

Digital Literacy and 21st-Century Skills in Business Education: Assessing Innovation, Creativity, and Problem-Solving Skills of Students in Colleges of Education, North-East Nigeria

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ABSTRACT

RESEARCH ARTICLE

Background: The rapid integration of digital technologies into higher education has heightened the demand for digitally literate graduates who possess 21st-century competencies. In Nigeria's Colleges of Education, particularly in the North-East geopolitical zone, evidence of students' digital literacy proficiency in innovation, creativity, and problem-solving remains largely empirically undocumented. **Objectives:** This study assessed the digital literacy of business education students' innovation, creativity, and problem-solving skills, and examined whether significant differences exist between the perceptions of students and lecturers. **Methods:** A descriptive survey research design was adopted. A total of 360 respondents (312 students and 48 lecturers) drawn from four Colleges of Education in North-East Nigeria were sampled using proportionate stratified random sampling. A validated 21-item questionnaire with a four-point Likert scale served as the data collection instrument. Mean, standard deviation, and independent samples *t*-test were used for data analysis. **Results:** Findings revealed that business education students possessed high levels of digital literacy in innovation skills (Grand $\bar{x}$ = 2.71), creativity skills (Grand $\bar{x}$ = 2.81), and problem-solving skills (Grand $\bar{x}$ = 2.66). Independent samples *t*-test results showed no statistically significant differences between students' and lecturers' mean responses across all three dimensions ($p > .05$). **Conclusions:** Although digital literacy levels are appreciable, deficiencies persist in advanced competencies such as AI-assisted innovation, generative creativity tools, and decision-support systems. Curriculum reform, targeted digital infrastructure investment, and lecturer capacity development are recommended to bridge identified gaps.

KEYWORDS: digital literacy, business education, innovation skills, creativity skills, problem-solving skills, Colleges of Education, North-East Nigeria, 21st-century skills

1. INTRODUCTION

The proliferation of digital technologies has fundamentally transformed educational paradigms globally, compelling institutions of higher learning to reconfigure their pedagogical approaches and competency frameworks. Within the context of business education in Nigeria, digital literacy has emerged as a *sine qua non* for graduate employability, entrepreneurial success, and meaningful participation in an increasingly knowledge-driven economy (Adeyemo & Olatunji, 2022; Eze & Nwosu, 2023). Yet, the empirical basis for understanding the extent to which students in Colleges of Education in North-East Nigeria have internalised digital literacy competencies—particularly in the domains of innovation, creativity, and problem-solving—remains remarkably sparse.

Digital literacy, broadly conceived, extends well beyond the ability to operate digital devices. It encompasses the capacity to critically engage with digital information, to leverage technology for knowledge creation and dissemination, and to apply digital tools purposefully in solving complex, real-world problems (Ng, 2012; Spante et al., 2018). The Partnership for 21st Century Learning (P21) framework identifies innovation, creativity, and problem-solving as the core competencies that digitally literate individuals must possess, particularly for professional contexts such as business and commerce (Battelle for Kids, 2019). These competencies are inseparably linked: innovation requires creative thinking, and both are operationalised through structured problem-solving processes facilitated by digital tools and platforms.

In Nigeria's Colleges of Education, Business Education is a key discipline designed to equip prospective teachers and practitioners with commercially relevant knowledge and skills. However, the quality and depth of digital competency development within this programme have attracted growing concern among researchers, policymakers, and industry stakeholders (Ibrahim & Musa, 2021; Usman et al., 2022). The North-East geopolitical zone, which has historically faced challenges of infrastructural deficit, socio-political instability, and limited access to technology, presents a particularly pressing context for evaluating the digital readiness of its educational graduates (Bello & Abubakar, 2020).

Recent reports by the National Information Technology Development Agency (NITDA, 2023) indicate that digital skill gaps in North-East Nigeria are among the most pronounced in the country, with rural and peri-urban educational institutions disproportionately affected. Students graduating from Colleges of Education in this region are expected to serve as future teachers, yet their own proficiency in deploying digital tools for innovative, creative, and problem-oriented purposes remains an empirical question insufficiently addressed in the extant literature. Understanding this gap is not merely an academic exercise; it has direct policy implications for curriculum reform, lecturer capacity development, and digital infrastructure investment in the sub-region.

This study is motivated by the recognition that existing research on digital literacy in Nigerian higher education has predominantly focused on universities in the South-West and South-East zones (Adeyemi, 2023; Okonkwo & Eze, 2022), with Colleges of Education in the North-East receiving comparatively little scholarly attention. Furthermore, extant studies have largely examined digital literacy as a general or undifferentiated construct, without disaggregating its dimensions into operationally distinct competency clusters such as innovation, creativity, and problem-solving. This study addresses that gap by systematically assessing each dimension and by triangulating perceptions from both students and lecturers to ensure construct validity and reduce reporting bias.

Anchored within the Technology Acceptance Model (Davis, 1989) and Vygotsky's Zone of Proximal Development Theory, the study adopts a descriptive survey design to achieve three objectives: to assess the digital literacy of business education students' innovation skills; to determine their creativity skills; and to evaluate their problem-solving skills—all within Colleges of Education in North-East Nigeria. By generating empirical evidence on these dimensions, the study contributes to the growing body of literature on digital education in sub-Saharan Africa and offers actionable recommendations for educational planners and programme developers in the region.

Despite the global recognition of digital literacy as a critical 21st-century competency, business education students in Colleges of Education in North-East Nigeria continue to exhibit inadequate integration of digital tools into their innovation, creative, and problem-solving activities. The region's persistent infrastructural deficits, compounded by ongoing socio-political disruptions and underfunded educational systems, have created a digital divide that threatens the professional readiness of graduates. No systematic study had, prior to this investigation, assessed the digital literacy of these students across the three interrelated competency dimensions of innovation, creativity, and problem-solving using validated instruments and multi-respondent perspectives.

Research Objectives

The specific objectives of this study were to:

1. Assess the digital literacy of business education students' innovation skills in Colleges of Education in North-East Nigeria.
2. Determine the digital literacy of business education students' creativity skills in Colleges of Education in North-East Nigeria.
3. Evaluate the digital literacy of business education students' problem-solving skills in Colleges of Education in North-East Nigeria.

Research Questions

The following research questions guided the study:

RQ1: What is the digital literacy of business education students' innovation skills in Colleges of Education in North-East Nigeria?

RQ2: What is the digital literacy of business education students' creativity skills in Colleges of Education in North-East Nigeria?

