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Reframing LIS Education for the AI-Data Era: An Integrated Competency Model for Data Literacy, Computational Thinking and Digital Scholarship

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Abstract

Library and information science (LIS) education is being reshaped by the convergence of artificial intelligence (AI), data-intensive research, computational methods and digitally mediated scholarship. Traditional competency models remain important because information evaluation, ethics, user orientation and professional judgment continue to underpin LIS practice, but they are no longer sufficient on their own. This conceptual research paper synthesises recent peer-reviewed literature and professional competency frameworks to develop an integrated model for LIS education and continuing professional development. The review focuses on three interlocking domains: data and AI literacy, computational thinking, and digital scholarship. Evidence indicates that the emerging competency gap is not simply a deficit of technical skills. Rather, it is a coordination problem in which technical capability, critical evaluation, ethical reasoning, research support and collaborative practice must be developed together. Recent LIS scholarship identifies uneven AI-literacy provision, gaps in applied data skills, continuing demand for research data management capabilities, and strong employer expectations for digital scholarship competence. On this basis, the paper proposes a three-stage progression model—understand, apply, and create/lead—supported by an interdisciplinary curriculum and authentic assessment. The paper argues that LIS programmes should move from isolated technology modules toward integrated learning experiences in which data, AI, computational thinking and digital scholarship are applied to real research and information-service problems.

Keywords: library and information science education; AI literacy; data literacy; computational thinking; digital scholarship; professional competencies; academic libraries.

1. Introduction

Library and information science is historically concerned with the organisation, evaluation, preservation and use of knowledge. Those responsibilities remain stable, but the information environments in which they are performed have changed materially. Academic libraries now operate alongside algorithmic discovery systems, machine-generated text and images, research data infrastructures, digital repositories, computational research methods and networked scholarly communication. The result is a profession in which information practice increasingly requires the ability to reason across people, data, models, platforms and research workflows rather than only across collections and users (Cox, 2023; Dube, Rammutloa and Matatiele, 2024).

This transformation is visible in professional competency documents. The Association of College and Research Libraries' 2025 AI competencies organise library-worker capability around ethical considerations, knowledge and understanding, analysis and evaluation, and use and application (Association of College and Research Libraries, 2025). The structure is significant because it treats AI literacy as more than tool operation: it embeds critical evaluation, privacy, fairness, accountability and context-sensitive adoption. This orientation extends the ACRL information literacy tradition, in which authority, creation, value, inquiry, conversation and strategic exploration are treated as interconnected conceptual practices rather than isolated skills (Association of College and Research Libraries, 2016).

Recent empirical and review evidence also indicates that LIS education is uneven in its response. Bridges et al. (2025) identify fragmentation and institutional variation in the integration of critical AI literacy within LIS curricula. Oladokun and Umar (2026) similarly find a distinction between broad awareness of AI and the deeper practical, analytical and technical competencies needed for effective application. Montesi et al. (2025) show that AI literacy can be operationalised as a measurable LIS construct, while Deshen and Aharony (2026) demonstrate that AI literacy among information professionals is now sufficiently mature to warrant focused educational attention.

The central argument of this paper is therefore not that LIS should become a computing discipline. Rather, LIS education should develop a connected competency architecture in which technical literacy is embedded within the profession's established commitments to evidence, context, ethics, access and human judgment. Data and AI literacy provide the ability to understand and interrogate computational information systems; computational thinking provides a disciplined way of decomposing and automating information problems; and digital scholarship provides the research context in which these capabilities become professionally meaningful.

Research gap and contribution

Although recent studies have examined AI literacy, data literacy, computational thinking and digital scholarship separately, the literature remains fragmented across competency studies, curriculum analyses and professional frameworks. The specific gap addressed here is therefore integrative: there is limited LIS-focused synthesis showing how these capabilities can be developed as a connected competency architecture and assessed across progressive levels of practice. The paper contributes a conceptual model that links the four domains to curriculum design, authentic assessment and continuous workplace feedback. The model is intended as a transferable framework rather than a claim that all LIS programmes should adopt an identical curriculum.

