The Journal of Academic Librarianship 50 (2024) 102886

Contents lists available at ScienceDirect

The Journal of Academic Librarianship

journal homepage: www.elsevier.com/locate/jacalib

B-Wheel – Building AI competences in academic libraries

Heli Kautonen, PhD [a,*], Andrea Alessandro Gasparini, PhD [b]

[a] Åbo Akademi University, Information Studies, Tuomiokirkontori 3, 20500 Turku, Finland
[b] University of Oslo Library, Norway

ARTICLE INFO

Keywords:
Academic libraries
Artificial intelligence
Competence
Design

ABSTRACT

Academic libraries have moved swiftly to grasp the challenges and opportunities of the new Artificial Intelligence (AI) technologies. The body of academic and practice-based literature is growing fast, showing how libraries are exploring their role in Information Literacy (IL) and AI, ethics and AI, and how they vigorously test and adopt various AI-powered tools for their services. Across these accounts, librarians express concern about their competence, skills and knowledge of the new technology and its implications for the research community. In this article, we present a holistic process model called the B-Wheel that addresses the phenomenon's complexity with approaches adopted from design thinking ideologies. We propose design approaches as an alternative strategy for academic libraries that want to avoid partial optimisation of AI skills and to ensure more generative competency building in their organisation. We drew inspiration for the B-Wheel model from the principles and pedagogy of the 20th-century Bauhaus art and design school in Germany. The article focuses on the model's features and its elements, constructed through workshops in Scandinavian research libraries. We also present experiences from the first use case in a University Library in Scandinavia. We propose that the main principles of the B-Wheel process model – a holistic design approach and learning by doing – are transferable across and beyond academic libraries.

Introduction

In 2023, the public discussion about the newly launched and publicly available chatbot *ChatGPT* has awakened the research communities to notice the potential of Artificial Intelligence (AI) technologies. As a swift reaction, libraries serving academia have put effort into understanding the new AI phenomenon and its implications for research and society in general. To serve their patrons and home universities, libraries have sought means to establish responsible practices for the use of AI, e.g., by publishing AI guidelines. These local instructions lean on national or international AI policies, such as the ones by the European Commission (2019), UNESCO (2022), or OECD (2022). These policies aim to foster innovation and address various AI-related concerns, including ethics, transparency, privacy, and equitable access to information.

In the workplace, the AI revolution is viewed from another perspective among everyday library practices. Librarians can experience the challenges of the new AI era as a threat to their professional identity, or, in contrast, they may see themselves as "agents of the desired change" (Gasparini & Kautonen, 2022). Academic research in, for example, the disciplines of computer science and digital humanities is developing and exploring the potential of AI technologies. At the same time, other members of the university community may turn to their trusted library, as they always have done, to get information about the new algorithm-powered research assistants or the responsible use of the generative AI chatbot. In this complex situation, librarians may feel unsure about their role and competency in answering their patrons' questions.

Both the development of AI governance and the reshaping of library work require new knowledge and skills from an individual librarian, as well as new competencies from the library as an organisation. This need has been recognised and manifested in visions of the potential or desirable paths for improving AI competencies in libraries. When reviewing the literature, we noticed that most of these accounts take one viewpoint at a time while AI technology penetrates all library operations. Suppose a library wishes to claim and conquer the new phenomenon. In that case, it is not enough to assign the task of improving AI skills and knowledge to one operational unit or activity. Likewise, building AI policies without operationalised and implemented practices is not advisable, as Lo (2023) also emphasises.

This paper addresses the challenge of building AI competencies in

* Corresponding author.
E-mail addresses: heli.kautonen@abo.fi (H. Kautonen), a.a.gasparini@ub.uio.no (A.A. Gasparini).

https://doi.org/10.1016/j.acalib.2024.102886
Received 18 January 2024; Received in revised form 27 April 2024; Accepted 30 April 2024
Available online 7 May 2024

academic libraries by presenting a strategic approach that draws on and promotes using principles and methods from design theories.

Design approaches, particularly Design Thinking, have been successfully used to manage organisational changes (Foster, 2021; Kimbell, 2019) and to tame complex problems (Buchanan, 1992). Designers have tools and methods that help provide an overview of various tasks in different contexts. Design approaches also emphasise including multiple viewpoints and stakeholders in the problem-solving process (Krippendorff, 2006). When exploring new organisational competencies and inviting perspectives from the personnel, the leadership may also benefit from design approaches and a design-thinking mindset.

As an outcome of applying design approaches in the problem area, we present the B-Wheel process model. We constructed the model by accumulating ideas and librarians' needs from three online workshops that focused on the use of AI in research libraries. To find a scheme for the model, we recalled the graduate-time experiences of one of the authors about the curriculum and principles that originate from the early 20th century Bauhaus School of art and design. The Bauhaus principles have been applied in design education institutions across the Western world long after the extinction of the original school in Germany. The Bauhaus method of teaching design has been recognised for its ability to build a knowledge base that meets the conditions of generativity (Le Masson et al., 2016). Strong generativity is associated with the ability to produce original ideas or transform existing elements or conditions into new solutions (ibid.).

The first chapter summarises the literature on libraries and AI, revealing the multitude of motivations and, furthermore, the multitude of skill and competency requirements that academic librarians anticipate regarding AI. The core of the article presents the model's inspirational source in the Bauhaus principles and curriculum. Then, the description of the structure and elements of the process model aims to reveal the rigour of the presented approach and demonstrate the model's applicability in a real-world situation.

The paper contributes to the vivid professional and scholarly discussion on AI in academic libraries. Its theoretical foundations are in the library and information science (LIS) understanding of libraries as professionals who contribute to the information seeking processes as information and knowledge providers. We build on Robson and Robinson's (2013, 2015) conceptualisations of collaborative communication as an essential part of human information behaviour.

The paper also presents the results from the preliminary validation of the proposed process model. After the workshops that contributed to the construction of the model, a Scandinavian university library tested the model and gave feedback about its application in the library work. With this paper, we aim to stimulate discussion about the best strategies for academic libraries to increase their competencies in relation to AI. The B-Wheel process model proposes a generative and holistic approach to building AI competencies in a library as an alternative to already tried and potentially exhausted methods.

Libraries exploring the challenges and opportunities of AI

The literature indicates a diversity of motivational drivers why libraries engage with AI technologies and all its evolving variants in the areas of machine learning, data science, and robotics (e.g., Andersdotter, 2023; Cox & Mazumdar, 2022; Gasparini & Kautonen, 2022). Libraries may wish to improve the existing library services, seize the opportunity, and take a proactive approach to the new technology, or they may just want to investigate the phenomenon. There is a track of literature warning against the perils of AI or expressing the need to safeguard the existing forms of library work or values of academia. Some authors anticipate a transformation of library work, and others speculate on the need to re-conceptualise library services. All these indicate an urgent need to upskill the library workforce and build libraries' competence as organisations.

The literature also reveals empirical or conceptual experiments of AI on all familiar areas of research library activity: from material discovery and access (the earliest example by Smith, 1976) through logistics and location services (Kanarkard et al., 2017), to preservation of special collections (Hähner & Seeger, 2009). These accounts indicate that libraries are eager to automate their internal processes and operations for better efficiency and quality. One of the prominent areas in implementing AI technology is metadata production and classification of library resources (Golub et al., 2020; Guo et al., 2015; Hjorland, 2002; Maringanti et al., 2019; Niininen et al., 2017). The libraries are also motivated to let machines generate and analyse operational data, e.g., about user behaviour or library expenditure, for better prediction and managerial decisions (Ennis et al., 2013; Lund et al., 2020; Walker & Jiang, 2019).

