



Information Processing Theory and Digital Reading: A Theoretical Framework for Academic Library Contexts

C. Melvin Jebaraj
Librarian, Suguna College of Arts and Science
Coimbatore. Tamil Nadu. India
mliscmelvin@gmail.com

ABSTRACT

The rapid expansion of digital information environments has fundamentally transformed reading practices within academic settings. Scholars increasingly engage with electronic journals, e-books, institutional repositories, and multimedia resources through complex digital interfaces. While these developments have expanded access to scholarly information, they have also altered the cognitive processes involved in reading and comprehension. This paper proposes a theoretical framework that applies Information Processing Theory (IPT) to explain digital reading behaviour in academic library environments. Drawing on cognitive psychology, information behaviour research, and Library and Information Science (LIS) scholarship, the study integrates the core components of IPT sensory memory, working memory, and long-term memory with the structural characteristics of digital reading, such as hypertext navigation, multimedia integration, and increased cognitive load. The paper argues that digital reading environments often impose greater cognitive demands than traditional print reading due to fragmented attention, non-linear navigation, and interface complexity. To conceptualise these relationships, the study introduces the Digital Reading Cognitive Model (DRCM), which illustrates how digital interface design, cognitive mechanisms, and reader strategies interact to shape comprehension and knowledge retention. By extending IPT into the study of digital information behaviour, the framework positions academic libraries as cognitive environments that significantly influence learning processes. The study contributes to LIS theory by integrating cognitive science perspectives into digital reading research and offers implications for library interface design, digital literacy instruction, and future empirical investigation.

Keywords: Digital Reading, Information Processing Theory, Academic Libraries, Cognitive Load, Information Behaviour, Digital Literacy, LIS Theory.

Received: 29 October 2025, Revised 27 December 2025, Accepted 2 January 2026

Copyright: DLINE

1. Introduction

The digital transformation of higher education has profoundly reshaped how students, researchers, and scholars access and interact with scholarly information. Academic libraries, traditionally centred on print collections and physical reading spaces, have evolved into digitally mediated knowledge environments where electronic resources dominate scholarly communication. Databases, digital repositories, electronic journals, and discovery systems now constitute the primary channels through which users encounter academic texts.

This shift from print-based to digital reading has significantly altered the cognitive dynamics of reading. Digital reading environments differ from traditional print contexts in both structure and interaction patterns. Whereas print reading typically involves linear progression through a text, digital reading often includes scrolling interfaces, hyperlink navigation, multimedia elements, and simultaneous interaction with multiple documents or tabs (Liu, 2005; Delgado et al., 2018). These features enable rapid access to information but can also fragment attention and increase cognitive effort.

Within Library and Information Science (LIS), research on information behaviour has extensively examined information seeking, search strategies, and resource usage patterns (Wilson, 1999; Nicholas et al., 2011). However, comparatively less theoretical attention has been given to the cognitive processes underlying digital reading, particularly within academic library contexts. Understanding how users cognitively process digital texts is essential for designing effective digital systems and supporting meaningful learning outcomes.

Information Processing Theory (IPT), originally developed within cognitive psychology, offers a robust theoretical framework for examining such processes. The theory conceptualises human cognition as a sequence of stages through which information flows from sensory perception to working memory processing and ultimately to long-term memory storage (Atkinson & Shiffrin, 1968). Applying IPT to digital reading enables scholars to analyse how interface design, multimedia elements, and navigation structures influence cognitive processing during reading.

This paper, therefore, aims to:

1. Apply Information Processing Theory to the study of digital reading in academic library environments.
2. Conceptualise academic libraries as cognitive information environments that influence learning processes.
3. Propose a theoretical framework the Digital Reading Cognitive Model (DRCM) that integrates digital interface features with cognitive mechanisms and reading outcomes.

By bridging cognitive psychology and LIS research, the study contributes to developing a stronger theoretical foundation for understanding digital reading behaviour.