2. Review approach and analytical framework

This study uses an integrative conceptual review rather than a meta-analysis or a systematic review intended to estimate pooled effects. The evidence base prioritises peer-reviewed LIS, academic-library and information-science research, especially publications from 2020 onward, supplemented by seminal studies and authoritative professional frameworks where they remain conceptually foundational. Sources were included when they directly addressed LIS education, AI literacy, data literacy, computational thinking, digital scholarship or closely related academic-library competencies; vendor material, promotional sources and literature without a direct conceptual connection to the paper were not treated as core evidence. The synthesis is thematic and interpretive because the underlying studies use heterogeneous populations, constructs and research designs. Professional frameworks from ACRL and UNESCO are treated as normative competency references, while peer-reviewed studies provide the principal evidence base for identifying recurring needs, gaps and educational implications.

Research questions guiding the synthesis are: RQ1, which capabilities are becoming core to contemporary LIS work; RQ2, how are data literacy, AI literacy, computational thinking and digital scholarship related; RQ3, what educational design features can convert these capabilities from awareness to practice; and RQ4, how can LIS programmes assess progression without reducing complex professional competencies to tool-specific checklists? These questions structure the synthesis and the conceptual framework presented in Figures 1-3.

Table 1. Evidence base informing the proposed competency architecture

Evidence stream	**Representative literature**	**Contribution to the model**
AI literacy in LIS	Montesi et al. (2025); Bridges et al. (2025); Deshen and Aharony (2026); Oladokun and Umar (2026)	Defines AI knowledge, critical evaluation, ethical use and applied competencies as distinct but connected capabilities.
Data literacy	Pothier and Condon (2020); Pinto et al. (2024); Dube, Rammutloa and Matatiele (2024)	Extends information literacy toward data provenance, quality, interpretation, communication and workplace use.

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Evidence stream	Representative literature	Contribution to the model
Computational thinking	Wing (2006); Weintrop, Morehouse and Subramaniam (2021); Subramaniam et al. (2018)	Supports decomposition, abstraction, algorithmic reasoning and assessment of computational practices.
Digital scholarship	King (2018); Sibiya and Ngulube (2023); Dube, Rammutloa and Matatiele (2024)	Positions librarians as research partners supporting data, digital methods, scholarly communication and research workflows.
Professional frameworks	ACRL (2016; 2025); UNESCO (2024)	Anchors competency progression in information literacy, human-centred AI, ethics and professional judgment.

Source: Authors' synthesis based on the cited literature.

3. Data literacy as an LIS core capability

Data literacy is best understood as an extension of information literacy into environments in which evidence is represented, transformed and interpreted through structured data. Pothier and Condon (2020) identify data literacy competencies that connect classroom learning to workforce needs, while related workplace-oriented literature emphasises that effective data literacy combines technical and non-technical capabilities rather than data analysis in isolation (Pothier and Condon, 2020). Within LIS, this distinction matters because librarians frequently mediate data rather than simply analyse it: they help users discover datasets, understand metadata, evaluate provenance, interpret contextual limitations, cite data and manage research outputs.

Assessment literature also suggests that data literacy remains difficult to define and measure consistently. Pinto et al. (2024) review approaches to information, media and data literacy assessment and show the field's diversity of tools, indicators and conceptualisations. For LIS education, the implication is that a generic "data skills" module may not be sufficient. Students need explicit practice with the information lifecycle of data—creation, description, quality assessment, analysis, preservation, access and reuse—alongside reflection on uncertainty, bias and context.

A strong LIS data-literacy curriculum should therefore include data provenance and documentation, metadata and standards, basic descriptive analysis, visual interpretation, data quality evaluation, privacy and ethical considerations, citation and attribution, and the communication of data findings to non-specialist audiences. The goal is not to create specialist data scientists in every LIS programme, but to ensure graduates can participate confidently in data-intensive scholarly and service environments and know when deeper technical expertise is required.

4. AI literacy: from tool familiarity to critical professional judgment

AI literacy is rapidly becoming a professional requirement because AI now enters the information lifecycle at multiple points: discovery, recommendation, text generation, summarisation, classification, metadata enhancement, reference assistance and research analysis. Cox (2023) argues that AI is likely to change the jurisdiction and competency profile of academic library work, while the 2025 ACRL competency framework formalises a broader model that includes ethics, understanding, analysis and evaluation, and application (Association of College and Research Libraries, 2025).

