



## INTERNATIONAL JOURNAL OF APPLIED TECHNOLOGIES IN LIBRARY AND INFORMATION MANAGEMENT

<http://www.jatlim.org>

International Journal of Applied Technologies in Library and Information Management 12 (1) 10 - 101 - 108

ISSN: (online) 2467 - 8120

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Manuscript Number: JATLIM - 2026-12.01/101 - 108

### Computer and Operating System Fundamentals in Library and Information Science: Concepts, Applications, and Professional Implications

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#### *Abstract*

*The continuous dependent on digital technologies has transformed libraries into complex information environments sustained by computing infrastructures. Within this context, computer and operating system fundamentals have become central to contemporary Library and Information Science, shaping how information is managed, accessed, secured, and preserved. This article examines the conceptual foundations of computers and operating systems and situates them within library practice, education, and professional responsibility. Drawing on recent Library and Information Science and information systems literature, the study adopts a conceptual and practice-oriented approach to explore how operating systems underpin core library functions, networked services, and digital platforms. The analysis highlights the role of operating system knowledge in supporting system reliability, ethical data management, and effective collaboration between librarians and technical personnel. Rather than treating computing as a purely technical domain, the article positions foundational system knowledge as a form of professional literacy essential to contemporary librarianship. The discussion further considers implications for library education and continuing professional development, emphasizing the importance of integrating conceptual understanding alongside application-based training. In environments characterised by rapid technological change and increasing reliance on cloud-based systems, such understanding supports professional autonomy, informed decision-making, and user-centred service delivery. By aligning technical fundamentals with professional values such as privacy, accountability, and service quality, the article argues that computer and operating system literacy strengthens the capacity of libraries to adapt and remain relevant. The study contributes to ongoing discourse on digital competence in librarianship by framing foundational computing knowledge as integral to sustaining ethical, responsive, and future-ready library services*

**Keywords:** *Computer fundamentals; Operating systems; Library and Information Science; Digital competence; Library practice*

#### **1.1 Introduction**

The modern library has moved far beyond its traditional identity as a quiet space defined by shelves of printed materials.

Today, it operates within a dynamic and increasingly complex digital environment, where networked systems, electronic resources, and platform-based services shape

how information is created, organized, accessed, and preserved. Breeding (2022) observe that this transformation is often framed in terms of technological advancement, yet such discussions frequently overlook its deeper implications for professional practice and institutional control. At the centre of this shift is not just the computer as a tool, but the operating system that governs how that tool functions. Cox and Corral (2023) emphasize that operating systems, though often invisible in everyday discourse, play a decisive role in determining system efficiency, data security, and user interaction. Their influence extends beyond technical performance to shape how library services are structured and experienced.

For librarians and information professionals, understanding computer and operating system fundamentals is therefore more than a technical requirement. It is closely tied to professional relevance and agency. Onyancha (2023) and Makhafola et al. (2025) note that while librarians demonstrate growing awareness of digital technologies, there remains a gap between surface-level familiarity and deeper system-level competence. This gap often leads to increased reliance on vendors and technical specialists, thereby limiting librarians' participation in decisions that directly shape service delivery. Library and Information Science (LIS) has historically evolved alongside technological change, from early automation systems to integrated library systems, digital repositories, and cloud-based infrastructures. Borgman (2000) and Breeding (2015) highlight how these developments have expanded the scope of library services. However, Dime et al. (2024) and Onyancha (2023) argue that this expansion has not been matched by a corresponding depth of infrastructure-level understanding, particularly in areas such as system configuration, data management, and digital preservation.

This article therefore moves beyond descriptive explanations to critically examine

computer and operating system fundamentals within LIS. Corral and Morgan (2023) frame this shift as part of a broader move toward infrastructure literacy, where professionals are expected not only to use systems but to understand and question them. In this context, the paper asks: how do these systems shape access to information? In what ways do they redistribute control within library environments? And how does limited system-level knowledge affect professional autonomy? By engaging with these questions, the paper positions foundational computing knowledge as central to contemporary librarianship, particularly in an era increasingly shaped by complex digital infrastructures.

## 2.1 Literature Review

### 2.2 Conceptual Foundations of Computers in Library Contexts

A computer is commonly defined as an electronic device capable of receiving data, processing it, storing it, and producing output. Breeding (2015) presents this definition as foundational to understanding digital systems in libraries. However, when applied to contemporary library environments, this definition offers only a partial view, as it frames the computer as a neutral tool rather than as a system that actively shapes information processes. In practice, computers in libraries do far more than process data. Borgman (2020) demonstrates that database structures and indexing systems influence how information is organized and retrieved, thereby shaping user access and discovery. These processes are not purely technical; they reflect embedded design decisions that may prioritize efficiency and standardization over contextual diversity and inclusivity. Within library environments, computers function both as operational tools and as infrastructural systems. Breeding (2015) explains that they support routine tasks such as cataloguing and circulation while also

underpinning complex systems such as digital repositories and online databases. While this dual role enhances efficiency and scalability, it also introduces new forms of dependency. Shen and Varvel (2021), alongside Alemna and Sam (2021), highlight that system failures, configuration limitations, and infrastructural weaknesses can significantly disrupt service delivery, particularly in environments with limited technical support.

