), the multilevel operationalisation developed by van Deursen and van Dijk (2014, 2019), the digital capital framework of Ragnedda and Ruiu (2020), and the SEM approach employed by Clamor and Saloma (2023), while addressing the specific contextual conditions of Ghanaian public higher education.

3. Methodology

3.1 Data, Population, Sampling, and Sample Size

The study population comprised all full-time undergraduate students enrolled at the University of Professional Studies, Accra, during the 2023/2024 academic year. According to institutional enrolment records, UPSA had approximately 9,800 undergraduate students across five schools: Business, Finance and Management Studies; Applied Arts and Technology; Graduate Studies and Professional Development; Research and Innovation; and Continuing Education. The sampling frame in this study was restricted to full-time undergraduate students to ensure comparability across degree programmes and to exclude part-time and postgraduate students whose digital engagement contexts differ substantially.

A stratified random sampling approach was adopted, with the academic school as the stratification variable. This approach was selected to ensure proportional representation of students from each school and to allow sub-group analyses by discipline. Within each stratum, students were randomly selected from departmental enrolment lists provided by the Office of the Registrar. The minimum sample size was determined using Cochran's (1977) formula for proportions, assuming a population proportion of 0.50, a 95% confidence level, and a 5% margin of error, yielding a minimum of 370 respondents. Accounting for an anticipated non-response rate of approximately 12%, a target sample of 420 questionnaires was distributed. Of these, 412 were returned with sufficient data for analysis, representing a response rate of 98.1%. The demographic profile of respondents is summarised in Table 1.

Table 1. Demographic Profile of Respondents (n = 412)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	215	52.2
	Female	197	47.8
Age (Mean = 22.4 yrs, SD = 2.81)	18 to 24 years	287	69.7
	25 years and above	125	30.3
Residence	Urban	253	61.4
	Peri-urban or Semi-rural	159	38.6
Household Income	Below GHS 1,500	141	34.2
	GHS 1,500 to 3,000	118	28.6
	GHS 3,001 to 5,000	88	21.4
	Above GHS 5,000	65	15.8
Departments of Enrolment	Business, Finance and Management	168	40.8
	Communication and Technology	124	30.1
	Other Schools	120	29.1
Year of Study	Year 1	89	21.6
	Year 2	143	34.7
	Year 3	112	27.2
	Year 4	68	16.5
Total		412	100.0

Note. Source: Field Survey Data, 2024.

3.2 Data Collection and Analysis

Data were collected via a structured, self-administered questionnaire over four weeks in May and June 2024. The questionnaire was developed in three stages: item generation grounded in the theoretical framework and prior validated instruments; expert validation through review by three academics with expertise in ICT education and social capital research; and pilot testing with 40 students drawn from the same population but excluded from the final sample. Minor revisions were made following the pilot to improve item clarity and reduce response time to an average of 18 minutes.

Bridging social capital was measured using an adapted version of Williams (2006) Internet Social Capital Scale, specifically the bridging subscale, supplemented by items from a resource generator adapted from van der Gaag and Snijder (2005) Survey on Social Networks of the Dutch, recontextualised for the Ghanaian university setting. The resource generator component asked respondents whether they had someone in their social network, outside their immediate family and closest friends, who could provide specific digital and educational resources. These included lending a laptop or tablet, assisting with installing or troubleshooting software, explaining how to find credible academic sources online, sharing mobile internet data, and advising on how to use digital platforms for academic tasks. Each resource generator item was coded dichotomously (0 = no, 1 = yes), consistent with the resource generator protocols recommended by Gentry et al. (2025) and van der Gaag and Snijders (2005). The William (2000) scale items used a five-point Likert scale ranging from strongly disagree to strongly agree. The combined bridging social capital scale achieved satisfactory internal consistency (Cronbach's alpha = 0.79).

Digital inequality was operationalised across three sequential dimensions following van Deursen and van Dijk (2019) multi-level framework. First-level digital access was measured through seven items capturing device ownership, including smartphone, laptop, and tablet, home internet access, mobile data availability, and perceived reliability of connectivity, scored as a composite index from 0 to 7. Second-level digital skills were assessed through eighteen items drawn from van Deursen et al. (2016) Internet Skills Scale, covering operational, information navigation, social, and creative skill dimensions on a five-point Likert scale. Third-level purposive digital use captured the frequency and diversity of academic and civic digital activities, including use of learning management systems, academic database searches, online collaboration, and digital content creation, measured on a frequency scale. All dimensions demonstrated acceptable reliability: access index alpha = 0.71; digital skills alpha = 0.84; purposive use alpha = 0.82.

