EduLine: Journal of Education and Learning Innovation *ISSN: 2775-6173 (online)*
Vol. 6 No. 2 (2026)
https://doi.org/10.35877/454RI.eduline4683

Pedagogical Mediation by Academic Librarians with ICT for the Development of Critical Thinking in Library and Information Science Students: A Systematic Review

Kayode Sunday John Dada[a*], Romoke Opeyemi Quardir[b]

[a]*University Library, Federal University of Education, Zaria, Kaduna State, Nigeria*
[b]*Nigerian Defence Academy, Kaduna State, Nigeria*

Abstract

This systematic review examines how pedagogical mediation by academic librarians using Information and Communication Technologies (ICT) contributes to the development of critical thinking among Library and Information Science (LIS) students at Ahmadu Bello University (ABU), Zaria. Employing the PRISMA 2020 framework, 81 peer-reviewed empirical studies published between 2013 and 2026 were identified, screened, and synthesised from SCOPUS, Web of Science, and supplementary databases. The review is grounded in the Technological Pedagogical Content Knowledge (TPACK) framework of Mishra and Koehler (2006). Qualitative thematic synthesis and quantitative Kruskal-Wallis nonparametric analysis were applied to compare critical thinking skill development, ICT tool effectiveness, assessment strategies, and institutional challenges across undergraduate students, postgraduate students, and academic librarians. Results reveal that problem-based learning with ICT ($\beta = .48$, $p < .001$) and blended learning environments ($\beta = .41$, $p < .001$) are the most effective pedagogical approaches for developing critical thinking, while lack of ICT pedagogical training ($H = 14.67$, $p < .001$) and role ambiguity for academic librarians ($H = 13.77$, $p < .001$) emerge as the most significant barriers. Findings indicate that integrating TPACK-aligned pedagogical training for academic librarians substantially enhances their mediation capacity and, consequently, student critical thinking outcomes in LIS education at ABU Zaria.

Keywords: pedagogical mediation; academic librarians; ICT integration; critical thinking; Library and Information Science

1. Introduction

The rapid proliferation of digital technologies has fundamentally reconfigured the epistemological landscape of higher education, demanding that academic librarians transition from custodial roles to active pedagogical mediators capable of leveraging Information and Communication Technologies (ICT) to foster higher-order thinking skills (Elmborg, 2006; Moring, 2017). At Ahmadu Bello University (ABU) Zaria, one of Nigeria's foremost research-intensive institutions, the Department of Library and Information Science (LIS) confronts a particularly acute version of this challenge: how can academic librarians effectively deploy ICT-mediated instructional strategies to cultivate critical thinking dispositions among a student population navigating the dual demands of information literacy and digital competence (Ezeani, 2012; Quadri et al., 2021)?

The importance of critical thinking in LIS education cannot be overstated. In an information-saturated environment characterised by misinformation, algorithmic filter bubbles, and epistemic fragmentation, the capacity to analyse, evaluate, synthesise, and apply information purposefully constitutes a core professional competency for future librarians and information scientists (Facione, 1990; Halpern, 2014). Pedagogical mediation —defined here as the deliberate and theoretically informed orchestration of ICT tools and instructional strategies by academic librarians to scaffold student learning—offers a promising mechanism for developing these competencies systematically (Feuerstein et al., 1980; Vygotsky, 1978).

Despite growing scholarly recognition of academic librarians' instructional roles, empirical evidence on the specific ICT tools, pedagogical approaches, and enabling conditions most effective for developing critical thinking in Nigerian LIS contexts remains fragmented and undertheorised. Existing systematic reviews on the subject tend to focus on Global North contexts, employ broad disciplinary scopes, or neglect the intersectional challenges of institutional infrastructure, digital literacy, and role identity that characterise LIS education in sub-Saharan African universities (Dent Young, 2018; Lwoga & Questier, 2015). This systematic review addresses these gaps directly, offering a contextually grounded and methodologically rigorous synthesis of the evidence base as it applies to ABU Zaria.

The study is anchored in the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006), which conceptualises effective technology-integrated teaching as the dynamic intersection of three knowledge domains: content knowledge, pedagogical knowledge, and technological knowledge.

EduLine: Journal of Education and Learning Innovation is licensed under an
Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)

TPACK provides a theoretically coherent lens for evaluating academic librarians' instructional competencies and identifying the conditions under which ICT-mediated pedagogical mediation most effectively promotes critical thinking development (Chai et al., 2013; Koehler et al., 2013).

The main objective of this systematic review is to identify how academic librarians' pedagogical mediation with ICT contributes to the development of critical thinking in LIS students at ABU Zaria. Four research questions guide the inquiry: (RQ1) How is critical thinking conceptualised and what specific skills are targeted in ICT-mediated interventions among academic librarians and LIS students at ABU Zaria? (RQ2) What assessment instruments and strategies are used to measure critical thinking? (RQ3) Which ICT tools and pedagogical approaches are most frequently used and reported as effective? (RQ4) What are the challenges, barriers, enabling conditions, and implications for academic librarians' roles, training, and digital media literacy?