2. Digital Reading in Library and Information Science

In information behaviour research, reading represents a critical stage of information use. While information seeking focuses on locating relevant resources, reading involves interpreting, evaluating, and integrating

information into existing knowledge structures (Wilson, 1999). Bawden and Robinson (2009) emphasize that reading is not merely a mechanical process but a complex cognitive activity involving attention, comprehension, and knowledge construction.

The increasing prevalence of digital resources has led to the emergence of new reading patterns. Digital reading in academic libraries commonly involves the use of:

- Electronic journals and e-books
- Digital repositories and research databases
- Online discovery platforms
- Multimedia scholarly resources

These digital environments differ from print-based reading in several important ways.

2.1 Hypertextual Structures

Digital texts frequently incorporate hyperlinks that connect documents across multiple layers of information. Hypertext structures enable non-linear navigation, allowing readers to follow branching information paths rather than sequential text progression (Chen & Rada, 1996). While such structures enhance exploratory learning, they can also disrupt sustained attention and the building of coherence during reading.

2.2 Interface Complexity and Navigation

Modern discovery systems incorporate faceted search tools, filters, recommendation systems, and multiple information layers. Although these features improve resource discovery, they also require users to make frequent decisions during reading and navigation. Such decision making processes consume cognitive resources and may increase cognitive load.

2.3 Multimedia Integration

Digital texts often combine written content with images, charts, videos, and interactive elements. According to multimedia learning theory (Mayer, 2009), such multimodal presentations require readers to process information across multiple cognitive channels. When effectively designed, multimedia elements can enhance comprehension; however, poorly integrated multimedia may overload working memory.

These structural features highlight the need for theoretical frameworks that explain how digital reading environments interact with cognitive processes.

3. Information Processing Theory and Cognitive Architecture

Information Processing Theory conceptualises human cognition as a system through which information flows in sequential stages. The foundational model proposed by Atkinson and Shiffrin (1968) identifies three primary components: sensory memory, working memory, and long-term memory.

3.1 Sensory Memory

Sensory memory is the initial stage of information processing, in which environmental stimuli are briefly registered through sensory channels such as vision and hearing. In digital reading environments, sensory input includes screen typography, layout structures, colour contrasts, icons, and interface elements.

The design of digital interfaces significantly influences this stage of processing. Poor screen design, such as cluttered layouts, small fonts, or inadequate contrast, may interfere with the accurate perception of textual information. Conversely, well-structured interfaces support efficient sensory encoding and facilitate the transition of information into working memory.

3.2 Working Memory

Working memory is responsible for the active processing and integration of information. It allows readers to interpret textual meaning, connect new information with prior knowledge, and construct coherent mental representations of the text. However, working memory has limited capacity, traditionally estimated at approximately seven information units (Miller, 1956).

Cognitive Load Theory further explains how the limitations of working memory influence learning processes (Sweller, 2011). Cognitive load can be categorised into three types:

- Intrinsic load: inherent complexity of the learning material
- Extraneous load: additional cognitive effort caused by poor design
- Germane load: cognitive effort devoted to meaningful learning

Digital reading environments often increase extraneous cognitive load due to frequent hyperlink navigation, multiple open tabs, pop-up windows, and multimedia interruptions. These elements may compete for attention and reduce the cognitive resources available for comprehension.

3.3 Long-Term Memory

Long-term memory stores knowledge structures known as schemas. These schemas allow individuals to organise information, recognise patterns, and integrate new knowledge with existing understanding.

Effective reading involves the encoding of information from working memory into long term memory through processes such as elaboration, repetition, and reflective thinking. However, fragmented attention in digital environments may weaken encoding processes, thereby reducing retention and comprehension (Delgado et al., 2018).

4. Academic Libraries as Cognitive Information Environments

Academic libraries are no longer merely repositories of information; they have evolved into digitally mediated cognitive environments in which users interact with complex information systems. These environments shape the ways in which readers process and interpret information.