The recent evidence suggests that AI literacy should not be equated with prompt writing. Montesi et al. (2025) develop AILIS 1.0 specifically because AI literacy in LIS is a distinct construct requiring systematic measurement. Bridges et al. (2025) report curricular fragmentation, while Oladokun and Umar (2026) identify a recurring gap between conceptual awareness and practical mastery. Deshen and Aharony (2026) further position AI literacy as a contemporary professional competence rather than an optional technology interest.

A recent scoping review of AI-literacy guidance for academic libraries likewise shows that professional organisations are developing guidance and policy resources, while also identifying the need for library professionals themselves to become more AI-literate (Ali and Richardson, 2025). This supports an education model that combines user-facing AI literacy with professional capability rather than treating AI as a narrow productivity tool.

Accordingly, the educational target should include at least five capabilities: understanding how common AI systems work at a conceptual level; critically evaluating outputs for accuracy, bias and authority; understanding privacy, copyright, attribution and data governance; selecting and applying AI tools to appropriate information tasks; and communicating AI limitations and decisions to users and institutional stakeholders. UNESCO's competency frameworks reinforce the importance of human-centred thinking, ethics, technical foundations and creation-oriented progression (UNESCO, 2024). These principles are highly compatible with LIS values because they position the professional as an informed intermediary rather than a passive adopter.

5. Computational thinking as the bridge between literacy and practice

Computational thinking is often misunderstood as synonymous with programming. Wing (2006) instead describes a broader way of formulating problems and solutions using concepts that can be carried out by an information-processing agent. In LIS, this matters because many contemporary professional tasks involve processes that are structured, iterative and potentially automatable. Examples include metadata transformations, data cleaning, text analysis, digital collection workflows, information retrieval pipelines and reproducible research support.

Library research shows that computational thinking can be brought into library education and programming through graduate curriculum design and through assessment of library-based learning activities (Subramaniam et al., 2018; Weintrop, Morehouse and Subramaniam, 2021). The evidence also indicates that practitioners can struggle to assess computational thinking when the construct is introduced without clear learning outcomes. The implication for LIS education is to frame computational thinking in domain-specific terms: decomposition of a complex information problem; abstraction of relevant features; recognition of patterns; stepwise procedural reasoning; evaluation of algorithmic outputs; and iterative testing.

The professional value of this approach is cumulative. A librarian who understands data but cannot structure a workflow may be limited to manual mediation. A librarian who can code but cannot evaluate the epistemic quality of the data may automate poor decisions. Computational thinking therefore functions as connective tissue between data and AI literacy and the practical work of digital scholarship.

6. Digital scholarship as the applied research context

Digital scholarship expands the locus of library work from collections toward research processes, methods and infrastructures. King (2018) identifies collaboration, technical competence and interdisciplinary work as central to digital scholarship librarianship. Sibiya and Ngulube (2023) provide empirical evidence from South Africa that employers expect LIS graduates to understand digital scholarship activities, research data management and digital publication ecosystems. Dube, Rammutloa and Matatiele (2024) similarly show the breadth of emerging technology-related competencies required of academic librarians.

Digital scholarship should therefore be treated as an integrative domain rather than a specialist elective. It includes research data management, digital curation, repository workflows, digital humanities methods, metadata, scholarly communication, research impact and collaboration with researchers. The value of the library in this environment lies partly in its ability to connect infrastructure with human support: helping researchers choose appropriate repositories, manage research objects, document workflows, interpret metadata standards and communicate results.

Because digital scholarship is inherently collaborative, curriculum design should expose students to authentic interdisciplinary problems. Joint projects with research offices, digital humanities centres, data services or faculty researchers can provide realistic contexts in which data literacy, AI literacy and computational thinking become operational rather than theoretical.

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The resulting competency architecture is summarised in Figure 1.