Structural equation modelling (SEM) was employed as the primary analytical technique, implemented using SmartPLS version 4.0 following the two-step approach recommended by Hair et al. (2010). The measurement model was first evaluated for reliability and validity before proceeding to structural estimation. Composite reliability (CR), average variance extracted (AVE), and the heterotrait-monotrait (HTMT) ratio were used to assess convergent and discriminant validity, respectively. Model fit was assessed using the standardised root mean square residual (SRMR), the normed fit index (NFI), and root mean square error of approximation (RMSEA). The Stone-Geisser Q2 statistic was computed through blindfolding to assess predictive relevance. Mediation analysis was conducted using bootstrapped confidence intervals based on 5,000 resamples. Variance accounted for (VAF) was calculated to quantify the proportion of total effects mediated by digital skills. Control variables included gender, age, income, school of enrolment, and year of study.

4. Findings and Discussion

4.1 Measurement Model Assessment

Before structural analysis, the measurement model was evaluated to confirm the reliability and validity of all constructs. Standardised factor loadings for all reflective indicators exceeded the recommended threshold of 0.60, with the majority surpassing 0.70, indicating strong item-construct convergence (Hair et al., 2017).

Table 2. Measurement Model: Factor Loadings, Reliability, and Validity

Construct / Indicator	Loading	CR	AVE	Alpha	VIF
Bridging Social Capital (BSC)		0.847	0.524	0.793	
BSC1: Peer assists with software	0.741				1.82
BSC2: Peer shares mobile data	0.714				1.74
BSC3: Peer lends device	0.698				1.68
BSC4: Peer advises on digital platforms	0.761				1.93
BSC5 to BSC9 (Williams items)	0.63-0.79				1.55-2.10
Digital Access Index (DA)		0.784	0.521	0.712	
DA1 to DA7 (device and connectivity items)	0.61-0.76				1.44-2.03
Digital Skills (DS)		0.882	0.584	0.843	
Operational skills (4 items)	0.71-0.81				1.77-2.31
Info-navigation skills (4 items)	0.72-0.83				1.81-2.44
Social skills (5 items)	0.64-0.77				1.58-2.12
Creative skills (5 items)	0.63-0.79				1.50-2.18
Purposive Digital Use (PDU)		0.869	0.565	0.821	
PDU1 to PDU8 (LMS, databases, collaboration)	0.66-0.82				1.61-2.28

Note. CR = Composite Reliability; AVE = Average Variance Extracted; VIF = Variance Inflation Factor. All loadings significant at $p < 0.001$. Items abbreviated for space.

As presented in Table 2, composite reliability values ranged from 0.784 for the digital access index to 0.882 for digital skills, all exceeding the acceptable minimum of 0.70 (Nunnally & Bernstein, 1994). AVE values ranged from 0.521 to 0.584, comfortably above the 0.50 threshold required for convergent validity (Fornell & Larcker, 1981). Variance inflation factor (VIF) values across all indicators were below 3.3, confirming the absence of problematic collinearity within constructs (Hair et al., 2017).

Table 3. Discriminant Validity: HTMT Ratios and Square Root of AVE (diagonal)

Construct	BSC	DA	DS	PDU
Bridging Social Capital (BSC)	0.724			
Digital Access (DA)	0.312	0.722		
Digital Skills (DS)	0.483	0.391	0.764	
Purposive Digital Use (PDU)	0.451	0.367	0.601	0.752

Note. Diagonal elements = square root of AVE. Off-diagonal elements = HTMT ratios. All HTMT values < 0.85 threshold (Henseler et al., 2015). BSC = Bridging Social Capital; DA = Digital Access; DS = Digital Skills; PDU = Purposive Digital Use.

Discriminant validity was assessed using the HTMT ratio, as reported in Table 3. All HTMT values were below the conservative threshold of 0.85 recommended by Henseler et al. (2015), and the diagonal elements, representing the square root of AVE, exceeded all off-diagonal inter-construct correlations, confirming adequate discriminant validity.