Libraries can also use the new technology as leverage to better serve their patron communities and the public. The new technologies are considered beneficial for developing more sophisticated research services (e.g., Schneider et al., 2019) or teaching and education in libraries (Färber & Sampath, 2020). Some authors expressed their economic motivation for improving the existing library services. Investing in AI can enhance the effective use of library resources (Iqbal et al., 2020) or reduce direct costs (Bethard et al., 2009). In addition, some indicate that investing in AI can bring a competitive advantage or enhance the library's reputation as a trusted partner among other players in the research ecosystem (Jakeway, 2020; Mitchell, 2006; Padilla, 2020).

AI technologies are considered to bring such a rapid and disruptive change that they challenge our understanding of many traditional library operations and services (Arlitsch & Newell, 2017; Ewing & Hauptman, 1995; Kim, 2019). It is considered crucial that librarians rethink and reconceptualise their core expertise, e.g., in cataloguing and metadata production (Miller, 2020; Yelton, 2019), reference services (Hauptmann et al., 1997), or digital library services (Arms, 2012). Library customers' expectations will also change (Gasparini, 2020; Koehler, 2004).

Libraries should not focus on their own sphere alone but on the far-reaching impact of AI on the entire research community, their practices, and cultures. Intelligent technology will transform the modes of search and discovery, publishing and other forms of scholarly communication, higher education, as well as the dynamics of academic communities (Arlitsch & Newell, 2017; Cox et al., 2019). As online information services become more automated, it is important to redefine the relationship between academic librarians and researchers (Nolin, 2013). New strategies for the creation, distribution and use of knowledge are needed.

A librarian who follows the discussion about AI's implications may feel an anxious about their AI skills and competencies. This is not only a concern of an individual librarian: The accountability and respectability of the entire profession can be seen at stake. Information and communication technology may fundamentally enhance and challenge professional identities in knowledge-intensive fields (Andersdotter, 2023; Cox, 2023; Cox et al., 2019; Lamb & Davidson, 2005).

The innovative role of academic libraries seems to remain underrepresented. Since the technology is evolving fast and new AI-based tools supporting research and library activities are launched at an increasing pace, the preferred approach for applying them in the library workflows should rely on something other than try-and-fail.

Libraries as information and knowledge provider professionals

In the increasingly digitalised and information-intensive society, libraries maintain their role as trusted partners in knowledge sharing. At the same time as the technology giants take an autocratic rule over the internet, showing little or no accountability to users, states or any other societal powers but themselves, libraries continue emphasising the importance of "literate, informed and participative societies" (IFLA, n. d., see also IFLA, 2012, 2023). In the academic context, research librarians make the effort to guarantee open exchange of scientific

information (e.g., Tsakonas et al., 2023).

The desire to understand the work in libraries has stimulated the generation of library and information science (LIS). In the first decades of the 20th century, studies were conducted about the use of libraries and the information sources they provided for science and technology (Wilson, 2000). Throughout the years, LIS research has reacted to and reflected societal changes, especially the transformation brought about by digital technologies. The focus has moved from libraries to other information use contexts, specifically to information users. Technological developments, the digital divide and the economic divide are anticipated to drive research in the future (Byström et al., 2019, pp. 168–169; Wilson, 2010).

The shift of scholarly attention in LIS from information systems to information users was undoubtedly necessary when information technology and digital devices emerged extensively in people's everyday lives. The focus on users may have obscured the role of information providers, especially librarians, as crucial agents in human-information interaction. Librarians are still the primary group of professionals who ensure access to information resources and contemporary information infrastructures, for example, by creating metadata (Pomerantz, 2015) or as teachers of Information Literacy (IL; Andersdotter, 2023).

The "bazaar of conceptual constructs" (Fidel, 2012, p. 9) in information scientific literature mainly brings forward the distinctive aspects of information seeking and using, and leaves the characteristics of information creation hidden. One of the exceptions is the Information Seeking and Communication Model (ISCM) by Robson and Robinson (2013, 2015). As the name indicates, the model builds on the existing conceptualisations of information behaviour and draws from the theories of human communication. Image 1, applied from the revised version of the ISCM, illustrates that the information provider has an equal role as the information user in the information behaviour process. The revised version also includes collaborative amendments, i.e., communication between actors of the same role (e.g., from information provider to information provider).

The emergence of such digital innovations that penetrate society requires, sooner or later, adaptation of workplace practices. The digitalisation of workplaces brings about continuous transformation of work processes and arrangements, as well as an ongoing evolution of the entire information environment that professionals use and produce. As sites of increasingly digital work tasks, workplaces challenge the information literacy skills and competencies of the entire workforce in new ways. This phenomenon has called for new research on and conceptualisations of workplace information literacy (WIL; Widén & Teixeira, 2023).

As knowledge professionals, librarians have a strong ethos to help their patrons by adopting new technological innovations in their daily work and by improving their WIL. Although the empirical evidence of the implications of AI technology to work in academic libraries is growing, the overviews that would help libraries make their strategic choices are primarily based on speculations. Admitting this condition, Cox (2023) has drawn scenarios of AI applications in academic libraries and competencies required from librarians to transform their workplace. He anticipates that librarians will need skills in AI projects, in licencing proprietary AI products, in offering their library's collections as data for AI, in supporting their communities led by data science academics, in building institutional AI communities, in participating in extra-institutional support communities, in customising AI products to local needs, in creating tool-agnostic infrastructures, and in building own AI tools (Cox, 2023, pp. 247–277). As this exhaustive list alone indicates, the possibilities are broad. The upskilling requirements may seem overwhelming for an individual librarian. For a library director, the strategic direction may seem obscure.

Design approaches for conquering complexity

During the last two decades, various design methods and approaches have been used to address complex societal problems (Brown & Wyatt, 2010). Complex problems are often denoted as wicked problems, where one relevant feature is the lack of a definitive formulation. Complex problems are difficult to solve; "Solutions to wicked problems cannot be true or false, only good or bad" (Rittel & Webber, 1973). However, design has the power to address great complexity because design approaches support a holistic understanding of the issue to be solved (see e.g., Foster, 2021). For example, when analysing users, the context, and the interaction with library services and service providers, design helps to gain a bird-eye view of the problem area. At the same time, design supports a creative and innovative way of approaching the issues (Juntunen et al., 2013).

Design approaches often use prototyping activities to examine real-world situations, such as the interaction between humans and technology. The co-creation process materialised in a prototype can be supported by design activities like the Wizard of OZ (Auernhammer, 2020). In the context of AI and libraries, having only a human-centred approach can be constraining. Firstly, there is a need for a holistic view of the entire socio-technical problem area. Focusing on more than just human-centric aspects may enable a broader understanding situation's dynamic. Secondly, admitting that AI can create lasting and complex changes outside and inside the workspace for academic libraries, the ability to react and innovate will be crucial. Thirdly, given the increasing speed and quantity of new AI-based tools for research and studies emerging, the design tasks need to address possible future scenarios, both wished and imposed. Therefore, using a designerly way of thinking, often based on available information and creativity, is a future-oriented path to plausible outcomes and solutions (Carlsson-Kanyama et al., 2008). Two main design methods, Design Thinking (Brown, 2008) and Transition Design (Irwin, 2018), support working and addressing social and work structures.