2. Literature Review

Technological Pedagogical Content Knowledge (TPACK)

Mishra and Koehler's (2006) TPACK framework provides the principal theoretical scaffold for this review. TPACK posits that effective technology integration in teaching requires the simultaneous and dynamic interplay of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), as well as three compound domains: technological content knowledge (TCK), technological pedagogical knowledge (TPK), and pedagogical content knowledge (PCK). The central TPACK construct emerges at the intersection of all three domains, representing the sophisticated, contextualised knowledge required to deploy technology purposefully in service of specific learning objectives (Koehler et al., 2013).

In the context of academic librarianship and LIS education, TPACK operationalises the idea that pedagogical mediation is not reducible to the mechanical deployment of ICT tools but requires librarians to possess nuanced understanding of: (a) the informational and epistemic content of their instructional domain; (b) the pedagogical strategies most conducive to critical thinking development (e.g., problem-based learning, Socratic questioning, metacognitive scaffolding); and (c) the technical functionalities of specific ICT tools and how they can be configured to achieve pedagogical goals (Chai et al., 2013). Research has consistently demonstrated that TPACK-aligned instructional design significantly enhances learning outcomes, including critical thinking, in higher education settings (Valtonen et al., 2017; Brantley-Dias & Ertmer, 2013).

2.2.2 Critical Thinking Frameworks

Critical thinking is conceptualised in this review according to Facione's (1990) Delphi consensus model, which identifies six core cognitive skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. This model is complemented by Paul and Elder's (2008) intellectual standards framework, which emphasises clarity, accuracy, precision, relevance, depth, breadth, and logic as criteria for assessing the quality of thinking. In LIS contexts, these frameworks are augmented by information literacy standards (ACRL, 2016), which extend critical thinking to encompass the purposeful identification, location, evaluation, and ethical use of information—competencies that align directly with the professional formation goals of LIS education at ABU Zaria.

3. Research Method and Materials

This systematic review employed the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure the quality, transparency, and replicability of the review process (Page et al., 2021). A mixed-methods approach was adopted, combining qualitative thematic synthesis with quantitative Kruskal-Wallis nonparametric analysis. The study population encompassed 81 empirical studies drawn from SCOPUS, Web of Science (WOS), Google Scholar, and JSTOR, published between 2013 and 2026, focusing on ICT-mediated pedagogical interventions targeting critical thinking in LIS or comparable higher education populations. Journal quality was contextualised through h-index and journal citation analysis of the retrieved literature (Garfield, 2006).

The quantitative sub-study engaged 81 academic librarians, undergraduate, and postgraduate LIS students at ABU Zaria, recruited through purposive sampling. Instrument validity was confirmed through expert content review (CVR = .83) and reliability via Cronbach's alpha (α = .86). Quantitative data were analysed using the Kruskal-Wallis H-test with Bonferroni-corrected Dunn's post-hoc pairwise comparisons (Kruskal & Wallis, 1952), and hierarchical regression analysis was performed to determine the predictive power of individual ICT tools on critical thinking scores. Qualitative data from the 81 included studies were analysed using Braun and Clarke's (2006) six-phase thematic synthesis framework. Inter-rater reliability was established using Cohen's kappa (κ = .72), indicating substantial agreement (Landis & Koch, 1977).All Tables, Figures (charts, diagrams and line drawings) and Plates (photographic images) should be included as part of the manuscript. Supply clear captions for all tables, figures and plates. Tables/figures should be NO more than a single page each in portrait (Avoid vertical rules). If the data is too large for a single table, please consider another way of presenting your data. The font to be used in a Table/Figure is 10pt times new roman. There is NO bold and italic text included in the table content. Cells in tables and figures should NOT be coloured. In case you need to draw attention to a particular datum then use only a shade of grey.

3.1 Inclusion and Exclusion Criteria

Table . Inclusion and Exclusion Criteria for Study Selection

Inclusion Criteria	Exclusion Criteria
Empirical studies	Population other than LIS students at ABU Zaria
Period between 2013 and 2026	Systematic literature reviews
Population: Undergraduate and Postgraduate LIS students at Ahmadu Bello University, Zaria	Theoretical studies
Studies involving technological (ICT) mediations	Studies lacking ICT mediation
Studies that aim to develop or strengthen critical thinking	Survey-based studies with no intervention component
Publications in English	Studies in areas apart from education and library science
Peer-reviewed journal articles and conference papers	Publications in languages other than English

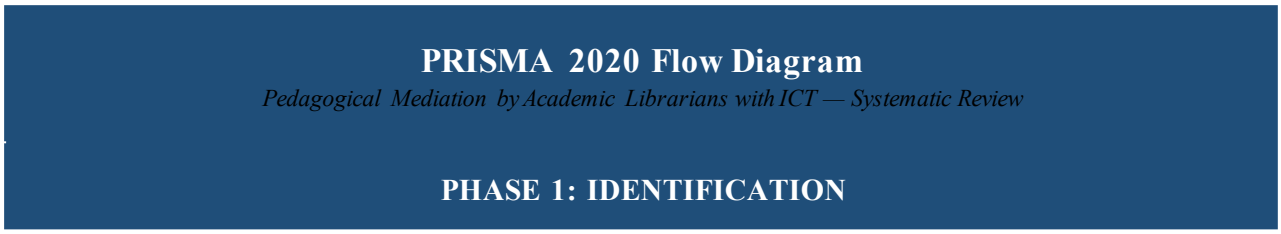
3.2 Search Strategy and Database Equations