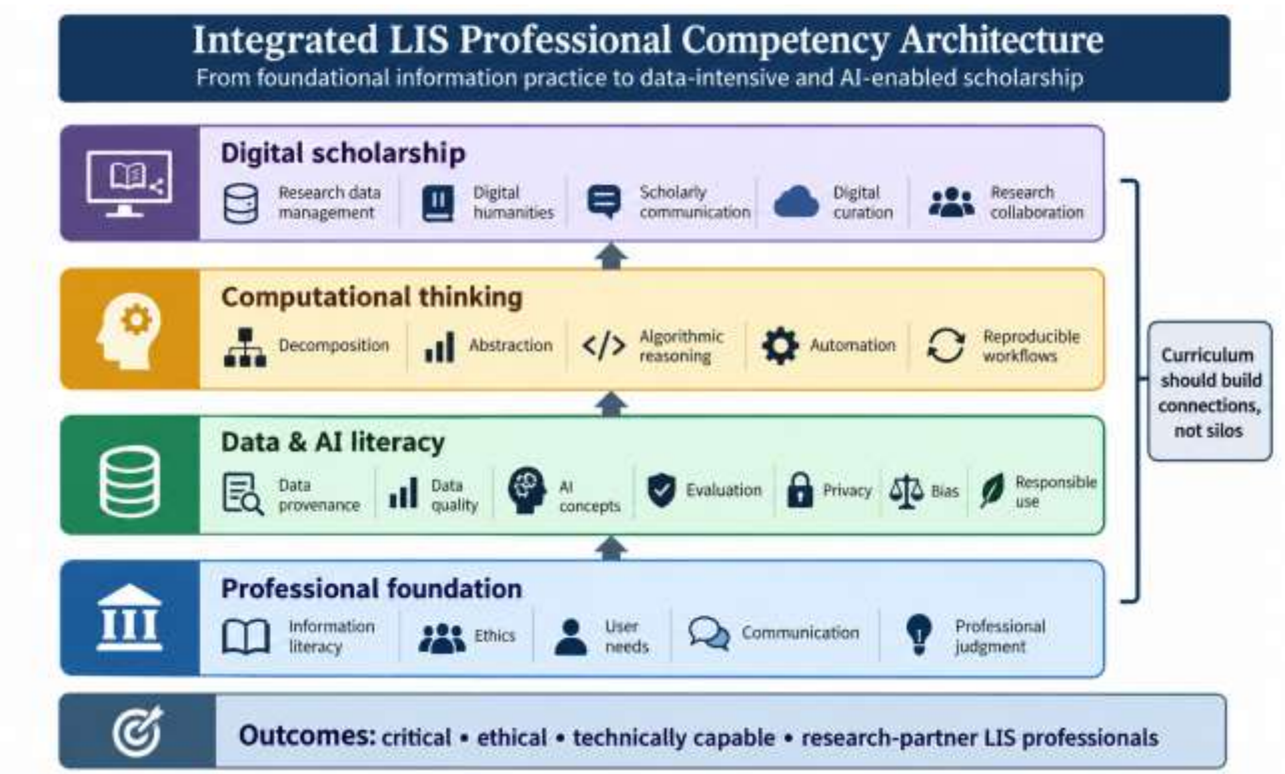

Figure 1. *Integrated LIS professional competency architecture linking foundational information practice with data and AI literacy, computational thinking and digital scholarship.*

Source: *Authors' synthesis based on ACRL (2016, 2025), Cox (2023), Montesi et al. (2025), Bridges et al. (2025), King (2018) and Sibiya and Ngulube (2023).*

Table 2. *Proposed integrated competency matrix for LIS programmes*

Domain	**Knowledge**	**Applied skill**	**Professional disposition**

Domain	Knowledge	Applied skill	Professional disposition
Data literacy	Data lifecycle, metadata, provenance, quality, uncertainty	Find, document, clean, interpret, visualise and communicate data	Curiosity, scepticism, transparency and respect for context
AI literacy	AI concepts, models, limitations, bias, policy and governance	Evaluate, select, prompt, verify and document AI-supported work	Critical judgment, ethical awareness and human-centred decision making
Computational thinking	Abstraction, decomposition, patterns, algorithms and iteration	Translate information problems into structured workflows and prototypes	Problem-solving, experimentation and tolerance for iteration
Digital scholarship	Research lifecycle, digital objects, RDM, repositories, scholarly communication	Co-design research support, curation, metadata and collaborative services	Partnership, interdisciplinarity, service orientation and continuous learning