The traditional breakdown of computer systems into hardware, software, data, procedures, and users remains analytically useful. However, Balnaves and Bulger (2021) argue that in practice, these components do not operate with equal influence. Software especially proprietary systems often dictates workflows and limits flexibility, while data structures can constrain how information is represented. This imbalance reflects broader concerns about technological dependency and reduced institutional control over digital infrastructures. More critically, the increasing reliance on complex computing systems raises questions about professional autonomy. Corral and Morgan (2023) and Onyancha (2023) observe that while librarians possess strong information management skills, limited engagement with underlying technologies restricts their ability to influence system design and implementation. This creates a situation in which librarians operate within systems they do not fully understand, reinforcing a largely passive relationship with technology.

At the same time, there is growing recognition that strengthening foundational computing knowledge can help shift this dynamic. Cox and Corral (2013) and Makhafola et al. (2025) emphasize that deeper technical understanding enhances librarians' ability to collaborate with IT professionals, evaluate technological solutions, and advocate for user-centred systems. Seen from this perspective, computer fundamentals are

not merely technical concepts but critical elements of professional practice. They intersect with broader issues such as access to information, system sustainability, and ethical responsibility. In an era increasingly shaped by advanced digital systems, a more critical and reflective engagement with these fundamentals is essential if librarians are to move beyond using technology and begin to shape it in meaningful ways.

### **Operating Systems: Meaning and Functional Significance**

Zhang and Liu (2023) explain that operating systems do much more than manage hardware. They shape how users interact with technology, manage data, and access services. In libraries, this means the operating system is not just a technical layer but a *critical mediator* for every digital service. It controls memory allocation, schedules processes, manages input/output devices, and enforces security. When it fails or is misconfigured, libraries face slow systems, crashes, and even data breaches, all of which can disrupt services and undermine user trust. Kumbhar (2021) emphasizes that librarians don't need to be full system administrators, but having a functional understanding of operating system principles allows them to collaborate more effectively with IT teams. This knowledge is especially useful during system migrations, troubleshooting issues, and advocating for designs that prioritize user needs. In short, understanding the OS empowers librarians to participate in decisions that directly affect service delivery, rather than being passive users of technology (Hassan & Daniel, 2024).

### **2.3 Historical Evolution of Computing in Libraries**

Nwalo (2021) and Onyancha (2023) note that libraries have been integrating computing technologies for decades, starting with mainframes and batch-processing systems that automated tasks like cataloguing

and circulation. At that time, librarians had minimal direct interaction with computers. The introduction of personal computers changed everything, giving librarians direct access to technology and enabling decentralized processing. Breeding (2022) highlights that integrated library systems (ILS) further transformed operations by combining multiple functions into a single platform, while user-friendly operating systems reduced technical barriers. The rise of the internet and networked services allowed libraries to expand beyond physical walls, offering online journals, institutional repositories, and virtual reference services. These advances increased reliance on operating systems capable of handling multitasking, networking, and security requirements. Ojo and Heravi (2025) argue that understanding these underlying systems is now essential for librarians to maintain autonomy, manage services effectively, and critically engage with vendors. Application of Computer Fundamentals in Core Library Operations

### ***Cataloguing and Metadata Management***

Suleiman and Olanrewaju (2024) explain that modern cataloguing is heavily dependent on digital systems. But it's not just the software it's how the operating system manages memory, file storage, and batch processing that determines efficiency. For example, importing large sets of bibliographic records requires memory management and file handling, which are OS-dependent. Librarians who understand these processes can quickly diagnose problems and optimize workflows, ensuring that metadata remains accurate and reliable. This knowledge transforms cataloguing from a technical task into a professionally strategic activity.

### ***Circulation and User Services***

Kim and Choi (2023) found that operating system performance directly affects

circulation systems, which process loans, returns, and renewals in real time. Self-service technologies, such as automated check-out stations and online account management, also rely on stable operating systems to handle multiple users simultaneously. Librarians who understand these fundamentals can anticipate system bottlenecks, communicate effectively during outages, and make informed adjustments that protect both efficiency and accessibility (Adeoye et al., 2025).

### ***Digital Libraries and Repositories***

Lafky et al. (2023) emphasize that operating systems are vital for digital libraries, managing servers, storage, access permissions, and backups. System choice affects sustainability, interoperability, and long-term preservation. Librarians involved in repository management must critically evaluate OS capabilities to ensure digital content remains accessible over time. According to Obi et al. (2024), OS-level decisions in digital libraries directly influence preservation success, data migration, and service reliability, making OS literacy a professional, not just technical, necessity.

### ***Operating Systems in Networked and Cloud-Based Library Environments***

Breeding (2022) highlights that networked and cloud-based libraries depend on operating systems not just locally but as part of a larger infrastructure. Networked OSs allow shared access to databases, printers, authentication services, and digital collections. Misconfiguration at this level can disrupt services and reduce user trust. Balnaves and Bulger (2021), along with Mensah and Adu (2025), note that open-source operating systems, like Linux, are increasingly preferred because they are transparent, adaptable, and sustainable. Open-source systems allow librarians to make critical decisions about configurations, security, and workflows rather than being constrained by vendor defaults. Salim and Said (2026) add that even in cloud-

based environments, where vendors manage most infrastructure, librarians still interact with OS components via local devices, authentication protocols, and administrative interfaces. Understanding these interactions allows librarians to critically engage with service agreements, security policies, and overall governance, rather than relying passively on external providers.