Table 4. Model Fit Statistics and Predictive Relevance

Fit Index	Obtained Value	Recommended Threshold	Assessment
SRMR	0.051	< 0.08 (Henseler et al., 2015)	Acceptable
NFI	0.847	> 0.80 (Hair et al., 2010)	Acceptable
RMSEA	0.055	< 0.08 (Browne and Cudeck, 1993)	Acceptable
R2 (Digital Access)	0.184	> 0.10 (Cohen, 1988)	Moderate
R2 (Digital Skills)	0.397	> 0.10 (Cohen, 1988)	Substantial
R2 (Purposive Digital Use)	0.412	> 0.10 (Cohen, 1988)	Substantial
Q2 (Digital Skills)	0.218	> 0 (Hair et al., 2017)	Predictive relevance confirmed
Q2 (Purposive Digital Use)	0.229	> 0 (Hair et al., 2017)	Predictive relevance confirmed

Note. SRMR = Standardised Root Mean Square Residual; NFI = Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; R2 = coefficient of determination; Q2 = Stone-Geisser predictive relevance statistic.

Model fit indices for the structural model are reported in Table 4. These values indicate an acceptable to good model fit, consistent with standards in the PLS-SEM literature (Hair et al., 2017). The positive Q2 values for both endogenous constructs confirm the predictive relevance of the structural model.

4.2 Direct Effects of Bridging Social Capital on Digital Inequality

The structural model results are presented in Table 5. Bridging social capital did not exert a statistically significant direct effect on first-level digital access ($\beta = 0.089$, $p = 0.214$), but produced significant positive effects on both digital skills ($\beta = 0.341$, $p < 0.001$) and purposive digital use ($\beta = 0.297$, $p < 0.001$). Income was the strongest predictor of digital access ($\beta = 0.312$, $p < 0.001$), while year of study and school of enrolment both produced modest but significant positive effects on digital skills. Gender produced no significant effect on any dimension once other variables were controlled.

Table 5. Direct Path Coefficients and Significance (Bootstrapped, n = 5,000)

Path	Beta	SE	t-value	p-value	Decision
BSC -> Digital Access	0.089	0.071	1.254	0.214	Not supported
BSC -> Digital Skills	0.341	0.058	5.879	0.000***	Supported
BSC -> Purposive Digital Use	0.297	0.061	4.869	0.000***	Supported
Digital Skills -> Purposive Digital Use	0.554	0.052	10.654	0.000***	Supported
Income -> Digital Access	0.312	0.063	4.952	0.000***	Supported
Income -> Digital Skills	0.168	0.059	2.847	0.005**	Supported
Year of Study -> Digital Skills	0.127	0.055	2.309	0.022*	Supported
School (Tech) -> Digital Skills	0.143	0.057	2.509	0.013*	Supported
Gender -> Digital Skills	0.041	0.054	0.759	0.449	Not supported

Note. SE = standard error; BSC = Bridging Social Capital; DS = Digital Skills; PDU = Purposive Digital Use. School (Tech) = Applied Arts and Technology school, reference category: other schools. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

The non-significant effect of bridging social capital on digital access is consistent with theoretical expectations and aligns with prior empirical findings. Access to digital devices and reliable internet connectivity is primarily determined by material conditions, specifically income, household infrastructure, and institutional provision, which are not easily altered by network connections alone. A student from a low-income household embedded in a wide bridging network may be better informed about available devices but still lacks the financial resources to acquire them. These finding parallels that of Clamor and Saloma (2023), who found that family income and type of residence were the primary determinants of digital capital at the resource level. In the UPSA context, income remained the strongest predictor of access-level digital inequality, underscoring that first-level divides are structural phenomena that social network interventions alone cannot resolve.

The significant positive effect of bridging social capital on digital skills ($\beta = 0.341$) is a substantively important finding. It suggests that students who maintain broader, more heterogeneous social ties are considerably more likely to develop stronger digital competencies, even after controlling for income, gender, year of study, and school of enrolment. This finding supports Putnam (2000) argument that bridging networks serve as conduits for novel information and practices and extends it to the domain of digital skill acquisition. In the university context, this likely reflects the role of informal peer mentoring in facilitating digital learning. Students who interact regularly with peers from different departments, year levels, and socioeconomic backgrounds encounter a wider diversity of digital practices, problem-solving strategies, and platform-specific knowledge. These encounters can substitute, at least partially, for formal digital skills instruction, consistent with Lybeck et al. (2024) observation that digital skills are primarily learned by doing rather than through formal education.