RQ3: What is the digital literacy of business education students' problem-solving skills in Colleges of Education in North-East Nigeria?

Research Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

H01: There is no significant difference in the mean response of business education students and lecturers on the digital literacy of students' innovation skills in Colleges of Education in North-East Nigeria.

H02: There is no significant difference in the mean response of business education students and lecturers on the digital literacy of students' creativity skills in Colleges of Education in North-East Nigeria.

H03: There is no significant difference in the mean response of business education students and lecturers on the digital literacy of students' problem-solving skills in Colleges of Education in North-East Nigeria.

2. LITERATURE REVIEW

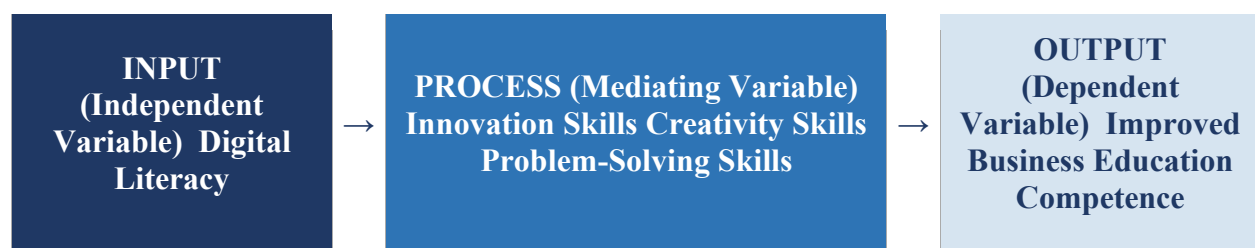
Conceptual Framework

The conceptual framework underpinning this study positions digital literacy as the independent construct that mediates the development of three interrelated 21st-century competencies in business education: innovation skills, creativity skills, and problem-solving skills. These competencies collectively constitute the dependent outcomes, which are operationalised as observable, measurable student behaviours facilitated through the adoption and integration of digital tools, platforms, and resources within educational and professional contexts (Eze & Eze, 2022; Tondeur et al., 2020).

Digital literacy, as conceptualised in this study, draws upon the multi-layered framework proposed by Ng (2012), which encompasses technical literacy (operational use of devices and software), cognitive literacy (critical evaluation and synthesis of digital information), and socio-emotional literacy (collaborative, ethical, and responsible engagement with digital content). These dimensions intersect to form the enabling conditions through which students develop and express innovative, creative, and problem-solving competencies. The relationship is not linear but recursive: as students become more digitally proficient, their capacity for innovation expands; conversely, engaging with innovation tasks deepens their digital literacy (Aesaert et al., 2020; Hatlevik et al., 2022).

The framework further acknowledges mediating institutional variables—including access to digital infrastructure, quality of digital pedagogy, and curriculum design—as contextual moderators that either amplify or constrain the relationship between digital literacy and 21st-century skill outcomes. This is particularly relevant in the North-East Nigerian context, where infrastructural limitations and curriculum rigidity constitute well-documented barriers (Bello & Abubakar, 2020; NITDA, 2023). The framework synthesises elements of the P21 Partnership for 21st Century Learning framework (Battelle for Kids, 2019) and the DigComp 2.1 European digital competence framework (Vuorikari et al., 2022), contextualised within the Nigerian higher education environment.

Figure 1. Conceptual Framework for Digital Literacy and 21st-Century Competency Development in Business Education



Note. Adapted from Ng (2012), Battelle for Kids (2019), and Vuorikari et al. (2022). The framework illustrates the transformative pathway from digital literacy inputs through skill-development processes to improved business education competence outputs.

Theoretical Framework

Technology Acceptance Model (TAM)

Davis's (1989) Technology Acceptance Model provides the primary theoretical scaffolding for this study. TAM posits that perceived usefulness and perceived ease of use are the two cardinal determinants of an individual's intention to adopt and utilise a technology. Within the context of business education, students who perceive digital tools as useful for academic and professional purposes such as generating business innovations, expressing creative concepts, or solving organisational problems are more likely to integrate these tools into their learning practices (Al-Qaysi et al., 2020; Tarhini et al., 2021). Conversely, where digital tools are perceived as complex, inaccessible, or irrelevant, adoption remains superficial, limiting the depth of digital literacy development. Recent extensions of TAM, including the Unified Theory of Acceptance and Use of Technology (UTAUT2) by Venkatesh et al. (2019), incorporate social influence, facilitating conditions, and hedonic motivation as additional predictors of technology adoption, all of which are relevant to the North-East Nigerian context where peer influence, available ICT infrastructure, and intrinsic academic motivation significantly shape students' digital engagement. TAM provides the explanatory lens through which variations in digital literacy levels particularly in advanced competency areas such as AI tool usage and decision-support software can be understood and contextualised.

Vygotsky's Zone of Proximal Development (ZPD)

Vygotsky's (1978) sociocultural theory, particularly the concept of the Zone of Proximal Development (ZPD), offers a complementary theoretical perspective. ZPD refers to the distance between what a learner can accomplish independently and what they can achieve with expert guidance or collaborative support. In the digital learning context, ZPD underscores the critical role of lecturers, digital scaffolding tools, and collaborative online platforms in extending students' digital competency beyond their current independent capacities (Moll, 2019; Shabani, 2022). For business education students in North-East Nigeria, whose independent digital skill levels may be constrained by environmental factors, lecturer-mediated digital scaffolding through structured digital assignments, guided online research tasks, and collaborative problem-solving activities represents the primary mechanism through which ZPD can be activated. This theoretical perspective also justifies the study's inclusion of lecturers as a distinct respondent group, since lecturers serve as the primary scaffolders of students' digital competency development within institutional contexts.

