



Enhancing Digital Library Accessibility through Artificial Intelligence for Individuals with Disabilities: A Systematic Literature Review

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Abstract

Digital libraries are now the main route to scholarly content, yet their content, interfaces and services still exclude many disabled users, and promotion of artificial intelligence (AI) as a remedy has outpaced evidence that it works for them. Framed by the social model of disability and the Convention on the Rights of Persons with Disabilities (CRPD), this systematic literature review, reported according to PRISMA 2020, examined which AI technologies have been applied to digital library accessibility, what has been measured, and what follows for disabled users. Boolean searches of OpenAlex, Semantic Scholar, the Directory of Open-Access Journals, PubMed and ERIC identified 1,056 records; after removal of 429 duplicates and two-stage screening against explicit criteria (peer-reviewed, 2016–2025, English), 26 studies were included and synthesised thematically. Speech synthesis, speech recognition, natural language processing, document AI, optical character recognition, computer vision alt text and machine learning personalisation were studied, mostly for blind and print-disabled users. Coding every claim into three registers showed that 11 studies only describe what a technology does, 13 measure system or provider-side performance, and only two report outcomes measured with disabled users, both through self-report; this absence of outcome evidence is a principal finding. Audited conformance of scholarly documents is poor; disabled people appear mainly as beneficiaries, not co-designers. The review contributes an evidence-graded, five-stage integration model that specifies actors, gates and failure handling, and recommends treating AI outputs as unverified until evaluated with disabled users. Findings rest on single-reviewer screening and published records, and the model awaits empirical testing.

Introduction

The evolution of digital libraries has been shaped significantly by advances in technology, particularly artificial intelligence (AI). Libraries once stored information in print, and digitising collections was an early step toward broader access; as retrieval systems grew more sophisticated, AI technologies such as natural language processing (NLP), speech recognition, and machine learning further revolutionised how digital libraries operate (Almufareh et al., 2024).

The term AI was introduced by John McCarthy and colleagues in their 1955 proposal for the Dartmouth summer research project held in 1956 (McCarthy et al., 2006), and is now generally understood as the science and engineering of creating intelligent machines capable of performing tasks typically requiring human intelligence (Cox & Mazumdar, 2024). AI systems operate with varying levels of autonomy, and their applications are crucial for improving accessibility: speech



recognition, for instance, can assist users who are deaf or hard-of-hearing by converting spoken words into text, and users with physical impairments by replacing keyboard input with voice, while NLP supports search and summarisation that ease information retrieval (Almufareh et al., 2024; Chemnad & Othman, 2024). Speech synthesis, often called text-to-speech, is a distinct technology that converts written text into audible speech for blind, partially sighted and print-disabled readers.

The British Library has used AI to identify underutilised resources and recommend collection updates, keeping collections relevant and accessible (Ikwuanusi et al., 2023). Likewise, Okunlaya et al. (2022) propose a conceptual framework for AI library services intended to make university libraries more inclusive and equitable, although it has not been evaluated with disabled users.

Few statements on AI ethics have been issued within the library profession, and the Robodebt case, in which datasets were combined through AI methods without adequate safeguards, shows why ethically grounded practice is needed (Bradley, 2022; Henman, 2025). Before reviewing the evidence, the paper therefore defines its object of study and the rights framework against which AI is judged.

Defining the Object of Study

This review defines a digital library as an organised collection of digital content together with the services, operational policies and professional staff that support information discovery, retrieval and long-term use for a designated community (Borgman, 2025). It includes institutional repositories, digital collections and the interfaces through which users reach them. A catalogue or library website is one point of access, while an e-learning platform and a records archive have different primary purposes. Studies of these adjacent systems are considered only when their technology acts on digital library content or interfaces (Tammaro, 2024).

Scholarly documents such as journal articles, e-books and theses, and the platforms that deliver them, are treated as digital library content because they are the objects that library users retrieve. Physical library way-finding, prosthetics, rehabilitation systems and e-government websites therefore fall outside the scope of the review.