4.1 Interface Design and Cognitive Load

Library discovery systems, digital repositories, and database interfaces serve as the primary gateways to scholarly content. Interface complexity, including excessive filtering options, layered navigation structures, and dense information displays, can increase extraneous cognitive load. When cognitive resources are diverted toward navigation rather than comprehension, the quality of reading and learning may decline.

4.2 Hypertext Navigation and Attention Fragmentation

Hyperlinks allow readers to explore related information rapidly; however, they also encourage frequent shifts in attention. Each navigation decision requires cognitive processing, which interrupts the continuity of reading and may hinder the integration of ideas across texts.

4.3 Information Architecture and Knowledge Encoding

Effective information architecture, such as consistent metadata structures, logical categorisation, and intuitive navigation, supports the formation of cognitive schemas. When information systems are organised in ways that align with users' mental models, readers can more easily connect new information with existing knowledge structures.

5. The Digital Reading Cognitive Model (DRCM)

To synthesise the interactions between digital environments and cognitive processes, this study proposes the Digital Reading Cognitive Model (DRCM). The model conceptualises digital reading as an interaction among four interconnected components:

5.1 Digital Interface Factors

These include design elements of digital systems, such as:

- Navigation complexity
- Hyperlink structures
- Multimedia integration
- Information architecture

These features determine the cognitive demands imposed on readers.

5.2 Cognitive Processing Mechanisms

These mechanisms correspond to IPT components:

- Attention allocation
- Working memory capacity
- Cognitive load management
- Information encoding processes

Interface features directly influence these cognitive processes.

5.3 Strategic Reading Processes

Readers employ strategies to regulate their cognitive engagement, including:

- Digital literacy skills
- Metacognitive monitoring
- Annotation and note-taking
- Selective reading and filtering

Such strategies help mitigate cognitive overload.

5.4 Learning Outcomes

The interaction of interface factors, cognitive mechanisms, and reading strategies ultimately affects:

- Depth of comprehension
- Critical evaluation of information
- Knowledge retention
- Scholarly learning outcomes

5.5 Framework for Digital Reading Cognitive Model

In this theoretical framework, we develop a Digital Reading Cognitive Model, with components shown in the following figures.

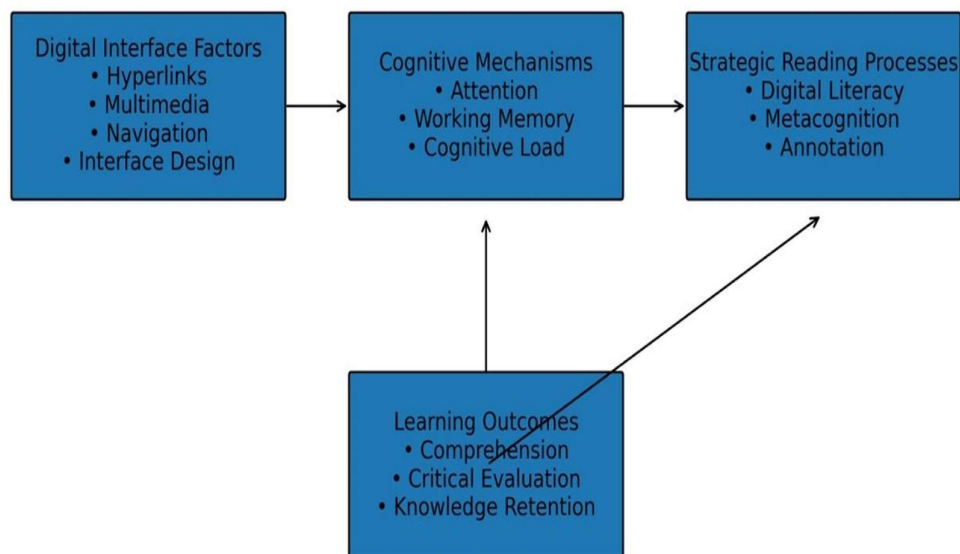


Figure 1. Digital Reading Cognitive Model (DRCM)

Figure 1. The Digital Reading Cognitive Model (DRCM) illustrates the interactions among digital interface factors, cognitive processing mechanisms, strategic reading processes, and learning outcomes in academic library environments.