Many design approaches encourage the involvement of external stakeholders in design activities. For instance, brainstorming first internally in the library and together with students could create a

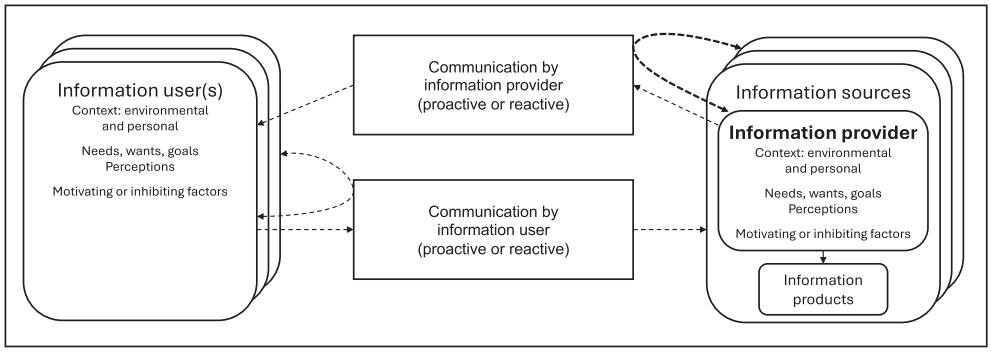

Image 1. Information Seeking and Communication Model, applied from Robson and Robinson (2015).

"*shared vision and purpose*" (Ippoliti, 2021, p. 303). Involving the stakeholders during the entire project may also ensure shared ownership of the outcome, which is a truly participatory design activity (Bech-Petersen et al., 2016).

Leaning on these design approaches, we have investigated the issues and possibilities for academic libraries in the context of AI (Gasparini et al., 2018; Gasparini & Kautonen, 2022). While looking for the best strategies to improve library competencies in AI, we organized three online workshops on the topic. The participants of the workshops were all library managers or special librarians from Europe. Each workshop lasted <2 h and had the same format. After a short presentation of relevant AI-based tools for libraries (for example, Yewno, Keenious, and Iris.ai), we conducted the first exercise on the collaboration platform (miro.com). We asked the participants to answer the question on virtual post-it notes: "What are the acute questions concerning AI/ML?" After a small break, the workshop continued with a presentation of findings from an extensive literature review on literature about AI in the context of research libraries developed by the authors (Gasparini & Kautonen, 2022). In the second exercise, we asked the participants to write answers to the following two questions: "Why should libraries involve themselves with AI/ML?" and "What kinds of AI strategies would you need in your library?"

We used the results from these three workshops to inform the development of the process model. The creative elements, such as "shifting perspective" and "seeing new possibilities" (c.f., Cropley, 2006), were crucial for enriching the outcome. The data gathered during each workshop fed the development of the model with, e.g., more practice-based concepts.

Inspiration from the Bauhaus School

Bauhaus is one of the most famous art and design schools in the history of Western education. It was founded by architect Walter Gropius in Germany in 1919 and was closed down by the Nazis in 1933. During the fourteen years of its existence, the school gathered together some of the most famous and influential modern-time artists and designers: Joseph Albers, Johannes Itten, Paul Klee, Wassily Kandinsky and László Moholy-Nagy (Whitford, 1995).

The Bauhaus School not only revolutionised art education but also industrial design. In contrast to traditional education in art and design, the Bauhaus School emphasised the integration of craftsmanship and artistic vision. The education relied on learning skills by doing exercises under the supervision of more experienced workshop masters, an idea adopted from the mediaeval guild system. The Bauhaus approach was successful, influencing the design industry and art education afterwards. "It altered the look of everything from the chair you are sitting into the page you are reading now" (Wolf von Eckardt in Whitford, 1995, p. 10).

Walter Gropius, who was the founder and director of the school in the beginning, wrote the main principles of the school into a Manifesto in 1919 (Whitford, 1995). The first principle states that the ultimate aim of all creative activity is a building, a complete house. This meant that designers should master all elements of a building, from architectural structures to furniture and fabrics. This holistic principle was adopted and maintained in other design schools throughout the Western world.

The second Bauhaus principle pursued elevating the status of the crafts to the level of fine arts. This was operationalised as shifting the level of artistic ambition in every design task, with every method and material. The roots of this principle were in the arts and crafts movement of the 19th century and designer-artists such as William Morris. The teaching methodology reflected the second principle, grounded on workshops where Bauhaus students learned the needed skills through hands-on exercises. (Whitford, 1995.)

The third Bauhaus principle emphasises establishing contacts and collaborating with the industry. The underlying goal was to ensure the economic survival of the school. However, it was also a reflection of modern, industrial times: Crafts-based art and design should not just produce unique items for individual households but be manufactured in masses and for masses. (Schuldenfrei, 2009; Whitford, 1995.)

The principles were reflected in the pedagogy and curriculum of the school, although not rigorously, and were altered from teacher to teacher (Saletnik, 2009; Siebenbrodt & Schöbe, 2012). The study element that had the most fundamental effect and long-lasting existence was the "Preliminary Course", "Vorlehre" in German. The course was a combination of elementary knowledge about visual morphology, in other words, the foundations of art and design. Students from all design disciplines participated in this course before specialising in their fields. Image 2 illustrates the curriculum structure of the Bauhaus School. It shows how the preliminary course (the outer circle) preceded the studies on advanced techniques and materials (middle circles) and the ultimate goal of building a house (the "bulls-eye").

The three Bauhaus principles – a holistic approach, learning by doing, and collaboration with the industry – have been applied by other art and design schools afterwards (Korvenmaa, 2009; Saletnik & Schuldenfrei, 2009). As late as the 1980s, at least one design school in Scandinavia offered a Bauhaus-style preliminary course for its first-year students, as one of the authors of this article witnessed during their graduate studies. The Bauhaus principles also inspired the development of the process model when we were thinking of approaching the AI competence challenges in libraries.

The B-Wheel process model

In this chapter, we describe the elements of the B-Wheel process model and explain its logic. It is essential to understand that the model is not a step-by-step guide to using any specific AI tool or skill but an open and non-deterministic approach based on principles that should help with any AI application in the research library context.

The B-Wheel process model aims to help libraries approach emerging AI technologies and tools from a holistic and generative viewpoint by considering the existing library operations. The Bauhaus Manifesto stated that to reach the ultimate goal of building a house, a designer (team) should master the fundamental principles of design and various techniques and materials. Similarly, the B-Wheel model encourages aiming at AI competency, which consists of AI-related skills and practices in many library operations.

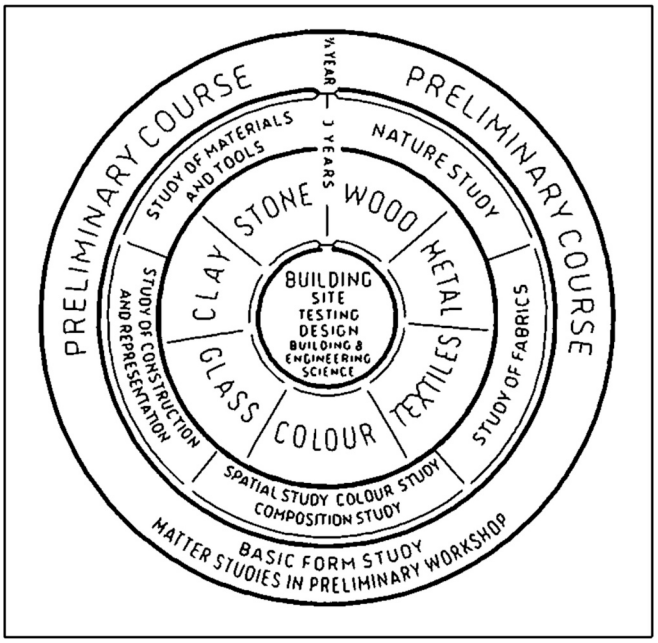

Image 2. The curriculum of the Bauhaus School, redrawn and based on Siebenbrodt and Schöbe (2012).

Components of the B-Wheel

The B-Wheel model consists of a frame of foundations, a set of operations, tasks and tools, indispensable value considerations, and a central goal of AI competencies. These are visually represented as a circle filled with sectors, an inner circle and a focal point, a "bull's-eye" in the middle (see Image 3).