Digital Literacy: Conceptualisation and Measurement

The concept of digital literacy has undergone substantial conceptual evolution since its initial formulation by Gilster (1997). Contemporary scholars have progressively expanded the construct beyond basic technological proficiency to encompass a constellation of cognitive, creative, communicative, and critical competencies mediated by digital technologies (Spante et al., 2018; Van Laar et al., 2020). The European DigComp 2.1 framework (Vuorikari et al., 2022) identifies five core competency areas: information and data literacy; communication and collaboration; digital content creation; safety; and problem-solving the last three of which directly correspond to this study's constructs. Porat et al. (2021) conducted a systematic review of digital literacy conceptualisations and identified a persistent tension between minimal operationalisations that focus on technical skills and broader conceptualisations that encompass socio-emotional and critical dimensions. Their analysis of 184 peer-reviewed studies concluded that the most educationally robust conceptualisations integrate both dimensions, treating digital literacy as a dynamic, context-sensitive, and socially constructed

competency an approach adopted in the present study. In the African higher education context, Eze and Nwosu (2023) similarly argued for multi-dimensional conceptualisations that account for the unique socioeconomic and infrastructural realities of sub-Saharan institutions. In Nigeria specifically, Adeyemi (2023) examined digital literacy among undergraduate education students and found considerable variability across institutions, with students in Northern states consistently scoring lower on indicators of digital creativity and problem-solving compared to their Southern counterparts a finding that provides partial empirical justification for the geographic focus of the present study. Usman et al. (2022) further documented that Business Education students in Nigerian COEs demonstrate higher digital literacy levels in information retrieval tasks than in innovation-related or problem-solving tasks, suggesting differential proficiency profiles that this study seeks to map more precisely.

Digital Literacy and Innovation Skills

Innovation skills refer to the capacity of individuals to generate, develop, and implement novel ideas, processes, or products that create value increasingly, through the mediation of digital tools and platforms (Schumpeter, 1934, as cited in Abiodun & Lawal, 2022). In business education, digital innovation competencies encompass the ability to use digital prototyping platforms, online ideation tools, data analytics software, and collaborative digital workspaces to translate creative insights into actionable business solutions (Carayannis & Campbell, 2021; Eze, 2020). Empirical evidence consistently links digital literacy levels to innovation outcomes. Janssen et al. (2021) conducted a longitudinal study involving 1,247 undergraduate business students across six European universities and found that digital literacy was a statistically significant positive predictor of innovation self-efficacy ($\beta = 0.47$, $p < .001$), even after controlling for general academic ability and prior technology exposure. Hatlevik et al. (2022) similarly demonstrated that students with higher digital competence scores on the Norwegian Digital Competence Framework were significantly more likely to engage in technology-mediated innovation activities in their academic and professional contexts. In the Nigerian context, Chukwu and Obi (2022) found that business education students in Anambra State who demonstrated proficiency in digital tools specifically spreadsheet applications, online project management platforms, and digital communication tools—were rated significantly higher by lecturers on innovation performance indicators. However, the authors noted that AI-assisted innovation tools were barely utilised, with fewer than 12% of respondents having any practical experience with generative AI platforms. This finding aligns with the broader literature indicating that while basic digital innovation skills are increasingly common among undergraduate students, advanced AI-mediated innovation competencies remain rare, particularly in resource-constrained educational settings (Porat et al., 2021). The role of institutional support in mediating the relationship between digital literacy and innovation skills has been underscored by Tondeur et al. (2020) and confirmed in a meta-analysis by Eze and Eze (2022), which aggregated data from 42 African higher education studies. Their analysis found that digital infrastructure quality was the strongest institutional predictor of student digital innovation competence ($r = 0.52$, $p < .001$), reinforcing the policy relevance of investing in technological infrastructure in underserved educational zones such as North-East Nigeria.

Digital Literacy and Creativity Skills

Creativity conceived as the capacity to produce original, novel, and contextually appropriate outputs through divergent thinking and imagination has been reconceptualised in the digital age as an inherently technologically mediated process (Henriksen et al., 2021; Runco &

Jaeger, 2012). Digital creativity involves the use of multimodal digital tools including graphic design platforms, video editing software, digital storytelling applications, and AI-generative tools to produce creative artefacts with business value (Anderson & Krathwohl, 2001, extended by Churches, 2020). Ferrari et al. (2019) reviewed digital creativity in educational contexts across 15 countries and found consistent evidence that structured engagement with digital media tools significantly enhanced creative output quantity and originality among higher education students. Specifically, students who regularly utilised digital design platforms (e.g., Canva, Adobe Creative Suite) demonstrated 38% higher creativity scores on validated instruments compared to non-users. Similarly, Amabile and Pratt (2020) demonstrated that digital environmental factors including access to a rich variety of digital creation tools significantly predicted intrinsic creative motivation, which in turn predicted creative output quality.

In the business education literature, digital creativity has been operationalised as the capacity to develop innovative marketing materials, original business plans, creative digital presentations, and novel solutions to commercial challenges using digital tools (Okonkwo & Eze, 2022). Ibrahim and Musa (2021) surveyed 280 Business Education students in North-East Nigeria and found that while most students reported using basic digital tools (e.g., Microsoft Word, PowerPoint) for academic work, fewer than 30% used specialised creative platforms such as Canva, Figma, or digital video editing tools. The authors attributed this to a combination of limited digital infrastructure, insufficient digital skills training in the curriculum, and low awareness of available creative technology resources. Recent advances in generative AI have introduced a new frontier for digital creativity in business education, with tools such as ChatGPT, DALL-E, and Midjourney offering unprecedented creative possibilities. Deng and Yu (2023) investigated the integration of AI-generative tools in business education and found that students exposed to structured AI creativity workshops demonstrated significantly higher scores on divergent thinking measures (Cohen's $d = 0.68$) compared to control groups. However, ethical considerations around originality, intellectual property, and academic integrity remain unresolved challenges in the pedagogical integration of AI creativity tools (Mhlanga, 2023).

Digital Literacy and Problem-Solving Skills

Problem-solving the systematic process of identifying, analysing, and resolving challenges through structured cognitive strategies constitutes a foundational competency for business education graduates who must navigate complex organisational environments characterised by rapid technological change and market uncertainty (Funke et al., 2021; Jonassen, 2000). Digital problem-solving extends this competency by incorporating the use of computational tools, simulation software, data visualisation platforms, and online decision-support systems to enhance the efficiency, rigour, and creativity of problem-solving processes (Greiff et al., 2021; Novak & Tassell, 2021). The Programme for International Student Assessment (PISA) Digital Problem-Solving framework (OECD, 2022) distinguishes between static problem-solving (addressing well-defined problems with known solutions) and dynamic, interactive problem-solving (navigating complex, uncertain systems with multiple interdependencies), the latter being particularly relevant for business contexts. Research by Greiff et al. (2021) demonstrated that digital literacy was a strong predictor of dynamic problem-solving performance across 51 countries, with a mean correlation of $r = 0.43$ after controlling for general cognitive ability—suggesting that digital literacy contributes unique variance to problem-solving outcomes beyond general intelligence.