The DRCM thus provides a conceptual framework linking digital system design, cognitive processing, and educational outcomes within academic libraries. Figure 1 presents the conceptual structure of the Digital Reading Cognitive Model (DRCM), which explains how digital reading occurs within academic library environments. The model illustrates four interconnected components: digital interface factors, cognitive mechanisms, strategic reading processes, and learning outcomes. Digital interface factors such as navigation complexity, hyperlink structures, and multimedia elements shape the cognitive demands placed on readers. These demands influence cognitive mechanisms, including attention allocation, working memory utilisation, and cognitive load management. Strategic reading processes, such as digital literacy skills, metacognitive monitoring, and annotation practices, act as moderating factors that help readers manage cognitive demands. The interaction among these elements ultimately determines learning outcomes, including depth of comprehension, critical evaluation, and knowledge retention. The model highlights the role of academic library systems as cognitive environments that influence information processing during digital reading.

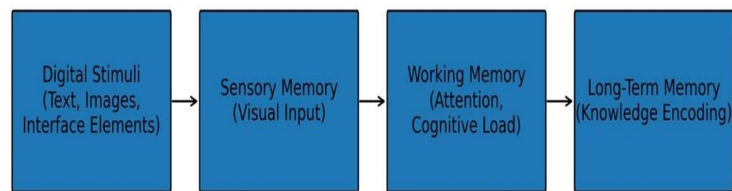


Figure 2. Information Processing Theory Flow in Digital Reading

Figure 2. Information Processing Theory, applied to digital reading, describes the flow of digital stimuli through sensory memory, working memory, and long-term memory.

Figure 2 illustrates the application of Information Processing Theory (IPT) to digital reading contexts. The figure depicts the sequential flow of information beginning with digital stimuli, including textual content, images, and interface elements presented on digital library platforms. These stimuli are first perceived through sensory memory, where visual input from the screen is briefly registered. The information then moves to working memory, where readers allocate attention, interpret meaning, and manage cognitive load. Because working memory has limited capacity, excessive interface complexity or multimedia interruptions can overload cognitive resources. When information is effectively processed, it is encoded into long-term memory, where knowledge structures and schemas are formed. The figure demonstrates how digital interface design influences the efficiency of this cognitive processing sequence.

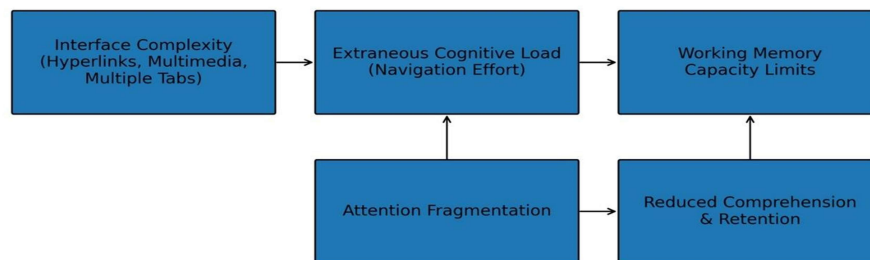


Figure 3. Cognitive Load Dynamics in Digital Reading Environments

Figure 3. Cognitive load dynamics in digital reading environments illustrate how interface complexity (hyperlinks, multimedia, and multitasking) increases extraneous cognitive load, leading to working memory overload, attention fragmentation, and reduced comprehension.