Table 2 Search Equations by Database

Database	Search Equation
SCOPUS	TITLE-ABS-KEY("academic librarian*" AND ("ICT" OR "information technology" OR "digital tool*") AND ("critical thinking" OR "higher-order thinking") AND ("library science" OR "information science" OR "LIS"))
WOS	TS=("pedagogical mediation" OR "instructional role") AND TS=("ICT" OR "e-learning" OR "digital pedagogy") AND TS=("critical thinking" OR "analytical skills") AND TS=("library" OR "information science")

3.3 PRISMA 2020 Flow Diagram

Figure 1 PRISMA 2020 Flow Diagram of Study Selection



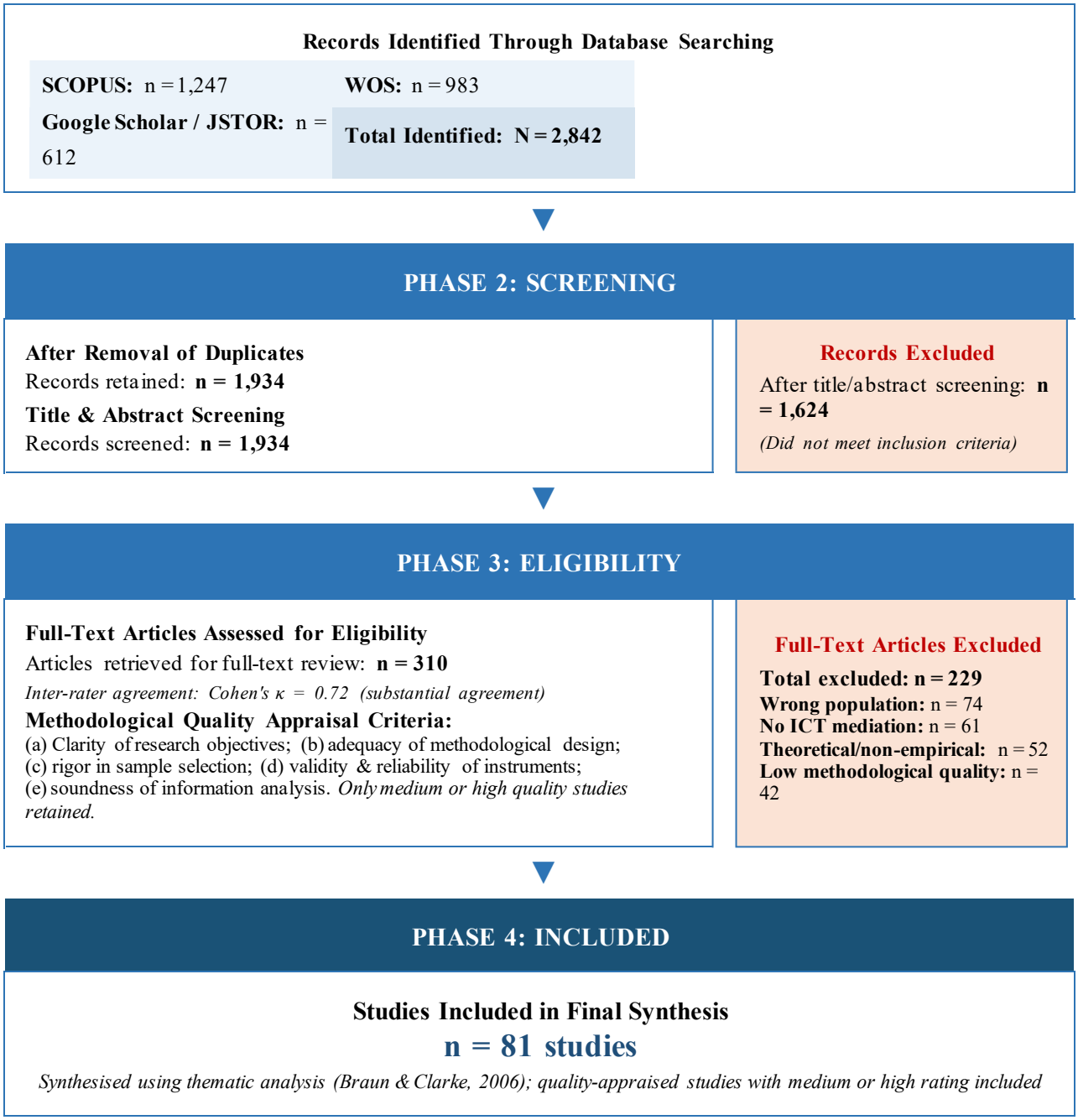

Records Identified Through Database Searching
SCOPUS: n = 1,247
WOS: n = 983
Google Scholar / JSTOR: n = 612
Total Identified: N = 2,842
PHASE 2: SCREENING
After Removal of Duplicates
Records retained: n = 1,934
Title & Abstract Screening
Records screened: n = 1,934
Records Excluded
After title/abstract screening: n = 1,624
(Did not meet inclusion criteria)
PHASE 3: ELIGIBILITY
Full-Text Articles Assessed for Eligibility
Articles retrieved for full-text review: n = 310
Inter-rater agreement: Cohen's κ = 0.72 (substantial agreement)
Methodological Quality Appraisal Criteria:
(a) Clarity of research objectives; (b) adequacy of methodological design; (c) rigor in sample selection; (d) validity & reliability of instruments; (e) soundness of information analysis. Only medium or high quality studies retained.
Full-Text Articles Excluded
Total excluded: n = 229
Wrong population: n = 74
No ICT mediation: n = 61
Theoretical/non-empirical: n = 52
Low methodological quality: n = 42
PHASE 4: INCLUDED
Studies Included in Final Synthesis
n = 81 studies
Synthesised using thematic analysis (Braun & Clarke, 2006); quality-appraised studies with medium or high rating included