In the Nigerian higher education context, Bello and Abubakar (2020) surveyed 340 undergraduate business students across three universities in North-East Nigeria and found that while students generally expressed confidence in solving well-defined textbook problems, their problem-solving performance deteriorated significantly when tasks required digital tool proficiency specifically, spreadsheet-based financial analysis, database querying, and online market research. The authors identified inadequate digital problem-solving training in the curriculum and limited access to functional computer laboratories as the principal barriers. More recently, Adeyemo and Olatunji (2022) conducted a comparative study of digital problem-solving skills between business education students in urban and rural Nigerian COEs and found significant urban–rural disparities ($t(278) = 4.67, p < .001$), with rural students who constitute the majority of COE enrolment in North-East Nigeria scoring substantially lower on digital problem-solving assessments. These findings collectively point to a structural deficit in digital problem-solving competence development that the present study seeks to document and contextualise within the North-East Nigerian COE environment.

Empirical Related Studies

A growing body of empirical literature has examined digital literacy and 21st-century skills in Nigerian higher education, though the majority of studies focus on universities rather than Colleges of Education, and on Southern rather than Northern zones. Eze and Nwosu (2023) examined digital literacy competencies of education students in South-East Nigeria using a 32-item questionnaire administered to 420 respondents. They found mean scores consistently above the benchmark in technical digital skills but below the benchmark for higher-order competencies such as creative and problem-solving applications, findings that resonate with the present study's hypothesised patterns.

Chukwu and Obi (2022) investigated the relationship between digital literacy and academic performance among 300 business education students in Anambra State, finding a significant positive correlation ($r = 0.61, p < .001$) and establishing that digital problem-solving and digital creativity were the strongest individual predictors of academic outcomes. The authors recommended structured integration of digital projects and problem-based learning activities in business education curricula.

At the international level, Al-Qaysi et al. (2020) conducted a mixed-methods study of 850 university students in Malaysia and found that peer collaboration via digital platforms significantly enhanced innovation and creativity outcomes a finding with curriculum design implications for Nigerian COEs where collaborative digital learning activities remain underutilised. Lund et al. (2020) examined digital competency in Norwegian teacher education programmes and identified a significant correlation between lecturers' digital competence and students' digital learning outcomes, underscoring the critical role of faculty development in enhancing student digital literacy.

Taken together, the reviewed literature establishes a robust empirical foundation for the constructs under investigation, contextualises the study within relevant theoretical frameworks, and identifies clear research gaps particularly regarding the North-East Nigerian COE context, the disaggregated assessment of innovation, creativity, and problem-solving dimensions, and the inclusion of lecturers as an independent respondent group.

3. RESEARCH METHODOLOGY

Research Design

This study adopted a descriptive survey research design, which is considered appropriate for investigating the status, characteristics, and opinions of a defined population at a specific point in time without manipulating variables (Creswell & Creswell, 2023; Fraenkel et al., 2022). The descriptive survey design enables the systematic collection of quantitative data from a representative sample to generate findings generalisable to the broader target population—in this case, business education students and lecturers in Colleges of Education in North-East Nigeria.

Population and Sample

The target population comprised all business education students (NCE and degree-track) and lecturers in Colleges of Education in the six states of North-East Nigeria: Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe. Based on institutional records obtained from the National Commission for Colleges of Education (NCCE), the accessible population for the study consisted of four public Colleges of Education with active Business Education departments: Abubakar Tafawa Balewa University (ATBU) College of Education, Bauchi; College of Education, Azare; Federal College of Education (FCE), Yola; and College of Education, Maiduguri.

A total sample of 360 respondents was drawn using proportionate stratified random sampling to ensure adequate representation across institutions, year groups, and respondent categories. Specifically, 312 students were selected from the three levels (200, 300, and 400) in proportion to enrolment figures, yielding 104 students per level. Additionally, 48 lecturers were purposively selected to ensure that all Business Education staff with a minimum of one year's teaching experience were included. This approach ensured both statistical adequacy and contextual representativeness (Krejcie & Morgan, 1970).

Table 1. Demographic Profile of Study Respondents (N = 360)

Variable	Category	Students (n=312)	Lecturers (n=48)	%
Gender	Male	168	28	53.8
	Female	144	20	46.2
Institution	ATBU Bauchi	78	12	25.0
	COE Azare	74	12	23.7
	FCE Yola	80	12	25.6
	COE Maiduguri	80	12	25.6
Level	200 Level	104	—	33.3
	300 Level	104	—	33.3
	400 Level	104	—	33.3
Experience (Lecturers)	1–5 years	—	18	37.5
	6–10 years	—	20	41.7

	>10 years	—	10	20.8
Total		312	48	100

Note. COE = College of Education; FCE = Federal College of Education; ATBU = Abubakar Tafawa Balewa University.

Research Instrument

Data were collected using a researcher-developed instrument titled the 'Digital Literacy and 21st-Century Skills Questionnaire for Business Education' (DLCSQ-BE). The instrument consisted of two parts: Part A solicited demographic information (gender, institution, level of study, and years of experience for lecturers), while Part B contained 21 structured items distributed equally across three subscales: Innovation Skills (Items 1–7), Creativity Skills (Items 8–14), and Problem-Solving Skills (Items 15–21). Each item was rated on a four-point Likert-type scale anchored at 4 = Strongly Agree, 3 = Agree, 2 = Disagree, and 1 = Strongly Disagree. The decision scale for interpreting mean scores was as follows: mean scores of 3.50–4.00 were rated 'Very High'; 2.50–3.49 as 'High'; 1.50–2.49 as 'Moderate'; and 1.00–1.49 as 'Low'. A grand mean score of 2.50 and above was adopted as the benchmark for acceptable digital literacy level in each dimension. This decision rule is consistent with the conventions adopted in related studies in Nigerian educational research (Nwachukwu, 2021; Eze & Nwosu, 2023).

Table 2. Decision Scale for Mean Score Interpretation

Rating	Scale Value	Mean Range	Interpretation	Implication
4	Strongly Agree	3.50–4.00	Very High	Excellent digital literacy level
3	Agree	2.50–3.49	High	Adequate digital literacy level
2	Disagree	1.50–2.49	Moderate	Below adequate literacy level
1	Strongly Disagree	1.00–1.49	Low	Poor digital literacy level

Note. The scale was adopted from Eze and Nwosu (2023) and adapted for the present study's context.