This representation reflects the holistic principle: First, we argue that AI technologies will eventually, if not already, affect all library operations and, therefore, should be considered in all of them. Currently, many more AI applications assist in research support tasks than other library operations. Still, a library should also explore the potential of AI in, e.g., acquisition and metadata production. At the very least, a library should recognise the emergence of AI technologies in its digital systems and services because of their direct influence on patrons' service experience. This is obvious when the systems and services are developed in-house. However, it should be even more critical when the library has outsourced these systems and services to external technology providers.

The holistic principle is displayed in the model as an inward converging learning process that starts from the general understanding (the outermost circle) through diverse operations (sectors of the wheel on three levels) towards the ultimate goal (the focal point): AI competence (see Image 4.) Thus, the wheel consists of five levels, and the orientation, i.e., the process of building AI competence, proceeds from the outer levels towards the centre.

Next, we present the B-Wheel in detail and explain the purpose of each element. We also describe the origins or reasoning behind each element.

The outermost circle: orientation to and identification of AI basics

Aim: To orientate to the phenomenon of AI and its basic concepts.

Origins: The idea originates from the Bauhaus school's preliminary course. To focus on some skill, one needs to understand the "culture" or the fundamental "laws" of the craft and related industry. Thus, to understand and adopt AI in an academic library, one has to comprehend the foundations of AI, including the basic concepts.

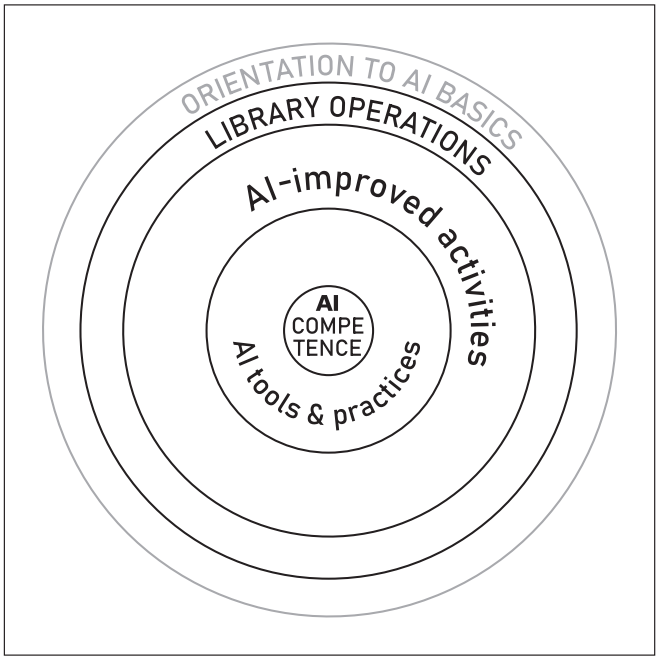

Image 3. The B-Wheel process model consists of phases visualised as nested circles.

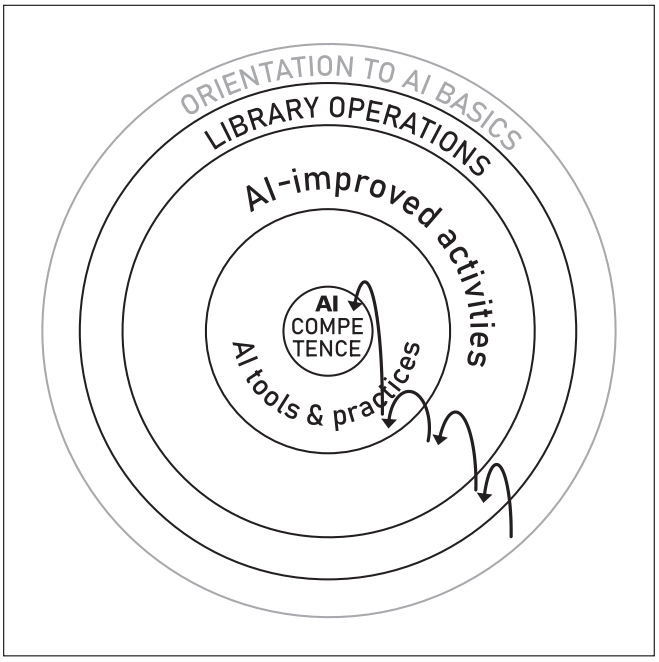

Image 4. AI competence is built from converging learning activities, starting with an orientation to AI basics and ending with the ultimate goal in the middle.

Coloured circle: existing fields of library operations

Aim: To focus on the most familiar or interesting area to a librarian or a library because it is too overwhelming to try and grasp all possible AI tools and practices simultaneously.

Origins: The presented distribution of fields is generated by authors based on three resources: a literature review of AI tools in libraries (Gasparini & Kautonen, 2022), feedback from first workshops and authors' practice-based experience of library work. The original idea is from the Bauhaus School: After the preliminary course, students focus on different areas of craftsmanship with distinctive techniques and materials. Correspondingly, different library operations can be considered as "crafts".

Middle circle: AI-improved activities or tasks (i.e., motivation to implement AI)

Aim: To define an activity or task that may/should be improved with AI. Every library or librarian has their own improvement needs. Also, the level of ambition must be adjusted to the available resources – and available AI technologies.

Origins: The examples are derived from the literature (Gasparini & Kautonen, 2022) and authors' explorations of existing tools (Gasparini & Kautonen, 2023). This is an evolving field and a moving target as new AI-powered tools will be developed over time.

Inner circle: AI tools and practices that enable the operations and activities

Aim: To experiment with and develop new AI tools and practices or test existing ones. Transitional times require a new mindset and methods for planning future library operations and activities. Instead of contemplating the aspects of AI, skills and knowledge are gained through hands-on tests and exercises, or, in other words, learning by doing.

Origins: The examples of tools and best practices are based on authors' explorations, for example, on practitioners' forums and resource lists such as the AI4LAM community. The participants of the workshops expressed strong support for hands-on experiments, as opposed to "theoretical discussions".

Centre of the circle: competence building through sharing of experiences and knowledge

Aim: To build the competence of an individual librarian as well as that of the organisation and the entire library community – for library patrons, academia and society.

Origins: The idea of reaching ultimate competence originates from the Bauhaus School. As in the times of the Bauhaus, individual geniuses seldom can master all areas of craftsmanship – or AI in libraries. Instead, building competence is group work that requires sharing aims, ideas, and experiences.

Skills are built through goal-oriented hands-on testing

The second fundamental principle of the B-Wheel model emphasises goal-oriented testing of available AI-powered tools – as opposed to just reading, hearing and talking about the possibilities or restrictions of AI. The model encourages to define clear goals for hands-on testing based on the different library operations and relevant activities included in each operation. As a difference to the general discourse about AI that focuses on the new technologies and their characteristics, the B-Wheel model urges to define the goal, the activity that a librarian or a team would prefer to improve or alter with the help of AI. Our presentation of the model suggests some exemplary activities for each sector of library operations (see Table 1).

In (Kautonen & Gasparini, 2023), we provide some examples of tools and best-practice cases for each area of library operations and related activities. In addition, we have updated the list of relevant tools (Gasparini & Kautonen, 2023) a few times as we have learned of new and relevant AI applications for the research community or libraries.

Table 1
Examples of AI-improved library activities within diverse library operations.