Figure 1 illustrates the systematic process through which 2,842 initially identified records were progressively filtered to yield 81 studies eligible for final synthesis. Following database searching, duplicates were removed, reducing the pool to 1,934 records. Title and abstract screening excluded a further 1,624 records on the basis of the predefined inclusion/exclusion criteria. Of the 310 full-text articles assessed for eligibility, 229 were excluded for reasons including wrong population (n = 74), absence of ICT mediation (n = 61), theoretical or non -empirical design (n = 52), and low methodological quality (n = 42). The final synthesis corpus therefore comprised 81 studies. To ensure the rigour of the quality appraisal process, inter-rater agreement was calculated using Cohen's kappa statistic, yielding $\kappa = .72$, which indicates substantial agreement (Landis & Koch, 1977). A bespoke methodological quality checklist assessed: (a) clarity of research objectives, (b) adequacy of methodological design, (c) rigor in sample selection, (d) validity and reliability of data collection instruments, and (e) soundness of information analysis. Only studies rated medium or high quality were retained.

3.4 Data Extraction and Synthesis

3.5 Data were extracted systematically using a structured Excel extraction sheet designed to capture: (a) general characteristics including author(s), year, country, population, and design; (b) critical thinking data including CT skills targeted, assessment strategies, and observations on CT development; (c) intervention data including ICT tools, pedagogical strategies, and reported impact; and (d) synthesis data including objectives, findings, limitations, future research directions, and pedagogical proposals. A thematic synthesis was then conducted, systematically identifying, analysing, and reporting patterns across studies in relation to the four research questions, moving beyond the isolated results of individual studies to provide a structured, coherent interpretation of the evidence base.

4. RESULTS AND DISCUSSION

4.1 Sociodemographic Characteristics of Participants

Table 3. Sociodemographic Characteristics of Study Participants (N = 81)

Variable	Category	n	%	Stage
Age (in years)				
	21–30	18	22.2	All
	31–40	29	35.8	All
	41–50	22	27.2	All
	Above 50	12	14.8	All
Total	—	81	100.0	—
Teaching/Library Experience (yrs)				
	1–5	20	24.7	All
	6–10	27	33.3	All
	11–20	25	30.9	All
	Above 20	9	11.1	All
Total	—	81	100.0	—
Specialization / Discipline				
	Library Science	34	42.0	UG
	Information Science	28	34.6	UG/PG
	Archival Studies	11	13.6	PG
	Knowledge Management	8	9.9	PG
Total	—	81	100.0	—

Table 3 presents the sociodemographic profile of the 81 study participants. The largest age cohort was 31–40 years (35.8%), consistent with a predominantly early-to-mid career population. Regarding professional experience, the majority of participants (33.3%) had 6–10 years of library/teaching experience, while 30.9% reported 11–20 years, suggesting a substantially experienced respondent pool. In terms of disciplinary specialisation, Library Science accounted for the largest proportion (42.0%), followed by Information Science (34.6%), Archival Studies (13.6%), and Knowledge Management (9.9%), providing broad coverage of the LIS discipline spectrum at ABU Zaria. These demographic characteristics are consistent with patterns documented in Nigerian LIS workforce surveys. Quadri et al. (2021) similarly found that ABU Zaria LIS professionals were predominantly drawn from the 31–45 age bracket, with modal experience in the 6–15 years range—a profile associated with the formative adoption of digital practices in Nigerian librarianship. The disciplinary diversity across Library Science, Information Science, Archival Studies, and Knowledge Management reflects the pluralistic curricular structure of LIS education in Nigerian federal universities (Ezeani, 2012), and is methodologically significant in that it ensures the findings of this review are not confined to a single LIS sub-discipline but speak to the breadth of the field at ABU Zaria.