Figure 3 illustrates the dynamics of cognitive load generated during digital reading. The figure demonstrates how interface complexity such as hyperlinks, multimedia content, and multiple open tabs can increase extraneous cognitive load. This additional cognitive demand places pressure on the limited capacity of working memory. As cognitive load increases, readers may experience attention fragmentation, characterised by frequent shifts in focus and interruptions in reading continuity. These disruptions can reduce comprehension efficiency and weaken knowledge retention. The figure highlights the importance of minimising unnecessary interface complexity in digital library systems in order to support effective information processing and deep reading.

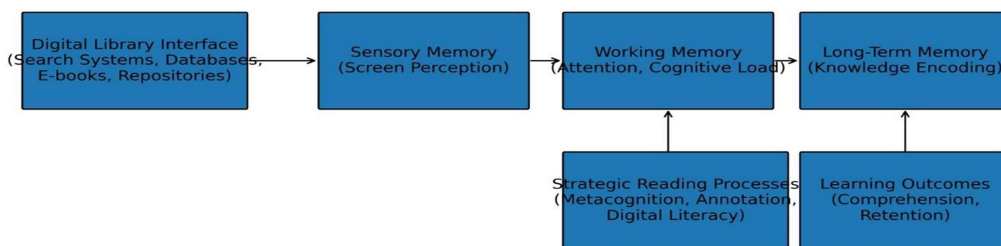


Figure 4. Integrated Framework Combining IPT and DRCM

Figure 4. Integrated framework combining Information Processing Theory (IPT) and the Digital Reading Cognitive Model (DRCM). The model demonstrates how digital library interfaces interact with sensory memory, working memory, and long-term memory processes, moderated by strategic reading behaviours, to produce learning outcomes.

Figure 4 integrates Information Processing Theory with the Digital Reading Cognitive Model to provide a comprehensive framework for understanding digital reading behaviour in academic library environments. The framework demonstrates how digital library interfaces serve as the initial source of information stimuli, which enter the cognitive processing system through sensory perception. The information then passes through working memory, where attention allocation and cognitive load management occur. Strategic reading processes, including digital literacy, annotation, and metacognitive regulation, support the effective processing of information. When these processes function efficiently, information is encoded into long-term memory, contributing to meaningful learning outcomes. This integrated framework highlights the interdependence between system design, cognitive mechanisms, and user strategies in shaping reading comprehension and knowledge acquisition.

Table 1 compares the structural characteristics of digital and print reading environments. The table highlights differences in navigation patterns, information presentation formats, interaction styles, and reading pace. Digital reading is characterised by non-linear navigation through hyperlinks, multimedia integration, and integration, and interactive search functions, which encourage scanning and selective reading behaviours. In contrast, print reading typically follows a linear structure with sustained attention and continuous engagement with a fixed text. These structural differences demonstrate how digital reading environments promote exploratory access to information but may also introduce interruptions that affect reading continuity.

Dimension	Digital Reading	Print Reading
Navigation Structure	Non-Linear with hyperlinks	Linear and sequential
Attention Pattern	Fragmented and multitask oriented	Sustained and focused
Information presentation	Multimedia Integration (text, video, graphics)	primarily text-based
Reader Interaction	Interactive navigation and Searching	Passive interaction with fixed text
Reading pace	Scanning and Selective reading	Deep and Continuous reading

Table 1. Structural differences between digital reading and print reading environments

Cognitive Factor	Digital Reading	Print Reading
Working Memory Load	Higher due to interface complexity	Lower Cognitive Interference
Attention Distribution	Frequent shifts due to hyperlinks and multitasking	Sustained Attention
Information Integration	Fragmented across multiple sources	Integrated within Single text Structure
Comprehension Depth	Moderate to shallow when Multitasking	Deeper Comprehension
Knowledge Retention	Potentially reduced retention	Stronger Long-Term Retention

Table 2. Cognitive processing differences between digital and print reading based on Information Processing Theory

Table 2 summarises the cognitive processing differences associated with digital and print reading. The table shows that digital reading environments often impose higher working memory demands due to interface complexity and multitasking behaviours. Attention in digital contexts tends to shift frequently as readers navigate hyperlinks and multiple documents. As a result, information integration may become fragmented, potentially leading to shallower comprehension and reduced retention. In contrast, print reading typically supports sustained attention, integrated text processing, and deeper comprehension. The comparison underscores the importance of developing reading strategies and interface designs that support effective cognitive processing in digital environments.