The significant effect of bridging social capital on purposive digital use ($\beta = 0.297$) indicates that well-networked students engage more frequently and diversely with digital platforms for academic and civic purposes. This encompasses activities such as using learning management systems, accessing academic databases, creating digital content for coursework, and participating in online academic discussions. In the UPSA context, students

embedded in heterogeneous networks appear to have greater awareness of the range of digital tools available for academic engagement, and greater motivation to use them productively, because they have encountered models of effective digital academic practice through their diverse network ties.

Regarding control variables, income remained the most powerful predictor of first-level digital access ($\beta = 0.312$, $p < 0.001$), confirming that material constraints are the primary driver of access-level inequalities at UPSA. Year of study positively predicted digital skills ($\beta = 0.127$, $p < 0.05$), consistent with the expectation that extended exposure to digital learning environments yields incremental skill gains. School of enrolment predicted variation in digital skills, with students in Applied Arts and Technology reporting higher digital proficiency than those in Business and Finance, plausibly attributable to the greater digital skills content of technology-oriented curricula. Gender did not significantly predict any of the three digital inequality dimensions once other controls were included, a finding consistent with Clamor and Saloma (2023) and with the growing body of evidence suggesting that gender gaps in foundational digital access have narrowed considerably among younger university cohorts.

4.3 Mediation Analysis

The mediation analysis results are summarised in Table 6. Digital skills significantly mediated the relationship between bridging social capital and purposive digital use (indirect $\beta = 0.189$, 95% CI [0.134, 0.249], $p < 0.001$). The VAF of 63.7% indicates partial mediation with digital skills as the dominant pathway, since the direct effect of bridging social capital on purposive digital use remained significant after digital skills were included in the model.

Table 6. Mediation Analysis: Indirect Effects through Digital Skills (Bootstrap $n = 5,000$)

Indirect Path	Beta	SE	t-value	95% CI	p-value	VAF%
BSC -> DS -> PDU	0.189	0.029	6.517	[0.134, 0.249]	0.000***	63.7%
Income -> DS -> PDU	0.093	0.031	3.000	[0.034, 0.155]	0.003**	

Note. SE = standard error; CI = bias-corrected bootstrapped confidence interval; VAF = variance accounted for (indirect/total effect); BSC = Bridging Social Capital; DS = Digital Skills; PDU = Purposive Digital Use. *** $p < 0.001$; ** $p < 0.01$. Total effect of BSC on PDU = $0.297 + 0.189 = 0.486$ before decomposition. VAF = $0.189/0.297 = 63.7\%$.

The mediation result aligns strongly with Lybeck et al. (2024) decomposition analysis, which showed that digital skills mediated over 80% of educational differences in online political participation. In both studies, the structural mechanism is similar: social position or social connectivity shapes skill development, and skills in turn enable more purposeful digital engagement. The slightly lower proportion of mediation in the present study compared to Lybeck et al.'s finding is likely explained by the distinct nature of the treatment variable: where Lybeck and colleagues examined formal education as the independent variable, a more distal structural factor, the present study examines bridging social capital, which already carries some direct motivational and informational pathway to digital use beyond its skill-development effect. This interpretation is consistent with Lin (2001) framework, in which social capital provides both information benefits and direct resource benefits to network members.

The mediation finding has a practical implication of considerable importance. If the pathway from bridging social capital to purposive digital use is substantially mediated by skills, then interventions designed to foster bridging networks among students should be expected to improve digital use outcomes primarily through their upstream effect on skill development rather than through direct exposure to digital platforms. This suggests that peer-learning communities, cross-departmental study groups, and structured mentoring programmes that bring together students with different digital competence levels may be among the most cost-effective approaches to reducing second and third-level digital inequalities in resource-constrained university settings.

4.4 Theoretical and Contextual Implications

Taken together, the findings advance the theoretical understanding of digital inequality in several respects. First, they confirm the multilevel structure of digital inequality, with material factors dominating at the access level and

social capital factors becoming increasingly explanatory at higher levels. This layered pattern supports van Deursen and van Dijk (2019) sequential divide model and applies it to a sub-Saharan African university context, filling an important empirical gap in the geographic coverage of this literature.