Library operations	Examples of AI-related activities
Metadata production and validation	– (Semi)automated metadata production (MARC records, DC records) – Multilingual subject indexing (terms from a LOD ontology)
Collections management (including digitization)	– Automatic recognition of text, images, sound, – video, etc., in the digitization process – (Semi)automated collections management – Shelving robots
Systems development or procurement	– In-house development of machine learning (ML) and AI-powered systems – Procurement process of ML/AI products or services – Partnerships for developing ML/AI systems
Discovery and information retrieval	– Algorithm-powered search – Algorithm-powered recommendation – Data-based logistics
Information literacy for library staff and patrons	– Provide AI literacy training – Provide guidelines for AI ethics – Increase AI competencies through education and training
Support services for research and education	– Automatic meta-analyses and reviews – Relevance evaluation for publications – Machine-generated references – Workshops, courses, and instructions provided by the library
Leadership and administration	– Formulate AI strategy for the library – Establish AI labs for staff – Establish AI labs for students – Adopt algorithm-powered operations management systems
Acquisition of information resources	– Prediction of use of information resources – (Semi)automatic selection of new materials (based on data about use) – Set AI application criteria for licencing agreements or contracts

Competence requires a holistic view

Following the B-Wheel process, an organisation approaches AI competence, visually represented in the middle of the circle (see Image 5). The concept refers to the social construction of knowledge and skills within an organisation – workplace information literacy, WIL – or among communities of practice. Concentrating the experiences and knowledge from the various library operations and activities, tests, and experiments ensures the holistic view that was also one of the core principles of the Bauhaus School.

In the published presentation of the B-Wheel, we encourage sharing experiences by organising events and workshops. We also encourage communication so that all relevant findings and lessons learned from one experiment or elaboration can benefit colleagues who test and use the power of AI in other areas of library work. We recommend sharing the new skills and knowledge of AI across the wider library community via national and international networks.

In this phase, we recommend paying attention to values and rights. This element of the model is most connected to the broader discourses about the AI phenomenon. What the library values are and how they should be ensured is a topic of discussion rather than a well-defined policy and a course of action. Reflecting these notions, the B-Wheel does not explicitly express nor give examples of the values to be considered. It encourages paying attention to values and rights as an essential building block of AI competency.

Design methods in the process

As explained above, we have adopted some ideas for building the B-Wheel model from the fields of art and design. Furthermore, we encourage applying a designerly way of thinking throughout building AI competencies. In the published presentation of the model, we propose a combination of methods that build on design approaches, theories, and conceptualisations, such as Transition Design (Irwin, 2018).

The published version of the model briefly explains the reasoning for using design approaches and proposes links to information resources for a viewer interested in them. On occasions when we have had the chance

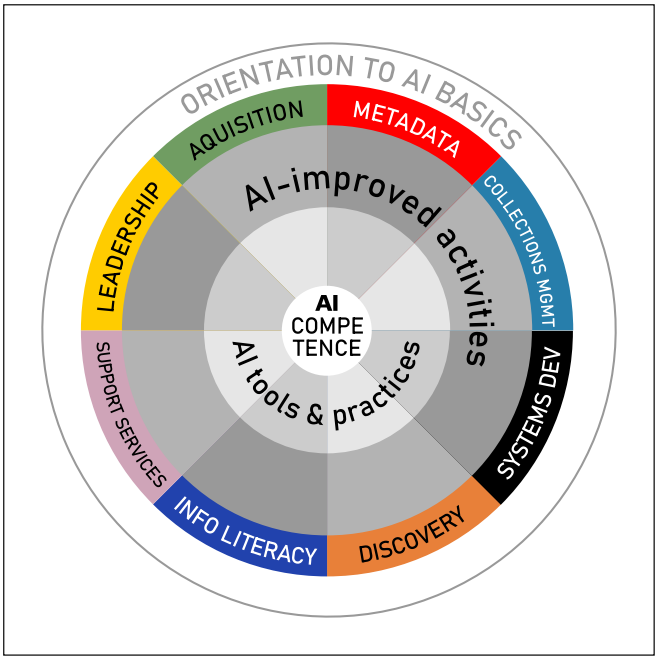

Image 5. The B-Wheel process model provides a holistic view of the existing library operations, emerging AI tools, and best practices that can be adapted to improve specific library activities.

to present the model to a live audience, we have been able to reflect more accurately on the reasons for the design approach. We have also explained that these approaches involve the competencies and practices librarians have cultivated over centuries. The entire B-Wheel model is our argument for the designerly approaches and methods.

Discussion

We published online a presentation of the B-Wheel process model and a list of relevant AI tools for research libraries in March 2023 (Kautonen & Gasparini, 2023). The publication established the working name, B-Wheel, which we had started using as a reference to the Bauhaus curriculum (see Image 1). As we had already used the B-Wheel in our workshops and mentioned the idea several times to our library colleagues, the demands to review and share the model were growing. Therefore, we created and published a presentation online for anyone to access and use. We attributed the presentation and the appending list with a Creative Commons non-copyleft free licence CC BY 4.0, hoping that the model would be applied and tested by many.

At approximately the same time, the news of the new Chat GPT chatbot by OpenAI reached the academic communities. It caused a rocketing interest in learning about AI among research libraries. Consequently, we have had plenty of invitations to share our knowledge on the topic and present the B-Wheel to diverse audiences. The response has been mostly positive: Some have appreciated the comprehensive overview that the model depicts about the application areas of AI in libraries. Others, however, have considered the model too abstract and distant from their needs. Still, within one year, the published presentation had been downloaded over 250 times.

Some libraries were alerted about the opportunities and importance of AI in the library context already before the launch of ChatGPT. In autumn 2022, we were invited to run a workshop focusing on AI in one medium-sized Scandinavian research library. In this workshop, we presented the B-Wheel as part of the programme and as an introduction to various exercises that helped the participants draft their roadmaps to adopting AI in their operations and services. This workshop served as a first validation, an "acid test", of the B-Wheel model.

At the end of the workshop, we collected feedback from the participants and asked their opinions about the usefulness of different parts and exercises. Of 30 respondents, 14 considered the presentation of the B-Wheel useful, 13 somewhat useful, and only four not very useful. The workshop was the first official introduction to the questions of AI for these librarians. Their feedback indicates that the B-Wheel model may help orientation to the phenomenon by providing an overview of the diversity of areas where AI tools can be implemented in an academic library. We argue that starting the process from existing library practices allows this. Referring to Guile (2019), who describes learning in the workplace as a continuous process of combining new knowledge with professional and vocational practices, we may say that the B-Wheel model is a tool for *recontextualisation* in the academic library.

We also made observations about workshop participants' reactions to the use of design methods. They appreciated the design activities as a means to express and materialise their concerns, doubts, questions, and fears about using AI in their work context. There is also a need to understand the practical implications of introducing AI-based tools and services for library patrons, and using design methods is a way to address the user perspective.

The participants' feedback conforms with the feedback we received from the leadership of the university library in an online interview that we conducted in spring 2024. The library has not reviewed the B-Wheel model after the workshop, but the first time was an "eye-opening bird-view" of AI's impact on the library. After the workshop, it was easier for them to choose two specific and relevant areas of library activities for further elaboration: "Research and learning processes: teaching, source criticism, tools" and "Document management: cultural heritage, metadata production, image recognition etc., library profession and culture, catalogue". The library also created an arena where personnel could be creative and exploratory with AI. As a result, the library produced a video and a course on AI for their patrons.

The principles of the Bauhaus School signposted the future of Western product design to unforeseen transformation. In the coming years or decades, the academic world may witness radical changes in scholarly practices because of the power of AI technologies. We want to harness the professional expertise of academic libraries in this change through the same principles applied in the Bauhaus School: a holistic approach, learning by doing, and collaboration with the industry.

The first three rows in Table 2 display the goals or intended impact of the Bauhaus principles on the design competencies and references to the literature discussing these impacts. The rightmost column presents our intention to apply equivalent features in the B-Wheel process model. As seen in the table, we have not been able to comprehensively implement the third Bauhaus principle – collaboration with the industry – in the model. This could be seen as a limitation of the work, or it could show directions for future development of the B-Wheel process model.