6. Implications for Library and Information Science

The integration of cognitive theory into digital reading research has several important implications for academic libraries.

6.1 Digital Literacy Instruction

Information literacy programs should incorporate cognitive reading strategies that help students manage digital reading challenges. Instruction can emphasise deep reading practices, attention regulation, annotation techniques, and critical evaluation of digital texts.

6.2 Interface and Usability Design

Library system designers should prioritise usability principles that minimise extraneous cognitive load. Clear navigation structures, simplified layouts, and integrated reading tools such as highlighting and annotation features can enhance cognitive engagement.

6.3 Hybrid Reading Approaches

Despite the dominance of digital resources, hybrid reading strategies that combine print and digital formats may support deeper comprehension. Academic libraries can facilitate such approaches by providing flexible access to both digital and print materials.

7. Conclusion

Digital reading has become a central component of scholarly engagement in contemporary academic environments. However, the cognitive implications of digitally mediated reading remain insufficiently explored within Library and Information Science research.

This paper demonstrates that Information Processing Theory provides a valuable framework for understanding how digital interfaces interact with human cognition. By examining the roles of sensory input, working memory limitations, and long-term memory encoding, the study highlights the cognitive challenges posed by digital reading environments.

The proposed Digital Reading Cognitive Model (DRCM) integrates digital interface design, cognitive processing mechanisms, and reader strategies to explain how comprehension and knowledge retention occur within academic library systems. The framework positions academic libraries as influential cognitive environments that shape learning outcomes through the design of digital infrastructures.

Future research should empirically test the DRCM through experimental and mixed-methods studies examining user interaction with digital library systems. Such research will strengthen theoretical development within LIS and support the creation of cognitively optimised digital reading environments.

References

[1] Atkinson, R.C., Shiffrin, R.M. (1968). Human memory: A proposed system and its control processes. In Spence, K.W., Spence, J.T. (Eds.), *The Psychology of Learning and Motivation* (Vol. 2, pp. 89–195). *Academic*

Press.

[2] Bawden, D., Robinson, L. (2009). The dark side of information: Overload, anxiety, and other paradoxes. *Journal of Information Science*, 35(2), 180–191.

[3] Carr, N. (2010). *The Shallows: What the Internet Is Doing to Our Brains*. W.W. Norton.

[4] Chen, C., Rada, R. (1996). Interacting with hypertext: A meta-analysis of experimental studies. *Human-Computer Interaction*, 11(2), 125–156.

[5] Delgado, P., Vargas, C., Ackerman, R., Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on comprehension. *Educational Research Review*, 25, 23–38.

[6] Liu, Z. (2005). Reading behaviour in the digital environment: Changes in reading behaviour over the past ten years. *Journal of Documentation*, 61(6), 700–712.

[7] Mangen, A., Walgermo, B.R., Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, 58, 61–68.

[8] Mayer, R.E. (2009). *Multimedia Learning* (2nd ed.). Cambridge University Press.

[9] Miller, G.A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63(2), 81–97.

[10] Nicholas, D., Rowlands, I., Clark, D., Williams, P. (2011). Google generation II: Web behaviour experiments. *Aslib Proceedings*, 63(1), 28–45.

[11] Sweller, J. (2011). Cognitive load theory. *Psychology of Learning and Motivation*, 55, 37–76.

[12] Wilson, T.D. (1999). Models in information behaviour research. *Journal of Documentation*, 55(3), 249–270.

[13] Wolf, M. (2018). *Reader, Come Home: The Reading Brain in a Digital World*. Harper.