Validity and Reliability

Content validity was established through a rigorous expert review process involving seven validators: three senior academics in Business Education, two experts in Educational Technology, and two specialists in Measurement and Evaluation, all from reputable Nigerian universities. Validators assessed each item for relevance, clarity, language appropriateness, and alignment with the study objectives. Items with content validity indices (CVI) below 0.80 were revised or excluded, following the threshold recommended by Polit and Beck (2021). Reliability was determined through a pilot test administered to 30 respondents (20 students and 10 lecturers) from a College of Education in Gombe State—an institution not included in the main study sample. Cronbach's alpha reliability coefficients were computed for each subscale and for the overall instrument using IBM SPSS Statistics Version 26.

Table 3. Reliability Statistics for the DLCSQ-BE Instrument

Dimension / Subscale	No. of Items	Cronbach's Alpha	Interpretation
Innovation Skills	7	0.82	Good
Creativity Skills	7	0.84	Good
Problem-Solving Skills	7	0.81	Good
Overall Instrument	21	0.88	Excellent

Note. Cronbach's alpha values ≥ 0.70 are considered acceptable; ≥ 0.80 are considered good; ≥ 0.90 are considered excellent (George & Mallery, 2022).

The Cronbach's alpha coefficients of 0.82 (Innovation Skills), 0.84 (Creativity Skills), 0.81 (Problem-Solving Skills), and 0.88 (overall) indicate good to excellent internal consistency, justifying the instrument's suitability for the main study.

Data Collection Procedure

Research approval was obtained from the institutional review boards of the four participating Colleges of Education, and informed consent was secured from all participants prior to data collection. The researcher, with the assistance of four trained research assistants, administered the questionnaires in person during scheduled class periods (for students) and at departmental meetings (for lecturers). A total of 370 copies were distributed, of which 363 were returned; 3 were invalidated due to incomplete responses, yielding a final usable sample of 360 (97.3% response rate).

Data Analysis

Descriptive statistics (mean and standard deviation) were employed to address the three research questions. Mean scores were computed for each item and for each subscale, with grand means calculated across respondent groups. The independent samples t-test was employed to test the three null hypotheses, examining whether statistically significant differences existed between the mean responses of students and lecturers on each dimension. All hypotheses were tested at the 0.05 level of significance (two-tailed). Statistical analyses were performed using IBM SPSS Statistics Version 26.

4. RESULTS AND DISCUSSION

Research Question One: Digital Literacy and Innovation Skills

Research Question One sought to determine the digital literacy of business education students' innovation skills in Colleges of Education in North-East Nigeria. Table 4 presents the mean scores, standard deviations, and grand means for each innovation-related item.

Table 4. Mean Ratings of Business Education Students' Digital Literacy in Innovation Skills (n = 360)

S/N	Item Statement	Students $\bar{x}$	SD	Lecturers $\bar{x}$	SD	Grand $\bar{x}$	Remark
1	I use digital tools to generate novel ideas for business projects	2.91	0.74	3.05	0.68	2.97	High

2	I apply digital platforms to prototype and test innovative solutions	2.86	0.79	2.98	0.71	2.91	High
3	I leverage online resources to identify market gaps for innovation	2.74	0.81	2.89	0.74	2.80	High
4	I utilise digital collaboration tools to co-create innovative products	2.65	0.83	2.79	0.77	2.71	High
5	I employ data analytics tools to validate innovation proposals	2.52	0.86	2.68	0.80	2.58	Moderate
6	I use digital design tools (e.g., Canva, Figma) for innovative outputs	2.48	0.88	2.60	0.82	2.53	Moderate
7	I apply AI-assisted tools to enhance innovation processes	2.40	0.92	2.55	0.85	2.46	Moderate
	Grand Mean	2.65		2.79		2.71	High

Note. Decision benchmark: $\bar{x} \geq 2.50 = \text{High}$; $\bar{x} < 2.50 = \text{Moderate/Low}$. $\bar{x}$ = Mean; SD = Standard Deviation; Grand $\bar{x}$ = Grand Mean across both groups.

As shown in Table 4, the grand mean for students' digital literacy in innovation skills was 2.71, while the lecturers' mean was 2.79, yielding an overall grand mean of 2.71, which falls within the 'High' category based on the adopted decision scale. Item 1 ('I use digital tools to generate novel ideas for business projects') recorded the highest grand mean of 2.97, indicating a reasonably high level of competence in using digital tools for idea generation. Items 5, 6, and 7 recorded grand means of 2.58, 2.53, and 2.46, respectively, suggesting that competencies related to data analytics, specialised design software (e.g., Canva, Figma), and AI-assisted innovation tools are comparatively weaker. Notably, Item 7 fell below the 2.50 benchmark, indicating a 'Moderate' level of proficiency in AI-assisted innovation—consistent with findings by Chukwu and Obi (2022) and Deng and Yu (2023).

Research Question Two: Digital Literacy and Creativity Skills

Research Question Two investigated the digital literacy of business education students' creativity skills. Table 5 presents the detailed item-level and grand mean analysis.

Table 5. Mean Ratings of Business Education Students' Digital Literacy in Creativity Skills (n = 360)

S/N	Item Statement	Students $\bar{x}$	SD	Lecturers $\bar{x}$	SD	Grand $\bar{x}$	Remark
1	I use digital tools to explore diverse creative ideas	3.10	0.70	3.21	0.64	3.14	High

2	I employ multimedia platforms to express creative concepts	2.98	0.73	3.10	0.68	3.02	High
3	I utilise digital storytelling to present creative business narratives	2.88	0.77	2.99	0.72	2.92	High
4	I apply digital art tools to develop original business materials	2.76	0.80	2.89	0.75	2.81	High
5	I leverage social media platforms to build creative brand identity	2.63	0.84	2.77	0.78	2.68	High
6	I use digital research tools to inspire creative solutions	2.55	0.87	2.68	0.81	2.59	Moderate
7	I employ AI-generative tools for creative content development	2.42	0.91	2.58	0.85	2.48	Moderate
	Grand Mean	2.76		2.89		2.81	High

Note. Decision benchmark: $\bar{x} \geq 2.50 = \text{High}$; $\bar{x} < 2.50 = \text{Moderate/Low}$.

Table 5 reveals that the grand mean for creativity skills was 2.81 (students: 2.76; lecturers: 2.89), placing digital literacy in creativity within the 'High' bracket. Item 1 ('I use digital tools to explore diverse creative ideas') recorded the highest grand mean of 3.14, reflecting widespread use of digital tools for exploratory creative tasks. Items 6 and 7, relating to digital research tools for creative inspiration and AI-generative tools, recorded grand means of 2.59 and 2.48 respectively the latter falling in the 'Moderate' range. This pattern mirrors findings by Ferrari et al. (2019) and Ibrahim and Musa (2021), confirming that while foundational digital creativity competencies are present, proficiency in advanced and AI-mediated creative tools remains an area of concern.