By promoting designerly ways of thinking and design approaches, we have pursued another goal that has been recognised as an impact of the Bauhaus approach. Le Masson et al. (2016) have demonstrated that the "splitting condition", i.e. the non-determinism and non-modularity of the Bauhaus curriculum, led to a high level of generativity. They argued that this was one of the success factors of the curriculum and its revolutionary impact on the design industry. With the openness of the B-Wheel model, i.e., the premise to implement the model in a way that suits an individual library in its context, we have aimed to equal generativity. The last row of Table 2 indicates this desired equivalence between the Bauhaus approach and the B-Wheel process model.

The media and the scholarly literature on AI mainly address values in alarming and protective modes. More attention has been paid to the values of libraries and academia in general. For example, the new strategy of the European Research Library Association LIBER points out rights and values as one of its key priorities (LIBER, 2022). Regarding AI, the values to be safeguarded by libraries highlight free access to knowledge, information literacy and reliability of algorithm-generated research resources or services. Librarians have begun to express their concerns about ethics and humanity's future in the age of AI.

In this diversity of viewpoints, we argue that an academic library

Table 2
Features of the Bauhaus curriculum, their goals or intended impact, and the equivalents in the B-Wheel model.

Curriculum of the Bauhaus School	Goal or intended impact	References	Equivalent in the B-Wheel model
The holistic principle, incl. teaching the fundamentals of design, different materials and methods	Achieve professional competency	Whitford, 1995	Holistic view to approaching AI in libraries, incl. orientation to AI basics, fields of library operations, tools and practices
Materiality explored through hands-on exercises	Demonstrate the potential of the "medium"; meaning induced through practice	Whitford, 1995; Saletnik & Schuldenfrei, 2009	Designerly methods, incl. hands-on testing of tools
Collaboration with the industry	Design for the mass-production to be used by the public (not only luxury products for a few)	Whitford, 1995; Schuldenfrei, 2009	Not applicable in the presented version of the model
The "splitting condition" (i.e. non-determinism and non-modularity) of the curriculum	High-level generativity	Le Masson et al., 2016	The openness (non-deterministic nature) of the process model

cannot build adequate AI competencies by improving its skills in narrow areas of AI implementation. A strategic approach requires acknowledging that AI applications will penetrate all library operations to some extent, sooner or later. The B-Wheel process model helps take a strategic charge over the new phenomenon, and it may also ease the tensions among library personnel, e.g., by helping more cautious library staff understand the AI enthusiasts.

By no means have we been the only ones to suggest approaches and compose lists of available AI-powered tools that are relevant in the library context. Individual librarians, libraries and library associations have answered the call from their communities by providing guidance, resource listings, workshops, and discussion forums (e.g., AI4LAM et al., 2021; IFLA, 2022; Quinn & Burns, 2023). We argue that our B-Wheel model complements these valuable resources with its overview of the application areas of AI, particularly from the perspective of existing library operations and activities.

More conceptual aids are needed to understand (reconceptualise) the new roles of libraries in the age of AI. Koehler (2004) envisions that AI and expert systems will increasingly help human information specialists in their role of expert intermediation. He predicts that smart technologies can become counterparts to humans in the mediation process between digital and non-digital collections and the library patron. Furthermore, Ylipulli and Luusua (2019) argue that a truly sustainable approach to societal transformation owing to new technologies should address the macro, *meso*, and micro levels of governance and collaboration models. In their view, libraries can open relevant meso-level design spaces where new technologies and services can be developed in a more inclusive manner (ibid.).

The B-wheel may also help library leaders better understand the role the library can take, both on the meso and macro levels. The library may be well positioned and skilled to address AI-related issues in research, as the increasing requests from faculties to their university libraries in Norway indicate. Thus, the library can take the meso-level role of an AI consultant in the university. At the macro level, the B-wheel may help the leadership inform wider stakeholder groups about different aspects of AI, also outside academia. In addition to ensuring workplace information literacy (WIL; Widén & Teixeira, 2023) in the university, the library can continue being the trusted partner in information literature (IL) and AI (Andersdotter, 2023).

With the detailed description of the B-Wheel model and its origins in this article, we aim to contribute to the scholarly discussion about the desirable approaches to adopting AI for knowledge discovery. We find resonance with the B-Wheel in the analysis by Cox and Mazumdar (2022). Drawing from the literature, they propose four types of AI use cases in libraries: library back-end processes, library services for users, data scientist community creation, data and AI literacy, and user management. All these types can be located on the middle circle of the B-Wheel: AI-improved activities or tasks that denote the motivation to implement AI in the library. Because the proposal by Cox and Mazumdar also offers an indication of required skills and knowledge, as well as key drivers and barriers, we can imagine the benefit of combining the knowledge from their conceptualisations with the B-Wheel model. Their arguments about the potential impact of AI on equality, diversity and inclusion provide an excellent example of the attention to values and rights that we allude to.

Conclusions and future work

In this paper, we have presented a process model targeted at academic libraries in their quest to approach, understand, and build competencies with AI technologies. We drew inspiration for the model from the Bauhaus School for art and design, which operated in Germany at the beginning of the 20th century. The principles and the curriculum of the Bauhaus School inspired us to name and shape the model: The B-Wheel process model has a resemblance with the visual representation of the Bauhaus curriculum. The incentives for the AI-related elements in the library context originated in our explorations of the literature on AI and with the available AI-powered tools. Three workshops for academic librarians informed and helped us shape the B-Wheel to the form we published online in March 2023.

The most severe limitation of the B-Wheel model is that it has not been extensively validated. The model has been tested on the field only once in a Scandinavian university library workshop. The workshop results and the interview of this library's leadership encourage further application of the model in other libraries. This study also invites feedback from other scholars looking for or constructing conceptual aids to better understand the phenomenon of AI competencies in research libraries.

Still, we consider that the model has potential as a starting point for more advanced elaborations and evolution. For example, the connection of the B-wheel with sustainable meso- and macro-level approaches could be addressed by adding a layer that extends outwards from the current elements. The B-Wheel could reach out from the library operations towards library patrons and other stakeholders in the society. If these stakeholders included the AI technology providers who provide services or partner with academic libraries, the B-Wheel model would finally apply the third principle of the Bauhaus School, namely, collaboration with the industry. Sustainable development goals could inform this kind of work in the future.

Funding

No funding was received for this work.

Intellectual property

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

Research ethics

We further confirm that any aspect of the work covered in this manuscript that has involved human participants has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

CRediT authorship contribution statement

Heli Kautonen: Writing – original draft, Visualization, Validation, Methodology, Investigation, Conceptualization. **Andrea Alessandro Gasparini:** Writing – original draft, Validation, Methodology, Investigation, Conceptualization.

Declaration of competing interest

No conflict of interest exists.

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Acknowledgements

We thank all the workshop participants and our colleagues in research libraries who contributed to this research during 2021–2022. We are especially grateful to Karin Cecilia Rydving from the University or Bergen Library for her encouragement and feedback on this work. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

AI4LAM, LIBER, A. of E. R. L., & BnF, B. N. de F. (2021, December 3). *New Workshop Series – 'Applying and deploying Artificial Intelligence (AI) in GLAMs.'* https://libereurope.eu/article/new-workshop-series-applying-and-deploying-artificial-intelligence-ai-in-glams/.

Andersdotter, K. (2023). Artificial intelligence literacy in libraries: Experiences and critical impressions from a learning circle. *Journal of Information. Literacy, 17*(2). https://doi.org/10.11645/17.2.14

Arlitsch, K., & Newell, B. (2017). Thriving in the age of accelerations: A brief look at the societal effects of artificial intelligence and the opportunities for libraries. *Journal of Library Administration, 57*(7), 789–798. https://doi.org/10.1080/01930826.2017.1362912

Arms, W. Y. (2012). The 1990s: The formative years of digital libraries. *Library Hi Tech.*. https://doi.org/10.1108/07378831211285068

Auernhammer, J. (2020). Human-centered AI: The role of human-centered design research in the development of AI. In S. Boess, M. Cheung, & R. Cain (Eds.), *Synergy - DRS International Conference 2020* (pp. 1315–1333). https://doi.org/10.21606/drs.2020.282, 11-14 August, Held online.