Second, the findings establish bridging social capital as a theoretically distinct and empirically validated mechanism for reducing second and third-level digital inequalities in higher education. This extends both Putnam (2000) bridging-bonding framework and the digital capital literature by identifying a specific social mechanism through which digital skill inequalities can be moderated without requiring direct material investment. In resource-constrained university environments where institutional ICT budgets are limited, this finding points to a potentially underutilised lever for equity-oriented intervention.

Third, the study's findings speak to Gentry et al. (2025) recommendation that higher education social capital research adopt more direct measures aligned with social capital theory. The use of a resource generator in this study, rather than a generic Likert scale of social interaction frequency, allowed for a theoretically precise operationalisation of bridging capital as the accessibility of diverse, cross-cutting social resources, and produced findings with clearer theoretical interpretability than studies using less aligned measures.

Finally, the mediation of digital skills positions informal peer learning as a key mechanism through which bridging social capital translates into digital outcomes. This resonates with Ragnedda and Ruii (2020) conceptualisation of digital capital as a practice-based form of capital, one that is acquired not primarily through formal instruction but through habitual and socially situated engagement with digital tools. For students at UPSA, exposure to digitally competent peers through heterogeneous networks appears to create learning opportunities that formal curricula do not consistently provide.

5. Conclusion

This study examines the role of bridging social capital in shaping digital inequality among undergraduate students at the University of Professional Studies, Accra. The findings demonstrate that bridging social capital exerts significant positive effects on digital skills and purposive digital use, though it does not overcome the material determinants of first-level digital access. Digital skills emerge as the primary mediating mechanism through which bridging networks translate into higher-order digital engagement, accounting for nearly two-thirds of the total effect. These findings are theoretically significant and practically consequential for policy and institutional practice in Ghana and the broader sub-Saharan African higher education.

From a theoretical standpoint, the study extends the digital capital framework by empirically demonstrating that bridging social capital functions as an antecedent condition for digital capital accumulation in a resource-constrained setting, a role analogous to but distinct from the bridge capital function attributed to digital capital itself in prior work (Lybeck et al., 2024). The study affirms the relevance of Putnam's (2000) bonding-bridging distinction for understanding educational inequalities in the digital age, a connection that has been theorised but rarely empirically tested in Global South higher education contexts.

This study makes a meaningful contribution to digital inequality and social capital in higher education by providing empirically grounded evidence from an underrepresented institutional and national context. The findings affirm that reducing digital inequality is not solely a technological or resource allocation challenge but is also a social one. How students are connected, and to whom, shapes their capacity to develop and exercise digital competencies in consequential ways. Addressing these social dimensions of digital inequality must be a core component of any serious institutional strategy to promote digital equity in African higher education.

6. Limitations

Various limitations are identified and acknowledged in this study. For example, the cross-sectional design precludes causal inference about the direction of relationships, and reverse causality remains possible since more digitally skilled students may easily form bridging networks. The restriction to a single institution limits the generalisability of findings to other Ghanaian or African universities with different institutional profiles. The resource generator relied on self-reported network access and may be subject to social desirability bias. As well, negative impact of social media on users is not being taken into account (Ivančík et al., 2024). Students must be alive to the negative impact of addiction to social media and improve their academic performance by managing the time when using these social media (Salari et al., 2025)

Future research should employ longitudinal designs tracking students across academic years and incorporate qualitative components to illuminate the specific social mechanisms through which bridging ties facilitate digital skill acquisition. Comparative studies across multiple Ghanaian universities, and within West Africa more broadly, would substantially advance the contextual generalisability of these findings.

7. Recommendations

The policy and practice implications of these findings are significant. Universities operating under constrained ICT infrastructure budgets should consider structured social interventions as complementary mechanisms for reducing digital skill inequalities. Specifically, institutions such as UPSA are encouraged to: establish formalised peer digital mentoring programmes pairing digitally proficient students with those reporting lower digital skills; design cross-departmental academic communities and study groups that cut across socioeconomic and disciplinary boundaries to maximise exposure to heterogeneous digital practices; integrate social capital development into student induction programmes, with explicit attention to bridging network formation; and develop targeted ICT access support for low-income students, including subsidised device schemes and campus Wi-Fi expansion, to address first-level access inequalities that social network interventions alone cannot resolve.

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