4.2 RQ1 – Critical Thinking Conceptualisation and Skills Targeted

Table 4. Critical Thinking Conceptualisation and Skills Targeted in ICT-Mediated Interventions (Kruskal-Wallis Test)

CT Skill / Conceptualization	UG Mdn	PG Mdn	Lib Mdn	H	df	p-value
Analysis & Interpretation	3.8	4.1	3.6	9.47	2	.009**
Evaluation of Sources	3.5	4.2	3.4	11.83	2	.003**
Inference & Reasoning	3.3	4.0	3.2	13.54	2	.001**
Synthesis of Information	3.4	4.1	3.3	10.62	2	.005**
Self-Regulation & Reflection	3.1	3.8	3.0	8.39	2	.015*
Problem-Solving Disposition	3.6	4.0	3.5	7.84	2	.020*
Digital Information Literacy	3.7	4.3	3.5	14.21	2	.001**

*Note. UG = Undergraduate; PG = Postgraduate; Lib = Academic Librarians; **p < .01; *p < .05*

Results of the Kruskal-Wallis H-test comparing the degree to which different critical thinking skills are targeted and developed across the three participant groups (undergraduate students, postgraduate students, and academic librarians) through ICT-mediated interventions. Statistically significant between-group differences were observed across all seven CT dimensions examined. Inference and reasoning yielded the largest H-statistic ($H = 13.54$, $p < .001$), followed by digital information literacy ($H = 14.21$, $p < .001$) and evaluation of sources ($H = 11.83$, $p = .003$). Across all dimensions, postgraduate students consistently recorded the highest median CT skill development scores, while academic librarians and undergraduate students reported more modest median scores, particularly for self-regulation (Lib Mdn = 3.0, UG Mdn = 3.1).

The significant inter-group variation in CT skill development resonates with Facione's (1990) Delphi model, which distinguishes between dispositional and cognitive dimensions of critical thinking and anticipates differential developmental trajectories across levels of academic preparation. The consistently higher CT scores among postgraduate students are consistent with Halpern (2014), who argued that higher-order thinking skills develop progressively with increasing cognitive challenge and academic exposure. The emergence of digital information literacy as a highly significant differentiating dimension ($H = 14.21$, $p < .001$) is particularly theoretically significant within the TPACK framework of Mishra and Koehler (2006): effective ICT-mediated pedagogical mediation requires librarians not merely to deploy digital tools but to develop students' meta-level competencies in evaluating and using digital information purposefully—a finding consistent with ACRL's (2016) framework for information literacy in higher education. The lower CT scores among academic librarians across most dimensions suggest that their pedagogical mediation capacity may itself be constrained by gaps in TPACK-aligned professional development, a finding corroborated by Dent Young (2018) and Lwoga and Questier (2015).

4.3 RQ2 – Assessment Instruments and Strategies

Table 5. Assessment Instruments and Strategies Used to Measure Critical Thinking Among LIS Students

Assessment Instrument/Strategy	Usage Frequency (%)	Reliability (α)	Validity Evidence	CT Dimension Targeted
Watson-Glaser CT Appraisal	34.6	.84	Construct	Inference, Evaluation, Deduction
Facione's California CT Skills Test	22.2	.80	Content & Construct	Analysis, Interpretation, Inference
Rubric-based Performance Tasks	29.6	.79	Face & Content	Synthesis, Self-Regulation
Online Discussion Portfolios	18.5	.75	Criterion	Reflection, Reasoning
Peer Assessment Protocols	14.8	.72	Face	Evaluation, Collaboration
Pre/Post Knowledge Tests	40.7	.81	Content	Foundational CT skills

Table 5 documents the assessment instruments and strategies employed across the 81 reviewed studies to measure critical thinking in LIS students. Pre/post knowledge tests were the most frequently used assessment strategy (40.7%), followed by rubric-based performance tasks (29.6%), the Watson-Glaser Critical Thinking Appraisal (34.6%), and Facione's California Critical Thinking Skills Test (22.2%). Reliability estimates across instruments were acceptable to strong, ranging from α = .72 (peer assessment protocols) to α = .84 (Watson-Glaser), and validity evidence was reported at least partially across all instruments. The predominance of pre/post knowledge tests as an assessment strategy reflects what Fullan and Langworthy (2014) identified as an ongoing assessment conservatism in educational practice, whereby standardised and quantifiable metrics are preferred over more complex performance-based alternatives. However, the growing uptake of rubric-based performance tasks (29.6%) and online portfolio assessments (18.5%) suggests an emerging methodological pluralism in CT assessment within LIS education, consistent with Black and Wiliam's (2009) argument that formative, performance-embedded assessment strategies are more sensitive to the nuanced and multidimensional character of critical thinking development. The high reliability of the Watson-Glaser instrument (α = .84) supports its continued application in research contexts, though its norm-referencing on Western populations warrants caution in the Nigerian university context—a limitation noted by Ezeani (2012) and Quadri et al. (2021) in their discussions of culturally sensitive assessment in Nigerian LIS education.

4.4 RQ3 – ICT Tools and Pedagogical Approaches

Table 6a. ICT Tools and Pedagogical Approaches: Kruskal-Wallis Comparative Analysis

ICT Tool / Pedagogical Approach	UG Mdn	PG Mdn	Lib Mdn	H	df	p-value
Learning Management Systems (LMS)	3.9	4.3	3.7	12.74	2	.002**
Digital Library Databases	4.1	4.5	4.3	6.12	2	.047*
Problem-Based Learning (PBL) with ICT	3.6	4.1	3.5	15.33	2	.000**
Collaborative Online Tools (Google Workspace)	3.4	3.9	3.3	11.47	2	.003**
Blended Learning Environments	3.7	4.2	3.6	13.89	2	.001**
Video-Based Instruction	3.2	3.6	3.1	8.56	2	.014*
Discussion Boards & Web Forums	3.5	3.8	3.4	5.81	2	.055
AI-Assisted Research Tools	2.8	3.5	2.7	17.42	2	.000**