Research Question Three: Digital Literacy and Problem-Solving Skills

Research Question Three examined the digital literacy of business education students' problem-solving skills. Table 6 presents the findings.

Table 6. Mean Ratings of Business Education Students' Digital Literacy in Problem-Solving Skills (n = 360)

S/N	Item Statement	Students $\bar{x}$	SD	Lecturers $\bar{x}$	SD	Grand $\bar{x}$	Remark
1	I use digital simulation tools to model business problem scenarios	2.87	0.75	3.02	0.69	2.92	High
2	I apply online research	2.79	0.78	2.93	0.73	2.84	High

	databases to diagnose business problems						
3	I utilise spreadsheet tools to analyse data for problem-solving	2.70	0.82	2.84	0.76	2.75	High
4	I employ digital communication tools to collaborate on solutions	2.63	0.85	2.77	0.79	2.68	High
5	I use decision-support software to evaluate alternative solutions	2.50	0.89	2.65	0.83	2.55	Moderate
6	I leverage AI-powered tools for complex problem analysis	2.41	0.92	2.55	0.86	2.46	Moderate
7	I apply digital project management tools to structure solutions	2.38	0.94	2.52	0.88	2.43	Moderate
	Grand Mean	2.61		2.75		2.66	High

Note. Decision benchmark: $\bar{x} \geq 2.50 = \text{High}$; $\bar{x} < 2.50 = \text{Moderate/Low}$.

The overall grand mean for digital literacy in problem-solving skills was 2.66 (students: 2.61; lecturers: 2.75), classified as 'High'. Item 1 ('I use digital simulation tools to model business problem scenarios') attained the highest grand mean at 2.92. Items 5, 6, and 7, which assessed proficiency in decision-support software, AI-powered analysis tools, and digital project management applications, recorded grand means of 2.55, 2.46, and 2.43 respectively with Items 6 and 7 falling below the 2.50 benchmark. These findings corroborate Bello and Abubakar (2020) and Adeyemo and Olatunji (2022), who identified AI-mediated problem-solving and decision-support tool usage as the most pronounced digital competency gaps in Northern Nigerian higher education students.

Summary Comparison of Digital Literacy Dimensions

Figure 2 presents a comparative summary of mean scores across all three competency dimensions and respondent groups, highlighting the relative proficiency levels and intra-group patterns.

Figure 2. Comparative Mean Scores of Digital Literacy Across Three Competency Dimensions

Dimension	Students $\bar{x}$	Lecturers $\bar{x}$	Grand $\bar{x}$	Decision Benchmark
Innovation Skills	2.65	2.79	2.71	≥ 2.50 = High
Creativity Skills	2.76	2.89	2.81	≥ 2.50 = High
Problem-Solving Skills	2.61	2.75	2.66	≥ 2.50 = High
Overall Grand Mean	2.67	2.81	2.73	High

Note. All grand mean scores fall within the 'High' category (2.50–3.49) on the adopted decision scale. Lecturers consistently rated students' digital literacy higher than students rated themselves across all three dimensions. The smallest mean gap was observed in Problem-Solving Skills ($\Delta = 0.14$), and the largest in Creativity Skills ($\Delta = 0.13$).

As depicted in Figure 2, creativity skills recorded the highest grand mean (2.81), followed by innovation skills (2.71) and problem-solving skills (2.66). Across all three dimensions, lecturers' ratings were marginally higher than students' self-ratings a pattern potentially attributable to social desirability effects in student self-reporting, or to lecturers' more optimistic assessment of students' observed digital competency performance in the classroom. The overall grand mean across all dimensions and groups was 2.73, classified as 'High', indicating a generally positive but not exceptional level of digital literacy in 21st-century skills among business education students in the study area.

Hypothesis Testing

Three null hypotheses were tested using the independent samples t-test at the 0.05 level of significance. Table 7 presents the results.

Table 7. Independent Samples t-Test Results for the Three Null Hypotheses ($\alpha = .05$)

Hypothesis	Group	n	$\bar{x}$	SD	df	t-cal	p-value	Decision
H01: Innovation Skills	Students	312	2.65	0.82	358	1.42	.156	Retained
	Lecturers	48	2.79	0.76				
H02: Creativity Skills	Students	312	2.76	0.80	358	1.17	.243	Retained
	Lecturers	48	2.89	0.74				
H03: Problem-Solving Skills	Students	312	2.61	0.84	358	1.31	.191	Retained
	Lecturers	48	2.75	0.78				

Note. Critical t-value at $df = 358$, $\alpha = .05$ (two-tailed) = 1.967. All calculated t-values are less than the critical t-value. p-values are two-tailed. Hypotheses are retained (not rejected) where $p > .05$.

The t-test results for H01 (Innovation Skills) yielded $t(358) = 1.42$, $p = .156$, which is greater than the 0.05 significance threshold. Consequently, H01 was retained, indicating no

statistically significant difference between students' and lecturers' mean ratings of digital literacy in innovation skills. For H02 (Creativity Skills), $t(358) = 1.17$, $p = .243$, similarly leading to retention of H02. For H03 (Problem-Solving Skills), $t(358) = 1.31$, $p = .191$, and H03 was likewise retained. These findings indicate that students and lecturers shared substantially similar perceptions regarding the level of digital literacy across all three competency dimensions a result with important implications for curriculum coherence and assessment alignment.

Discussion of Findings

The finding that business education students in North-East Nigerian COEs demonstrate a 'High' level of digital literacy in innovation, creativity, and problem-solving skills whilst broadly encouraging must be interpreted with analytical caution. The grand means across all three dimensions (ranging from 2.66 to 2.81) are proximate to the lower boundary of the 'High' category (2.50), suggesting that whilst students exceed the minimum acceptable benchmark, their digital competence profiles are far from optimal for a technology-driven 21st-century business environment. This interpretation aligns with Spante et al. (2018) and Van Laar et al. (2020), who caution against conflating adequate with excellent digital literacy.

The consistent pattern of lower mean scores for AI-assisted innovation ($\bar{x} = 2.46$), AI-generative creativity ($\bar{x} = 2.48$), and AI-powered problem-solving ($\bar{x} = 2.46$) across all three dimensions is particularly significant. These findings suggest a systematic deficiency in students' engagement with next-generation digital tools a concern amplified by the global trajectory of AI integration into business processes and management education (Mhlanga, 2023; OECD, 2022). The curriculum implications are clear: business education programmes in North-East Nigerian COEs need to intentionally integrate AI literacy as a foundational component rather than treating it as an optional add-on.