Source: *Authors' synthesis informed by Wing (2006), Pothier and Condon (2020), King (2018), ACRL (2016, 2025) and recent LIS competency studies.*

7. A three-stage progression model

The central pedagogical challenge is moving learners from awareness to competent application and then to leadership. A three-stage progression can provide a common architecture across programmes and continuing professional development. The first stage, understand, establishes the conceptual vocabulary and ethical foundations. The second, apply, places learners in authentic tasks where tools, workflows and evaluative judgments are required. The third, create/lead, asks learners to design new services, policies, research workflows or learning interventions and to justify those choices with evidence.

This model avoids reducing competence to a list of products. Specific tools will change rapidly; transferable reasoning practices are more durable. For example, learning to evaluate model provenance and output reliability remains valuable even when one generative AI platform is replaced by another. Similarly, learning to document datasets and workflows remains relevant as repository technologies evolve. Figure 2 translates this progression into a cross-domain learning architecture.

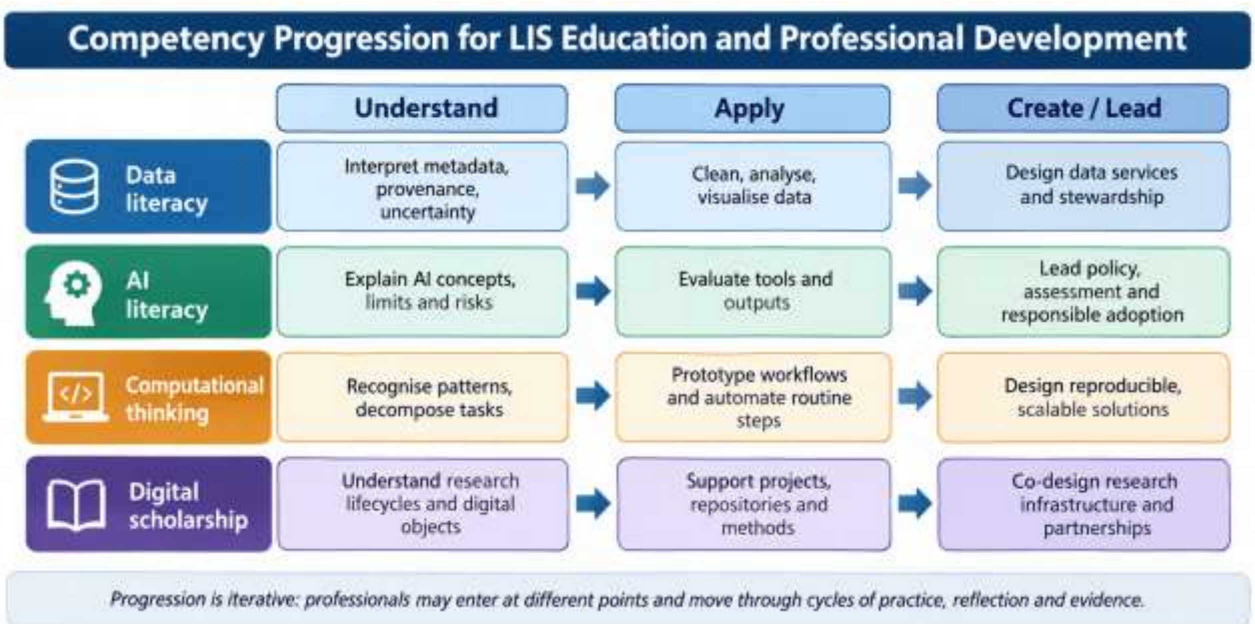

Figure 2. *Competency progression model from understanding to application and creation/leadership across the four domains.*

Source: *Authors' synthesis drawing on ACRL (2025), UNESCO (2024), Montesi et al. (2025), Pothier and Condon (2020), and Wing (2006).*

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8. Curriculum design implications

LIS programmes should resist the temptation to add a separate technology subject for every emerging tool. Instead, institutions can redesign existing modules so that new competencies are distributed across the programme. Information literacy modules can incorporate data quality and AI evaluation; research methods can incorporate computational workflows and reproducibility; cataloguing and metadata courses can incorporate data modelling and machine-assisted metadata evaluation; scholarly communication can incorporate repository deposit, open licensing and research metrics; and fieldwork can include digital service design.