#### **2.4 Security, Privacy and Ethical Implications**

Zimmer (2020) highlights that security and privacy are central to modern library computing, particularly as libraries increasingly manage sensitive personal and usage data. Operating systems serve as the foundation for enforcing security policies, controlling access permissions, and protecting systems from malicious attacks. Weaknesses at this layer can compromise entire library infrastructures, demonstrating that technical configurations are inseparable from professional accountability. Jones and Salo (2022) argue that operating systems mediate access to files, system logs, and network traffic, making them pivotal for privacy protection. Librarians who understand access control mechanisms, system auditing, and authentication protocols are better positioned to advocate for privacy-conscious configurations that safeguard user trust. From a critical perspective, OS literacy is therefore not just a technical skill. It is an ethical and professional responsibility, ensuring that information practices align with the values of confidentiality and equitable access. Cybersecurity incidents in libraries have increased in recent years, ranging from ransom ware attacks to data breaches. Shen and Varvel (2021) emphasize that libraries with stronger internal digital literacy, including awareness of operating system functions, respond more effectively to such threats. This reinforces the argument that foundational computing knowledge enhances

professional resilience, enabling librarians to maintain service continuity and uphold ethical standards in the face of technical challenges.

#### **2.5 Implications for Library Education and Professional Development**

Corrall and Morgan (2023) stress the need for LIS curricula to move beyond superficial IT training toward infrastructure literacy, including fundamental operating system knowledge. Such training empowers librarians to critically engage with systems, participate in design and evaluation processes, and advocate for user-centred solutions without requiring them to become engineers. Continuing professional development is equally important. As IFLA (2022) notes, operating systems and related technologies evolve rapidly, making ongoing skill updates essential. Workshops, online courses, and peer learning communities are effective strategies for keeping staff up to date. Libraries that invest in OS-level training report better collaboration between librarians and technical staff and foster more proactive problem-solving cultures. In developing contexts, where technical support may be limited, OS competence is particularly critical. Alemna and Sam (2021) and Onyancha (2023) show that librarians who understand system fundamentals can maintain service continuity and innovate within resource-constrained environments. In such settings, professional agency and operational resilience depend directly on foundational computing knowledge.

#### **2.6 Professional Identity and the Evolving Role of the Librarian**

Saunders (2020) observes that the integration of computing into library operations has redefined professional identity. Librarians increasingly serve as intermediaries between users, resources, and technological systems. By understanding operating system functions,

librarians can translate technical constraints into user-focused solutions, participate in system design decisions, and contribute to digital strategy. Tenopir et al. (2023) report that technological literacy enhances librarians' visibility within institutions, enabling involvement in strategic planning, cross-departmental collaborations, and digital transformation initiatives. Such competence also fosters professional confidence, reducing dependence on external technical experts and supporting ethical decision-making, user advocacy, and innovative service development.

### **2.7 Emerging Trends and Future Directions**

Rafiq and Ameen (2022) note that artificial intelligence, data analytics, and immersive technologies are placing new demands on library infrastructures. While librarians may not develop these systems, their ability to evaluate, integrate, and govern them depends on a foundational understanding of operating system principles. Virtualization and containerization technologies, which rely heavily on OS capabilities, are becoming standard in library IT environments, supporting experimentation and efficiency in digital scholarship projects. Sustainability is another emerging concern. Rafiq and Ameen (2022) emphasize that operating systems influence energy efficiency, hardware longevity, and overall system optimization, linking technical choices to institutional environmental goals. Awareness of these implications enables librarians to align operational practices with both professional ethics and organizational sustainability objectives.

### **Conclusion**

It has been established that digital competence in LIS extends beyond application-level skills to include foundational knowledge of computing and operating systems. This

competence is crucial for maintaining professional agency, ethical responsibility, and service reliability in increasingly complex, hybrid, and cloud-based environments. Operating systems, though often invisible to end-users, fundamentally shape library stability, security, accessibility, and the quality of service delivery. Librarians with grounded knowledge of OS principles can engage critically with systems, make informed technology decisions, advocate effectively for user needs, and collaborate with IT specialists. Such expertise supports system evaluation, proactive problem-solving, and sustained service quality across both physical and digital spaces. Ethical considerations such as data privacy, cybersecurity, and system integrity further highlight why OS literacy is central to professional practice. Understanding, questioning, and guiding OS-level configurations directly contributes to protecting user rights, safeguarding institutional accountability, and reinforcing the profession's core values. In a rapidly evolving technological landscape, librarians who master foundational computing concepts move beyond passive system use to active engagement, strategic participation, and innovative service provision. Recognizing computer and operating system literacy as integral to LIS strengthens the profession's ability to adapt, innovate, and uphold its values within the digital information ecosystem.

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