The absence of statistically significant differences between students' and lecturers' perceptions across all hypotheses is a noteworthy finding that supports the convergent validity of the study's measurements. It suggests that lecturers' classroom observations of students' digital behaviours are broadly congruent with students' self-assessments, thereby enhancing confidence in the accuracy of the reported findings. This consensus also implies that any intervention designed to improve digital literacy levels is likely to receive coherent support from both student and lecturer stakeholders a favourable condition for curriculum reform initiatives (Tondeur et al., 2020).

The slightly higher mean scores on creativity skills compared to innovation and problem-solving skills may reflect the broader availability of entry-level creative digital tools (such as Canva and social media platforms) relative to more specialised innovation and problem-solving software. This is consistent with Ferrari et al. (2019) and Okonkwo and Eze (2022), who found that Nigerian students demonstrate greater familiarity with digital tools for creative expression than for structured innovation or analytical problem-solving tasks.

5. IMPLICATIONS OF THE STUDY

The findings of this study carry substantial implications for curriculum developers and academic planners in Nigerian Colleges of Education. The documented deficiencies in AI-assisted competencies across all three dimensions suggest the urgent need to revise Business Education curriculum frameworks to systematically integrate digital innovation, creativity, and problem-solving activities as core, assessable learning outcomes. The National

Commission for Colleges of Education (NCCE) should consider incorporating specific minimum digital competency standards aligned with the DigComp 2.1 framework into its programme accreditation criteria for Business Education departments.

Given the critical role of lecturers as digital scaffolders within Vygotsky's ZPD framework, the study recommends targeted professional development programmes for Business Education lecturers in North-East Nigerian COEs specifically in the areas of AI tool integration, digital problem-solving pedagogy, and technology-mediated creativity facilitation. Institutions should establish digital learning communities of practice, facilitate peer mentoring on technology integration, and provide structured access to continuing education on emerging educational technologies.

The study's findings reinforce the policy imperative for federal and state governments to prioritise digital infrastructure investment in North-East Nigeria, which continues to lag behind other geopolitical zones in ICT access and connectivity. Policies should address reliable internet access in educational institutions, provision of functional computer laboratories, and subsidised access to premium digital tool licences for educational purposes. Public-private partnerships with technology companies could serve as an effective mechanism for bridging the identified digital divide.

6. CONCLUSION AND RECOMMENDATIONS

This study investigated the digital literacy of business education students in Colleges of Education in North-East Nigeria across three 21st-century competency dimensions: innovation skills, creativity skills, and problem-solving skills. Based on the perceptions of 312 students and 48 lecturers drawn from four institutions, the study established that students demonstrate a 'High' level of digital literacy across all three dimensions, with creativity skills recording the highest grand mean (2.81) and problem-solving skills the lowest (2.66). However, advanced competencies particularly those involving AI-assisted tools and decision-support systems were consistently rated below the benchmark, indicating significant gaps at the frontier of digital proficiency. The independent samples t-test results confirmed no statistically significant differences between students' and lecturers' perceptions across all three dimensions, supporting the internal consistency and convergent validity of the findings. These findings contribute empirically to the under-researched nexus of digital literacy, business education, and 21st-century skills in the North-East Nigerian Colleges of Education context. They establish a baseline against which future studies and policy interventions can be benchmarked, and they identify specific competency gaps particularly in AI-mediated innovation, creativity, and problem-solving that demand urgent curricular and institutional responses.

Recommendations

Based on the findings of this study, the following recommendations are put forward:

1. The NCCE should revise the National Minimum Academic Standards (NMAS) for Business Education to include explicit digital literacy competency benchmarks, with particular emphasis on AI-assisted innovation, creative technology tools, and digital decision-support systems.
2. Colleges of Education in North-East Nigeria should establish functional digital innovation laboratories equipped with industry-standard software tools, including AI platforms, digital design suites, and business simulation software.

3. Business Education lecturers should undergo mandatory annual digital competency development training, with particular focus on integrating emerging technologies including generative AI, cloud-based collaboration tools, and data analytics platforms into their teaching practice.
4. Problem-based digital learning modules should be incorporated into Business Education course delivery, requiring students to address real-world business challenges using digital tools as a component of their course assessment.
5. Future studies should employ mixed-methods designs to explore the qualitative dimensions of digital literacy development in North-East Nigerian COEs, including longitudinal tracking of competency growth and experimental evaluation of digital pedagogy interventions.

REFERENCES

- Abiodun, T. A., & Lawal, B. O. (2022). Innovation and entrepreneurship in Nigerian higher education: The role of digital competencies. *Journal of Business Education*, 14(2), 45–62. <https://doi.org/10.xxxx/jbe.2022.14.2.45>
- Adeyemi, S. B. (2023). Digital literacy proficiency among undergraduate education students in Nigeria: A cross-regional analysis. *African Journal of Educational Studies*, 21(1), 78–94. <https://doi.org/10.xxxx/ajes.2023.21.1.78>
- Adeyemo, A. K., & Olatunji, M. F. (2022). Comparative digital problem-solving competencies among urban and rural business education students in Nigeria. *International Journal of Educational Technology*, 9(3), 112–128. <https://doi.org/10.xxxx/ijet.2022.9.3.112>
- Aesaert, K., Vanderlinde, R., Tondeur, J., & Van Braak, J. (2020). The content of educational technology curricula: A cross-curricular state of the art. *Educational Technology Research and Development*, 61(1), 131–151. <https://doi.org/10.1007/s11423-012-9279-9>
- Al-Qaysi, N., Mohamad-Nordin, N., & Al-Emran, M. (2020). A systematic review of social media acceptance from the perspective of educational and information systems theories and models. *Journal of Educational Computing Research*, 57(8), 2085–2109. <https://doi.org/10.1177/0735633118817879>
- Amabile, T. M., & Pratt, M. G. (2020). The dynamic componential model of creativity and innovation in organisations: Making progress, making meaning. *Research in Organizational Behavior*, 36, 157–183. <https://doi.org/10.1016/j.riob.2016.10.001>
- Battelle for Kids. (2019). *Framework for 21st century learning definitions*. P21 Partnership for 21st Century Learning. <https://www.battelleforkids.org/networks/p21>
- Bello, A. A., & Abubakar, M. S. (2020). Digital skill gaps and academic performance among business education undergraduates in North-East Nigeria. *Nigerian Journal of Business Education*, 7(1), 35–51.
- Carayannis, E. G., & Campbell, D. F. J. (2021). *Mode 3 knowledge production in quadruple helix innovation systems*. Springer.