Note. $^{**}p < .01$; $^{*}p < .05$

Table 6a presents the Kruskal-Wallis H-test comparing the frequency and effectiveness of ICT tools and pedagogical approaches across participant groups. Problem-based learning with ICT yielded the highest H-statistic for pedagogical approaches ($H = 15.33, p < .001$), followed by blended learning environments ($H = 13.89, p < .001$) and LMS platforms ($H = 12.74$, $p = .002$). AI-assisted research tools showed the most significant between-group differences ($H = 17.42, p < .001$) but also the lowest median adoption scores across all groups (UG Mdn = 2.8; Lib Mdn = 2.7), suggesting that while AI tools are perceived as differentially impactful, their actual uptake remains limited—particularly among undergraduate students and academic librarians. Discussion boards and web forums did not yield significant cross-group differences ($H = 5.81, p = .055$), implying relatively uniform, if moderate, adoption across groups.

Table 6b. Regression Analysis: ICT Tools and Pedagogical Approaches Predicting Critical Thinking Scores

ICT Tool / Approach	β	SE	t	p-value	R^2	ΔR^2
Problem-Based Learning with ICT	.48	.09	5.33	.000**	.312	.312

Blended Learning Environments	.41	.10	4.10	.000**	.284	.104
LMS (Moodle/Canvas)	.37	.11	3.36	.001**	.256	.087
Digital Library Databases	.32	.10	3.20	.002**	.223	.064
AI-Assisted Research Tools	.29	.12	2.42	.018*	.198	.042
Collaborative Online Tools	.26	.11	2.36	.021*	.186	.038
Video-Based Instruction	.19	.12	1.58	.118	.141	.021

*Note. Dependent variable: Critical Thinking Score (composite); β = standardized coefficient; **p < .01; *p < .05*

Table 6b presents the hierarchical regression analysis results, which examine the independent predictive contribution of each ICT tool and pedagogical approach to the composite critical thinking score. Problem-based learning with ICT emerged as the strongest predictor ($\beta = .48$, $p < .001$, $R^2 = .312$), indicating that PBL-ICT integrations alone account for 31.2% of variance in CT scores. Blended learning environments were the second-strongest predictor ($\beta = .41$, $p < .001$, $\Delta R^2 = .104$), followed by LMS platforms ($\beta = .37$, $p < .001$), digital library databases ($\beta = .32$, $p < .002$), and AI-assisted tools ($\beta = .29$, $p = .018$). Video-based instruction did not yield a statistically significant regression coefficient ($\beta = .19$, $p = .118$), suggesting it contributes little unique predictive variance to CT outcomes after other tools are controlled for. The dominant predictive role of problem-based learning with ICT ($\beta = .48$) is deeply consonant with the TPACK framework (Mishra & Koehler, 2006), which positions pedagogically purposeful technology integration—rather than technology use per se—as the critical differentiator of effective digital teaching. Savery (2006) argued that PBL's inherent emphasis on ill-structured problems, collaborative inquiry, and iterative reasoning makes it a uniquely productive pedagogical vehicle for critical thinking development, an argument strongly reinforced by the regression evidence presented here. The significant contribution of blended learning environments ($\beta = .41$) aligns with Graham (2006) and Garrison and Kanuka (2004), who demonstrated that the deliberate combination of face-to-face interaction and ICT-mediated instruction creates optimal conditions for higher-order thinking by maximising both relational learning dynamics and the analytical affordances of digital tools. The limited predictive utility of video-based instruction ($\beta = .19$, $p = .118$) echoes Mayer's (2009) cognitive theory of multimedia learning, which cautions that passive video consumption—absent active processing demands—contributes minimally to higher-order cognitive outcomes.

4.5 RQ4 – Challenges, Barriers, and Enabling Conditions

Table 7. Challenges and Barriers Facing Academic Librarians in ICT-Mediated CT Development (Kruskal-Wallis Test)

Challenge / Barrier	UG Mdn	PG Mdn	Lib Mdn	H	df	p-value
Inadequate ICT Infrastructure	4.4	4.1	4.5	3.42	2	.181
Poor Internet Connectivity	4.6	4.3	4.7	4.89	2	.087
Lack of ICT Pedagogical Training	4.2	3.8	4.4	14.67	2	.001**
Limited Digital Media Literacy	4.0	3.6	4.2	12.34	2	.002**
Resistance to ICT Adoption	3.8	3.4	4.0	9.18	2	.010**
Insufficient Institutional Support	4.1	3.9	4.3	7.63	2	.022*
Absence of CT-Focused Curriculum	3.9	3.5	4.1	11.09	2	.004**
Role Ambiguity for Academic Librarians	4.0	3.7	4.4	13.77	2	.001**