Assessment should likewise move beyond examinations that test definitions. Suitable evidence includes annotated workflows, data-management plans, critically evaluated AI outputs, small computational prototypes, repository metadata packages, digital scholarship project plans and reflective portfolios. Such artefacts make competence visible and allow students to show not only what they can do, but how they know that what they did was appropriate.

Employer and researcher participation is another important design principle. Sibiya and Ngulube (2023) show the value of employer perspectives in identifying digital scholarship requirements, while Dube, Rammutloa and Matatiele (2024) demonstrate the breadth of technology competencies appearing in current library work. Regular curriculum review panels involving library employers, research-support staff and researchers can therefore serve as a practical feedback mechanism.

Figure 3 positions that curriculum model within a continuous feedback cycle between education and workplace requirements.

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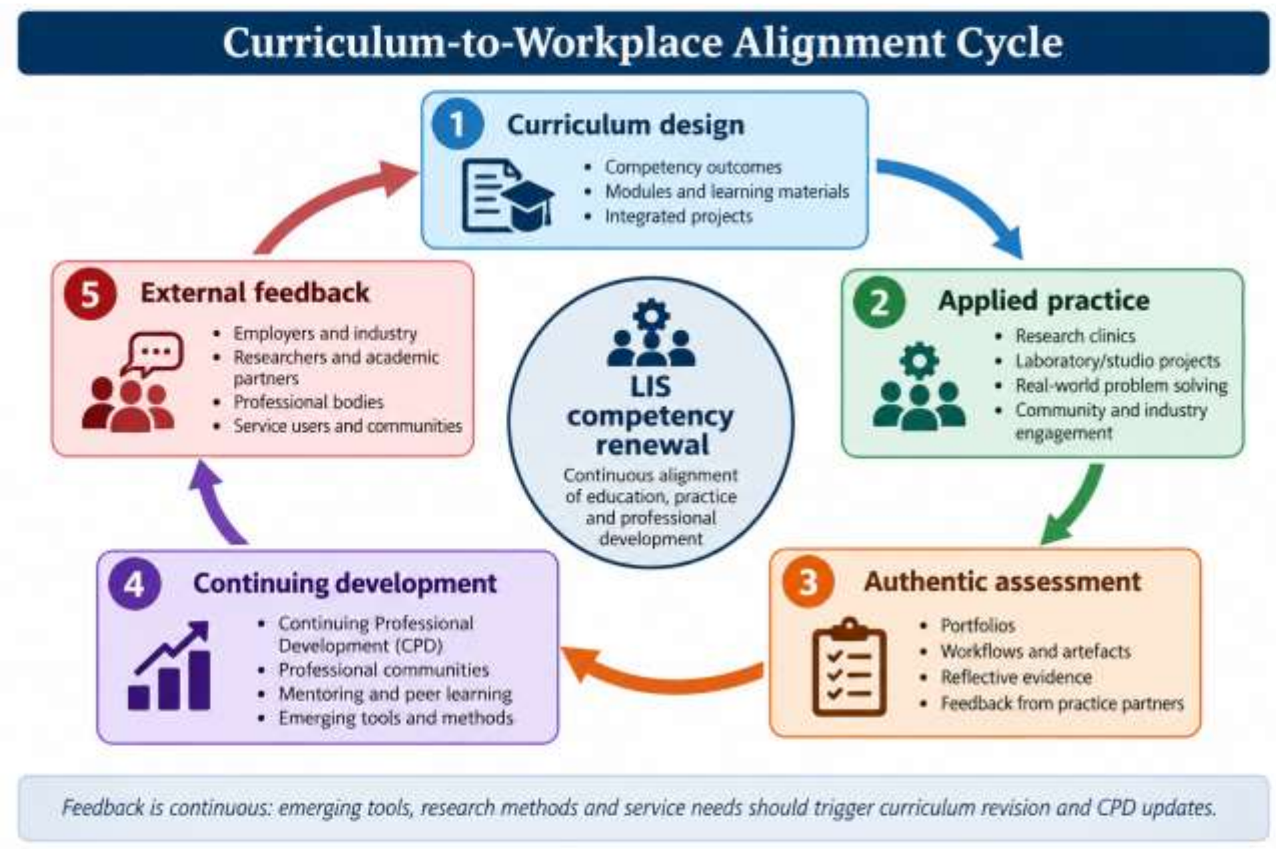