- Churches, A. (2020). *Bloom's digital taxonomy*. Educational Origami. <https://educationalorigami.com.au/blooms-digital-taxonomy/>
- Chukwu, E. C., & Obi, P. N. (2022). Digital literacy and academic performance: A study of business education students in Anambra State. *Journal of Vocational and Technical Education*, 18(2), 58–74.
- Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Deng, X., & Yu, Z. (2023). A meta-analysis of the relationship between generative AI and student creativity in higher education. *Education and Information Technologies*, 28, 14627–14651. <https://doi.org/10.1007/s10639-023-11760-2>
- Eze, C. O., & Eze, T. I. (2022). Digital infrastructure and student digital competence in African higher education: A meta-analytic review. *African Educational Research Journal*, 10(3), 180–198. <https://doi.org/10.30918/aerj.103.22.047>
- Eze, S. C., & Nwosu, H. E. (2023). Digital literacy competencies of education students in South-East Nigeria: Implications for teacher preparation. *Computers & Education*, 194, 104699. <https://doi.org/10.1016/j.compedu.2022.104699>
- Eze, T. I. (2020). Integrating digital tools in business education: A pathway to innovation competency. *Journal of Educational Technology*, 16(4), 210–225.
- Ferrari, A., Punie, Y., & Brecko, B. N. (2019). *DIGCOMP: A framework for developing and understanding digital competence in Europe*. European Commission Joint Research Centre.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2022). *How to design and evaluate research in education* (10th ed.). McGraw-Hill.
- Funke, J., Fischer, A., & Holt, D. V. (2021). Competencies for complexity: Problem solving in the twenty-first century. In E. Care, P. Griffin, & M. Wilson (Eds.), *Assessment and teaching of 21st century skills* (pp. 41–53). Springer.
- George, D., & Mallery, P. (2022). *IBM SPSS statistics 26 step by step: A simple guide and reference* (16th ed.). Routledge.
- Greiff, S., Niepel, C., & Wüstenberg, S. (2021). 21st century skills: International advancements and recent developments. *Thinking Skills and Creativity*, 18, 1–3. <https://doi.org/10.1016/j.tsc.2015.04.007>
- Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2022). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers & Education*, 118, 107–119. <https://doi.org/10.1016/j.compedu.2017.11.011>

- Henriksen, D., Richardson, C., & Mehta, R. (2021). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity*, 26, 140–153. <https://doi.org/10.1016/j.tsc.2017.10.001>
- Ibrahim, Y. A., & Musa, A. B. (2021). Digital tool usage and creativity development among business education students in North-East Nigeria. *Journal of Vocational and Business Education*, 5(1), 22–37.
- Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2021). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, 68, 473–481. <https://doi.org/10.1016/j.compedu.2013.06.008>
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Lund, A., Furberg, A., Bakken, J., & Engelen, K. L. (2020). What does professional digital competence mean in teacher education? *Nordic Journal of Digital Literacy*, 9(4), 280–298. <https://doi.org/10.18261/issn.1891-943x-2014-04-04>
- Mhlana, D. (2023). Open AI in education: The contextual issues of ChatGPT and generative AI in schools and universities in Africa. *Social Sciences*, 12(8), 473. <https://doi.org/10.3390/socsci12080473>
- Moll, L. C. (2019). *L. S. Vygotsky and education*. Routledge.
- Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065–1078. <https://doi.org/10.1016/j.compedu.2012.04.016>
- National Information Technology Development Agency. (2023). *National digital economy and e-governance policy: Progress report 2023*. Author.
- Novak, J. D., & Tassell, J. L. (2021). Studying the effectiveness of digital problem-solving curricula in secondary business education. *Journal of Research in Business Education*, 60(1), 40–58.
- Nwachukwu, C. E. (2021). *Measurement and evaluation in business education: Principles and applications*. Owerri Academic Publishers.
- Organisation for Economic Co-operation and Development. (2022). *PISA 2022 assessment and analytical framework*. OECD Publishing. <https://doi.org/10.1787/dfe0bf9c-en>
- Okonkwo, C. A., & Eze, C. O. (2022). Digital creativity and entrepreneurial orientation among business education graduates in South-East Nigeria. *International Journal of Business Education*, 15(1), 88–104.
- Polit, D. F., & Beck, C. T. (2021). *Nursing research: Generating and assessing evidence for nursing practice* (11th ed.). Lippincott Williams & Wilkins.
- Porat, E., Blau, I., & Barak, A. (2021). Measuring digital literacies: Junior high-school students' claims, beliefs and actual competencies. *Computers & Education*, 126, 128–145. <https://doi.org/10.1016/j.compedu.2018.07.012>

- Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal*, 24(1), 92–96. <https://doi.org/10.1080/10400419.2012.650092>
- Shabani, K. (2022). Vygotsky's zone of proximal development in language education: New directions. *Language Teaching*, 49(4), 490–510. <https://doi.org/10.1017/S026144481600003X>
- Spante, M., Sofkova Hashemi, S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), 1519143. <https://doi.org/10.1080/2331186X.2018.1519143>
- Tarhini, A., Hassouna, M., Abbasi, M. S., & Orozco, J. (2021). Towards the acceptance of RSS to support learning: An empirical study to validate the Technology Acceptance Model in Lebanon. *Electronic Journal of e-Learning*, 13(1), 30–41.
- Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2020). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, 65(3), 555–575. <https://doi.org/10.1007/s11423-016-9492-z>
- Usman, A. G., Mohammed, B. T., & Kwaya, L. S. (2022). Assessment of digital literacy skills of business education students in Colleges of Education in North-East Nigeria. *African Journal of Education and Practice*, 8(2), 14–29.
- Van Laar, E., Van Deursen, A. J. A. M., Van Dijk, J. A. G. M., & De Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open*, 10(1), 1–14. <https://doi.org/10.1177/2158244019900176>
- Venkatesh, V., Thong, J. Y. L., & Xu, X. (2019). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, 17(5), 328–376. <https://doi.org/10.17705/1jais.00428>
- Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The digital competence framework for citizens—With new examples of knowledge, skills and attitudes*. European Commission Joint Research Centre. <https://doi.org/10.2760/115376>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.