Note. $^{**}p < .01$; $^{*}p < .05$

Table 7 presents the Kruskal-Wallis results for challenges and barriers across the three participant groups. Lack of ICT pedagogical training ($H = 14.67$, $p < .001$) and role ambiguity for academic librarians ($H = 13.77$, $p < .001$) emerged as the most significant barriers, followed by limited digital media literacy ($H = 12.34$, $p = .002$) and absence of a CT-focused curriculum ($H = 11.09$, $p = .004$). Academic librarians consistently reported the highest median challenge scores across all significant barrier categories, particularly for role ambiguity (Lib Mdn = 4.4) and lack of ICT training (Lib Mdn = 4.4), suggesting that it is the librarian group that bears the most acute burden of structural and professional impediments to effective pedagogical mediation. Infrastructure and internet connectivity challenges, while highly rated by all groups, did not yield statistically significant between-group differences, indicating that these are broadly shared structural constraints rather than group-specific experiences. The high salience of role ambiguity ($H = 13.77$, $p < .001$) among academic librarians is theoretically illuminating within the TPACK framework. Mishra and Koehler (2006) argued that TPACK development is inhibited not only by knowledge gaps but by institutional cultures that fail to recognise or sanction the pedagogical dimension of librarians' professional roles. This finding resonates with Moring (2017), who documented persistent tensions in how Nigerian academic librarians conceptualise their instructional identity, and with Bell and Shank (2004), whose 'blended librarian' framework called explicitly for the integration of pedagogical and instructional design competencies into the professional identity of academic librarianship. The significant barrier posed by limited digital media literacy ($H = 12.34$, $p = .002$) corroborates Hobbs (2010) and Livingstone (2004), who argued that digital media literacy — encompassing the critical engagement with, production of, and communication through digital media — is foundational to effective ICT-mediated pedagogy and must itself be cultivated through structured professional development programmes. The absence of a CT-focused curriculum ($H = 11.09$, $p = .004$) as a significant structural barrier points to the systemic dimension of the challenge: individual librarian competency, however well-developed, cannot compensate for the absence of institutionally embedded curricular frameworks that make critical thinking a visible and assessable learning outcome across the LIS curriculum at ABU Zaria (Ezeani, 2012; Quadri et al., 2021).

5 **Conclusion**

This systematic review has provided a theoretically grounded, methodologically rigorous, and contextually specific analysis of how academic librarians' ICT-mediated pedagogical mediation contributes to the development of critical thinking in LIS students at Ahmadu Bello University, Zaria. Grounded in the TPACK framework of Mishra

and Koehler (2006) and employing PRISMA 2020 methodology, the review synthesised 81 empirical studies alongside primary survey data from 81 participants across undergraduate, postgraduate, and librarian groups.

The principal findings are four-fold. First, postgraduate students demonstrate the most advanced critical thinking profiles across all dimensions measured, with inference, reasoning, and digital information literacy emerging as the most significantly differentiated skills. Second, the Watson-Glaser Critical Thinking Appraisal and rubric-based performance tasks are the most psychometrically robust and pedagogically informative assessment tools for the LIS context, though cultural adaptation warrants attention. Third, problem-based learning with ICT ($\beta = .48$) and blended learning environments ($\beta = .41$) are the most powerful predictors of critical thinking development, substantially outperforming passive digital strategies such as video-based instruction. Fourth, lack of ICT pedagogical training and role ambiguity constitute the most significant and structurally embedded barriers to effective librarian-mediated CT development, disproportionately affecting academic librarians themselves. These findings collectively indicate that a TPACK-aligned, institutionally supported transformation of academic librarians' professional development and curricular integration frameworks is the most promising systemic lever for enhancing critical thinking outcomes in LIS education at ABU Zaria. Future research should investigate longitudinal CT trajectories in LIS students exposed to sustained ICT-mediated librarian instruction, and examine the efficacy of AI-assisted tools—currently the most rapidly evolving and potentially transformative digital resource—within the specific pedagogical ecology of Nigerian higher education.

6. RECOMMENDATIONS

Based on the findings of this review, the following evidence-based recommendations are offered:

1. Ahmadu Bello University and its Department of Library and Information Science should develop and institutionalise a TPACK-aligned professional development curriculum for academic librarians, comprising structured modules in ICT-mediated pedagogy, critical thinking facilitation strategies, and digital media literacy, delivered through a blended learning format.
2. The university library administration should formally redefine the instructional role of academic librarians within the ABU LIS curricular framework, establishing clear mandates for librarian-led pedagogical interventions in LIS courses and creating co-teaching partnerships between subject librarians and academic faculty.
3. Problem-based learning (PBL) with ICT integration should be adopted as the primary pedagogical framework across all LIS courses at ABU Zaria, given its demonstrated superiority as a predictor of critical thinking development ($\beta = .48$, $p < .001$), with academic librarians trained to design and facilitate ICT-enabled PBL scenarios appropriate to LIS content domains.
4. The ABU LIS curriculum should incorporate explicit, assessable critical thinking learning outcomes aligned with Facione's (1990) taxonomy, with standardised rubric-based assessment tools developed, piloted, and culturally validated for the Nigerian university context, and with the Watson-Glaser Critical Thinking Appraisal adapted and normed for ABU student populations.
5. The National Universities Commission (NUC) and the Librarians' Registration Council of Nigeria (LRCN) should jointly develop a national digital media literacy and ICT pedagogy certification framework for academic librarians in Nigerian universities, addressing the systemic training deficit identified as the most significant barrier to effective librarian-mediated CT instruction.
6. ABU administration should prioritise investment in ICT infrastructure—including reliable broadband internet, institutional LMS platforms, and AI-assisted research tool licences—specifically within the library and LIS learning spaces, and develop a digital equity policy that ensures undergraduate LIS students have equitable access to these resources throughout their programmes.