Figure 3. *Curriculum-to-workplace alignment cycle for continuous competency renewal in LIS education and professional development.*

Source: *Authors' synthesis based on Sibiya and Ngulube (2023), Dube, Rammutloa and Matatiele (2024), and the competency frameworks of ACRL (2016, 2025).*

Table 3. *Assessment evidence aligned to competency progression*

Level	Indicative assessment evidence	What should be judged

Level	Indicative assessment evidence	What should be judged
Understand	Concept map; short critical review; AI/data evaluation exercise	Conceptual accuracy, ethical awareness and ability to identify limitations
Apply	Research-data plan; verified AI-assisted literature workflow; metadata or computational task	Process quality, reproducibility, evidence use and contextual judgment
Create / Lead	Service prototype; policy proposal; digital scholarship project; curriculum intervention	Integration, stakeholder reasoning, governance, scalability and reflective justification

Source: *Authors' proposed assessment framework.*

9. Discussion

The literature suggests that the future LIS competency problem is not solved by simply increasing the volume of technical content. Three deeper issues must be addressed. First, competencies are interdependent. Data literacy without AI literacy can leave professionals unable to interrogate automated interpretation; AI literacy without information literacy can reduce critical evaluation to tool-specific advice; computational thinking without ethical reasoning can optimise processes without adequate attention to consequences; and digital scholarship without technical fluency can confine the library to reactive support roles.

Second, the evidence points to uneven institutional capacity. Bridges et al. (2025) identify fragmentation in AI literacy curricula, while Oladokun and Umar (2026) identify infrastructure, training and curriculum-related barriers. This means that a competency framework should be used as a shared reference while permitting local implementation. Programmes need not become identical, but they should make their intended capability profile explicit and assess whether students actually reach it.

Third, the profession must preserve human judgment as technology becomes more capable. The 2025 ACRL framework explicitly warns against indiscriminate adoption and emphasises context, ethics, accessibility and professional values (Association of College and Research Libraries, 2025). This is particularly important in LIS because the profession mediates not only information retrieval but trust, evidence and access. Professional competence in the AI era therefore involves the capacity to decide when not to use a tool as much as the capacity to use one effectively.

A limitation of the present paper is that it is a conceptual synthesis rather than a new empirical study. The proposed model should therefore be empirically tested across LIS programmes in different countries, with longitudinal assessment of learning outcomes and employer satisfaction. Future research should also investigate how competency requirements vary across academic, public, special and school library contexts.

10. Conclusion

LIS education is entering a period in which professional competence is increasingly defined at the intersection of information, data, algorithms and research infrastructure. The evidence reviewed here indicates a clear need to connect data and AI literacy, computational thinking and digital scholarship rather than teaching them as separate technology topics. An integrated curriculum should retain the profession’s foundations in ethics, evidence, user needs and critical evaluation while expanding the ability to work with data, assess AI systems, structure computational workflows and collaborate in digital research.

The proposed model provides a practical architecture: establish conceptual understanding, build competence through authentic application, and develop the capacity to create or lead services and policies. For LIS schools and professional-development providers, the immediate priority is not to predict every future tool. It is to develop graduates who can learn new tools quickly, interrogate their limitations, document their decisions, and connect technology to the enduring purposes of librarianship and information stewardship.