Bech-Petersen, S., Maerkedahl, L., & Krogbaek, M. (2016). Participatory design and public galleries, libraries, archives and museums (GLAM) sector. In *, 2. Proceedings of the 14th Participatory Design Conference: Short Papers, Interactive Exhibitions, Workshops* (pp. 115–116). https://doi.org/10.1145/2948076.2948095

Bethard, S., Ghosh, S., Martin, J. H., & Sumner, T. (2009). Topic model methods for automatically identifying out-of-scope resources. In *Proceedings of the 9th ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 19–28). https://doi.org/10.1145/1555400.1555405

Brown, T. (2008). *Design Thinking. Harward Business Review, 86*(6), 84–92.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation (SSIR). *Stanford Social Innovation Review, 30*(5).

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues, 8*(2), 5–21. https://doi.org/10.2307/1511637

Byström, K., Heinström, J., & Ruthven, I. (2019). Information at work: Information management in the workplace. *Facet*.

Carlsson-Kanyama, A., Dreborg, K. H., Moll, H. C., & Padovan, D. (2008). Participative backcasting: A tool for involving stakeholders in local sustainability planning. *Futures, 40*(1), 34–46. https://doi.org/10.1016/j.futures.2007.06.001

Cox, A. (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), 367–380. https://doi.org/10.1002/asi.24635

Cox, A. M., & Mazumdar, S. (2022). Defining artificial intelligence for librarians. *Journal of Librarianship and Information Science, 096100062211420*. https://doi.org/10.1177/09610006221142029

Cox, A. M., Pinfield, S., & Rutter, S. (2019). The intelligent library: Thought leaders' views on the likely impact of artificial intelligence on academic libraries. *Library Hi Tech, 37*(3), 418–435. https://doi.org/10.1108/LHT-08-2018-0105

Cropley, A. (2006). In praise of convergent thinking. *Creativity Research Journal, 18*(3), 391–404. https://doi.org/10.1207/s15326934crj1803_13

Ennis, D., Medaille, A., Lambert, T., Kelley, R., & Harris, F. C. (2013). A comparison of academic libraries: An analysis using a self-organizing map. *Performance Measurement and Metrics, 14*(2), 118–131. https://doi.org/10.1108/PMM-07-2012-0026

European Commission. (2019). *Ethics Guidelines in Trustworthy AI*. European Commission. https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai.

Ewing, K., & Hauptman, R. (1995). Is traditional reference service obsolete? *The Journal of Academic Librarianship, 21*(1), 3–6. https://doi.org/10.1016/0099-1333(95)90144-2

Färber, M., & Sampath, A. (2020). HybridCite: A hybrid model for context-aware citation recommendation. *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries in, 2020*, 117–126. https://doi.org/10.1145/3383583.3398534

Fidel, R. (2012). Theoretical constructs and models in information-seeking behavior. In R. Fidel (Ed.), *Human information interaction: An ecological approach to information behavior*. The MIT Press. https://doi.org/10.7551/mitpress/9780262017008.003.0003 (p. 0).

Foster, M. K. (2021). Design thinking: A creative approach to problem solving. *Management Teaching Review, 6*(2), 123–140. https://doi.org/10.1177/2379298119871468

Gasparini, A. (2020). *Design thinking for design capabilities in an academic library* [University of Oslo]. https://www.duo.uio.no/handle/10852/72835.

Gasparini, A., & Kautonen, H. (2022). Understanding artificial intelligence in research libraries – Extensive literature review. *LIBER Quarterly: The Journal of the Association of European Research Libraries, 32*(1). https://doi.org/10.53377/lq.10934

Gasparini, A., & Kautonen, H.. *AI-BASED TOOLS for research libraries*. https://urn.fi/URN:NBN:fi-fe2023032933862.

Gasparini, A., Mohammed, A. A., & Oropallo, G. (2018). Service Design for Artificial Intelligence. In *ServDes.2018 Conference Proceedings Co-Creating Services* (pp. 1064–1073).

Golub, K., Hagelback, J., & Ardo, A. (2020). Automatic classification of Swedish metadata using Dewey decimal classification: A comparison of approaches. *Journal of Data and Information Science, 5*(1), 18–38. https://doi.org/10.2478/jdis-2020-0003

Guile, D. (2019). The concept of "recontextualization": Implications for professional, vocational and workplace learning. *Learning, Culture and Social Interaction, 23*, Article 100343. https://doi.org/10.1016/j.lcsi.2019.100343

Guo, J.-L., Wang, H.-C., & Lai, M.-W. (2015). A feature selection approach for automatic e-book classification based on discourse segmentation. *Program, 49*(1), 2–22. https://doi.org/10.1108/PROG-12-2012-0071

Hähner, U., & Seeger, B. (2009). IT-supported long-term risk analysis for the Savigny estate at Marburg university library. *Restaurator. International Journal for the Preservation of Library and Archival Material, 30*(3), 149–164. https://doi.org/10.1515/rest.010

Hauptmann, A. G., Witbrock, M. J., & Christel, M. G. (1997). Artificial intelligence techniques in the interface to a Digital Video Library. In *CHI '97 extended abstracts on human factors in computing systems* (pp. 2–3). https://doi.org/10.1145/1120212.1120214

Hjorland, B. (2002). Domain analysis in information science: Eleven approaches: Traditional as well as innovative. *Journal of Documentation, 58*(4), 422–462. https://doi.org/10.1108/00220410210431136

IFLA. (2012). IFLA Code of Ethics for Librarians and other Information Workers (full version). https://repository.ifla.org/handle/123456789/1850?mode=full.

IFLA. (2023, December 20). IFLA newsletter, December 2023: The values, ethics and rights issue. IFLA Newsletter https://www.ifla.org/news/ifla-newsletter-december-2023/.

IFLA. (n.d.). IFLA, International Federation of Library Associations and Institutions. https://www.ifla.org/.

IFLA, A. I. S. (2022, December). 23 resources to get up to speed on AI in 2023. https://www.ifla.org/23-resources-to-get-up-to-speed-on-ai-in-2023/.

Ippoliti, C. (2021). Beyond the looking glass: Applying a futures thinking perspective for managing liaison roles. In R. Canuel, & C. Crichton (Eds.), *Approaches to liaison librarianship: Innovations in organization and engagement*. Association of College & Research Libraries. http://ebookcentral.proquest.com/lib/oslo/detail.action?docID=6423566.

Iqbal, N., Jamil, F., Ahmad, S., & Kim, D. (2020). Toward effective planning and management using predictive analytics based on rental book data of academic libraries. *IEEE Access, 8*, 81978–81996. https://doi.org/10.1109/ACCESS.2020.2990765

Irwin, T. (2018, June 28). The emerging transition design approach. In *Design Research Society Conference 2018, Limerick, Ireland*. https://doi.org/10.21606/drs.2018.210

Jakeway, E. (2020). *Machine learning + libraries summit event summary* (p. 39). Library of congress. https://labs.loc.gov/static/labs/meta/ML-Event-Summary-Final-2020-02-13.pdf.

Juntunen, A., Muhonen, A., Nygrén, U., & Saarti, J. (2013). Reinventing the academic library and its Mission: Service Design in Three Merged Finnish Libraries. In A. Woodsworth, & W. David Penniman (Eds.), *Vol. 36. Mergers and alliances: The wider view* (pp. 225–246). Emerald Group Publishing Limited. https://doi.org/10.1108/S0065-2830(2013)0000036011.