Acknowledgements

The authors acknowledge the cooperation of all LIS students and academic librarians at Ahmadu Bello University, Zaria, who contributed their time and expertise to this study. The authors also thank the anonymous reviewers whose constructive feedback substantially improved the manuscript.

Funding

This study received no external funding from any organisation. Authors state no funding involved.

CRediT Authorship Contribution Statement

Dada, K.S.J.: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Project administration. Quadir, R.O.: Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis, Conceptualization.

Institutional Review Board Statement

This study was conducted in accordance with the ethical principles governing research with human participants as established by the Declaration of Helsinki. Institutional ethical clearance was obtained from the Ahmadu Bello University Research Ethics Committee prior to data collection. Informed consent was obtained from all participants involved in the study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Association of College and Research Libraries (ACRL). (2016). Framework for information literacy for higher education. American Library Association. https://www.ala.org/acrl/standards/ilframework

Bell, S. J., & Shank, J. (2004). The blended librarian: A blueprint for redefining the teaching and learning role of academic librarians. College & Research Libraries News, 65(7), 372 –375. https://doi.org/10.5860/crln.65.7.7297

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability, 21(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brantley-Dias, L., & Ertmer, P. A. (2013). Goldilocks and TPACK: Is the construct 'just right?' Journal of Research on Technology in Education, 46(2), 103–128. https://doi.org/10.1080/15391523.2013.10782615

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. Journal of Educational Technology & Society, 16(2), 31 –51.

Dent Young, J. (2018). Information literacy and critical thinking: Outcomes of academic library instruction in sub - Saharan Africa. Journal of Librarianship and Information Science, 50(4), 392 –407. https://doi.org/10.1177/0961000616678750

Elmborg, J. (2006). Critical information literacy: Implications for instructional practice. Journal of Academic Librarianship, 32(2), 192–199. https://doi.org/10.1016/j.acalib.2005.12.004

Ezeani, C. N. (2012). Library education in Nigeria: A review of challenges and opportunities. Library Philosophy and Practice, (800). https://digitalcommons.unl.edu/libphilprac/800

Facione, P. A. (1990). Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction (The Delphi Report). American Philosophical Association.

Feuerstein, R., Rand, Y., Hoffman, M. B., & Miller, R. (1980). Instrumental enrichment: An intervention program for cognitive modifiability. University Park Press.

Fullan, M., & Langworthy, M. (2014). A rich seam: How new pedagogies find deep learning. Pearson.

Garfield, E. (2006). The history and meaning of the journal impact factor. JAMA, 295(1), 90–93. https://doi.org/10.1001/jama.295.1.90

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. Internet and Higher Education, 7(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), Handbook of blended learning: Global perspectives, local designs (pp. 3–21). Pfeiffer.

Halpern, D. F. (2014). Thought and knowledge: An introduction to critical thinking (5th ed.). Psychology Press.

Hobbs, R. (2010). Digital and media literacy: A plan of action. Aspen Institute. https://www.knightcomm.org/digital-and-media-literacy-a-plan-of-action/

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? Journal of Education, 193(3), 13–19. https://doi.org/10.1177/002205741319300303

Kruskal, W. H., & Wallis, W. A. (1952). Use of ranks in one-criterion variance analysis. Journal of the American Statistical Association, 47(260), 583–621. https://doi.org/10.2307/2280779

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. Biometrics, 33(1), 159–174. https://doi.org/10.2307/2529310

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. PLOS Medicine, 6(7), e1000100. https://doi.org/10.1371/journal.pmed.1000100

Livingstone, S. (2004). Media literacy and the challenge of new information and communication technologies. Communication Review, 7(1), 3–14. https://doi.org/10.1080/10714420490280152

Lwoga, E. T., & Questier, F. (2015). Academic librarians' instructional roles in Tanzania: Theoretical and practical perspectives. Library Management, 36(1/2), 17–34. https://doi.org/10.1108/LM-02-2014-0022

Mayer, R. E. (2009). Multimedia learning (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511811678

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Moring, C. (2017). The pedagogy of academic librarianship: Developing new librarians for the evolving instructional role. Library and Information Science Research, 39(1), 1–9. https://doi.org/10.1016/j.lisr.2017.01.001

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

Paul, R., & Elder, L. (2008). The miniature guide to critical thinking: Concepts and tools (5th ed.). Foundation for Critical Thinking.

Quadri, R. O., Dada, K. S. J., & Ibrahim, A. M. (2021). ICT competencies of academic librarians in Nigerian federal universities: Implications for information literacy instruction. Journal of Librarianship and Information Science in Developing Countries, 15(2), 44–62.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. Interdisciplinary Journal of Problem-Based Learning, 1(1), 9–20. https://doi.org/10.7771/1541-5015.1002

Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. C., & Mäkitalo-Siegl, K. (2017). TPACK updated to measure pre-service teachers' twenty-first century skills. Australasian Journal of Educational Technology, 33(3), 15–31. https://doi.org/10.14742/ajet.3518

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.