References

- Ali, M.Y. and Richardson, J. (2025) 'AI literacy guidelines and policies for academic libraries: a scoping review', IFLA Journal, 51(3), pp. 588-599. doi:10.1177/03400352251321192.
- Association of College and Research Libraries (2016) Framework for information literacy for higher education. Chicago, IL: American Library Association. Available at: https://www.ala.org/acrl/standards/ilframework (Accessed: 27 September 2026).
- Association of College and Research Libraries (2025) AI competencies for academic library workers. Chicago, IL: American Library Association. Available at: https://www.ala.org/acrl/standards/ai (Accessed: 27 September 2026).
- Bridges, L., Lopezosa, C., Centelles Velilla, M. and Ferran-Ferrer, N. (2025) 'Moving towards critical AI literacy in LIS education: a scoping review and syllabi analysis', The Electronic Library, 43(5), pp. 798-817. doi:10.1108/EL-06-2025-0224.
- Cox, A.M. (2023) 'How artificial intelligence might change academic library work: applying the competencies literature and the theory of the professions', Journal of the Association for Information Science and Technology, 74(3), pp. 367-380. doi:10.1002/asi.24635.
- Deshen, M. and Aharony, N. (2026) 'Librarians' and information science professionals' artificial intelligence literacy: an exploratory study', Journal of Education for Library and Information Science, 67(2), pp. 128-148. doi:10.3138/jelis-2025-0010.
- Dube, T.V., Rammutloa, M.W. and Matatiele, R. (2024) 'Skills and competencies of academic librarians to use information technology tools in the digital era: a systematic literature review', Information Development. doi:10.1177/02666669241302054.
- King, M. (2018) 'Digital scholarship librarian: what skills and competences are needed to be a collaborative librarian', The International Information & Library Review, 50(1), pp. 40-46. doi:10.1080/10572317.2017.1422898.
- Montesi, M., Álvarez Bornstein, B., Bautista Puig, N., Blázquez Ochando, M. and Sánchez Díez, A. (2025) 'AILIS 1.0: a new framework to measure AI literacy in library and

information science (LIS)', The Journal of Academic Librarianship, 51(5), 103118. doi:10.1016/j.acalib.2025.103118.

- Oladokun, B.D. and Umar, L. (2026) 'Artificial intelligence skills and competencies among librarians in 5IR libraries: systematic review', Information Services & Use, 45(3-4), pp. 201-214. doi:10.1177/18758789261418488.
- Pinto, M., Garcia-Marco, J., Caballero, D., Manso, R., Uribe, A. and Gomez, C. (2024) 'Assessing information, media and data literacy in academic libraries: approaches and challenges in the research literature on the topic', The Journal of Academic Librarianship, 50(5), 102920. doi:10.1016/j.acalib.2024.102920.
- Pothier, W.G. and Condon, P.B. (2020) 'Towards data literacy competencies: business students, workforce needs, and the role of the librarian', Journal of Business & Finance Librarianship, 25(3-4), pp. 123-146. doi:10.1080/08963568.2019.1680189.
- Sibiya, P.T. and Ngulube, P. (2023) 'Perceptions of employers in South Africa on library and information science graduates' skills, knowledge and competencies on digital scholarship', Heliyon, 9(2), e13531. doi:10.1016/j.heliyon.2023.e13531.
- Subramaniam, M., Johnston, M.P., Greene Taylor, N., Moore, J., Magee, R.M., Drouillard, C. and Sanchez, J. (2018) 'Expanding LIS youth services curriculum to embed computational thinking', Proceedings of the 2018 ALISE Annual Conference, pp. 207-210.
- UNESCO (2024) AI competency framework for students. Paris: UNESCO. doi:10.54675/JKJB9835.
- UNESCO (2024) AI competency framework for teachers. Paris: UNESCO. doi:10.54675/ZJTE2084.
- Weintrop, D., Morehouse, S. and Subramaniam, M. (2021) 'Assessing computational thinking in libraries', Computer Science Education, 31(2), pp. 290-311. doi:10.1080/08993408.2021.1874229.
- Wing, J.M. (2006) 'Computational thinking', Communications of the ACM, 49(3), pp. 33-35. doi:10.1145/1118178.1118215.