Kanarkard, W., Seemajaruek, C., Pongsuwan, T., & Inlam, T. (2017). Predictive analytic of library patron behavior. In *Proceedings of the 3rd international conference on communication and information processing* (pp. 1–5). https://doi.org/10.1145/3162957.3162961

Kautonen, H., & Gasparini, A. (2023). B-Wheel. In *A Process Model for approaching AI in research libraries* (Online Material) https://urn.fi/URN:NBN:fi-fe2023032933868).

Kim, B. (2019). Chapter 3. AI and creating the first multidisciplinary AI lab. *Library Technology Reports, 55*(1), Article 1.

Kimbell, L. (2019). Designing policy objects: Anti-heroic design. In T. Fisher, & L. Gamman (Eds.), *Tricky design: The ethics of things* (pp. 145–157). Bloomsbury Publishing Plc. https://doi.org/10.5040/9781474277211.

Koehler, W. (2004). Digital libraries, digital containers, "library patrons", and visions for the future. *The Electronic Library, 22*(5), 401–407. https://doi.org/10.1108/02640470410561910

Korvenmaa, P. (2009). *Taide & teollisuus: Johdatus suomalaisen muotoilun historiaan* (Taideteollinen korkeakoulu).

Krippendorff, K. (2006). *The semantic turn*. A New Foundation for Design: Taylor & Francis.

Lamb, R., & Davidson, E. (2005). Information and communication technology challenges to scientific professional identity. *The Information Society, 21*(1), 1–24. https://doi.org/10.1080/01972240590895883

Le Masson, P., Hatchuel, A., & Weil, B. (2016). Design theory at Bauhaus: Teaching "splitting" knowledge. *Research in Engineering Design, 27*(2), 91–115. https://doi.org/10.1007/s00163-015-0206-z

LIBER. (2022). *LIBER Strategy 2023–2027*. https://libereurope.eu/wp-content/uploads/2022/01/LIBER_STRAT_A5_digital-final-1.pdf.

Lo, L. S. (2023). AI policies across the globe: Implications and recommendations for libraries. *IFLA Journal, 49*(4), 645–649. https://doi.org/10.1177/03400352231196172

Lund, B. D., Omame, I., Tijani, S., & Agbaji, D. (2020). Perceptions toward artificial intelligence among academic library employees and alignment with the diffusion of Innovations' adopter categories | Lund | College & Research Libraries. *College and Research Libraries, 81*(5), 865–882. https://doi.org/10.5860/crl.81.5.865

Maringanti, H., Samarakoon, D., & Zhu, B. (2019). *Machine learning meets library archives: Image analysis to generate descriptive metadata*. Univeristy of Utah. https://www.lyrasis.org/Leadership/Documents/Catalyst%20Fund/UU-version2-MachineLearning-CatalystFund-WhitePaper.pdf.

Miller, J. (2020). The new library user: Machine learning. *EDUCASE Review, 55*(1). https://er.educause.edu/articles/2020/2/the-new-library-user-machine-learning.

Mitchell, S. (2006). Machine assistance in collection building: New tools, research, issues, and reflections. *Information Technology and Libraries, 25*(4), 190. https://doi.org/10.6017/ital.v25i4.3353

Niininen, S., Nykyri, S., & Link to external site, this link will open in a new window, & Suominen, O. (2017). The future of metadata: Open, linked, and multilingual – The

YSO case. *Journal of Documentation, 73*(3), 451–465. https://doi.org/10.1108/JD-06-2016-0084

Nolin, J. M. (2013). The special librarian and personalized meta-services: Strategies for reconnecting librarians and researchers. *Library Review, 62*(8/9), 508–524. https://doi.org/10.1108/LR-02-2013-0015

OECD. (2022). *Recommendation of the council on OECD Legal instruments artificial intelligence* (OECD/LEGAL/0449; OECD Legal instruments). https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449.

Padilla, T. (2020). Responsible operations: Data science, machine learning, and AI in libraries. https://www.oclc.org/research/publications/2019/oclcresearch-responsible-operations-data-science-machine-learning-ai.html.

Pomerantz, J. (2015). *Metadata.* The MIT Press.

Quinn, B., & Burns, E. (2023). *December 6*. Artificial Intelligence Tools for Detection, Research and Writing: Texas Tech University. https://guides.library.ttu.edu/artificialintelligencetools/aitools.

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155–169.

Robson, A., & Robinson, L. (2013). Building on models of information behaviour: Linking information seeking and communication. *Journal of Documentation, 69*(2), 169–193. https://doi.org/10.1108/00220411311300039

Robson, A., & Robinson, L. (2015). The information seeking and communication model: A study of its practical application in healthcare. *Journal of Documentation, 71*(5), 1043–1069. https://doi.org/10.1108/JD-01-2015-0023

Saletnik, J. (2009). Pedagogic objects Josef Albers, Greenbergian modernism, and the Bauhaus in America. In J. Saletnik, & R. Schuldenfrei (Eds.), *Bauhaus construct: Fashioning identity, discourse and modernism* (pp. 83–102). Routledge.

Saletnik, J., & Schuldenfrei, R. (Eds.). (2009). *Bauhaus construct: Fashioning identity, discourse and modernism.* Routledge.

Schneider, J., Adams, C., DeBauche, S., Echols, R., McKean, C., Moran, J., & Waugh, D. (2019). Appraising, processing, and providing access to email in contemporary literary archives. *Archives and Manuscripts, 47*(3), 305–326. https://doi.org/10.1080/01576895.2019.1622138

Schuldenfrei, R. (2009). The irreproducibility of the Bauhaus object. In J. Saletnik, & R. Schuldenfrei (Eds.), *Bauhaus construct: Fashioning identity, discourse and modernism.* Routledge.

Siebenbrodt, M., & Schöbe, L. (2012). *Bauhaus (1. Aufl.)*. Parkstone-International.

Smith, L. C. (1976). Artificial intelligence in information retrieval systems. *Information Processing & Management, 12*(3), 189–222. https://doi.org/10.1016/0306-4573(76)90005-4

Tsakonas, G., Zoutsou, K., & Perivolari, M. (2023). *Secondary Publishing Rights in Europe: Status, challenges & opportunities*. Zenodo doi:https://doi.org/10.5281/ZENODO.8428315.

UNESCO. (2022). Recommendation on the Ethics of Artificial Intelligence. https://www.unesco.org/en/artificial-intelligence/recommendation-ethics.

Walker, K. W., & Jiang, Z. (2019). Application of adaptive boosting (AdaBoost) in demand-driven acquisition (DDA) prediction: A machine-learning approach. *The Journal of Academic Librarianship, 45*(3), 203–212. https://doi.org/10.1016/j.acalib.2019.02.013

Whitford, F. (1995). *Bauhaus (reprinted, [preface 1991])*. Thames & Hudson.

Widén, G., & Teixeira, J. (Eds.). (2023). *Information literacy and the digitalization of the workplace.* facet publishing.

Wilson, T. D. (2000). Human information behavior. *Informing. Science, 3*, 49–56. https://doi.org/10.28945/576

Wilson, T. D. (2010). Fifty years of information behavior research. *Bulletin of the American Society for Information Science and Technology, 36*(3), 27–34. https://doi.org/10.1002/bult.2010.1720360308

Yelton, A. (2019). Chapter 2. HAMLET: Neural-net-powered prototypes for library discovery. *Library Technology Reports, 55*(1), Article 1.

Ylipulli, J., & Luusua, A. (2019). Without libraries what have we? Public libraries as nodes for technological empowerment in the era of smart cities, AI and big data. In *Proceedings of the 9th international conference on Communities & Technologies - transforming communities* (pp. 92–101). https://doi.org/10.1145/3328320.3328387