Three related terms are also kept distinct. Accessibility denotes the extent to which content and services can be perceived, operated and understood by disabled people on an equal basis with others, and is operationalised here through the Web Content Accessibility Guidelines (WCAG) (United Nations, 2006, art. 9; W3C, 2023a). Usability denotes the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in a specified context of use (ISO, 2018). Inclusion denotes full and effective participation in the life of the library and the academy (United Nations, 2006, art. 3). A service can conform to WCAG and still be unusable for a particular user, and it can be usable without being inclusive if disabled people had no say in its design; the three terms are therefore reported separately throughout.

Disability, Rights and the Conceptual Framework

The review adopts the social model of disability, in which disability arises from the interaction between people with impairments and barriers in the environment rather than from impairment alone (Oliver, 2013), extended by the human-rights model, which treats accessibility and participation as entitlements rather than as welfare (Degener, 2016). The CRPD gives this position legal form. Article 1 recognises that long-term impairments, in interaction with barriers, may hinder full and equal participation; Articles 9, 21 and 24 secure access to information and communications technologies, accessible formats and inclusive education; and Article 4(3) requires the active involvement of disabled people through their representative organisations (United Nations, 2006). Kenya ratified the CRPD in 2008 and has since enacted the Persons with Disabilities Act, 2025 (Republic of Kenya, 2025). The Act, in force from 27 May 2025, gives effect to



Article 54 of the Constitution of Kenya, which entitles persons with disabilities to reasonable access to information and to materials and devices that overcome disability-related constraints (Republic of Kenya, 2010, art. 54(1)(c), (e)). Section 26(3) requires public and private institutions to provide public information, including through the internet, in accessible formats, and section 20(8)(b) requires learning institutions to provide assistive devices and adaptive technologies (Republic of Kenya, 2025). The Marrakesh Treaty permits libraries to make accessible-format copies of published works for print-disabled readers (World Intellectual Property Organisation, 2013). The CRPD is therefore the reference instrument for this review.

This framing also answers the critique advanced by Clark and Lischer-Katz (2023). Drawing on their research on immersive technologies in academic libraries, they argue that libraries adopt AI and other emerging technologies under a technocratic logic in which accessibility is an afterthought, so that disabled users are made to adjust their bodies and senses to systems designed without them. Their argument implies that an AI tool cannot be judged accessible because of what it is designed to do; it must be judged by what happens when disabled people use it and by whether they helped to shape it. Figure A1 (Appendix A) sets out the resulting conceptual framework: rights obligations define the barriers that matter; AI functions are one possible response to those barriers; and every claim about a function is assigned to one of three evidence registers, namely what the technology does (Register A), what a study measured (Register B), and what followed for disabled users (Register C). Standards and law, ethics and data governance, and the participation of disabled people moderate every pathway.

Previous Reviews and the Gap

Earlier reviews establish the wider field but leave distinct questions for this paper. Chemnad and Othman (2024) examine AI and digital accessibility across settings, while Campoverde-Molina and Luján-Mora (2026) map AI in web accessibility. Tunjungsari and Suprihatin (2024) review AI and accessible library services using ScienceDirect, and Khumalo et al. (2025) consider smart technologies for disadvantaged users in academic libraries. This review focuses on digital library content and services, differentiates technical functions from measured outcomes for disabled people, and interprets the findings alongside disability rights and institutional obligations.

This review examines AI applications in digital libraries, the measures reported and the outcomes established for disabled users. It also identifies ethical and standards-related issues and develops an evidence-graded integration model for library decision makers.

The review addresses four questions. RQ1: Which AI technologies have been applied to digital library accessibility for disabled people between 2016 and 2025, for which impairment groups and for which functions? RQ2: What has been measured in these studies, and what outcome evidence exists for disabled users? RQ3: What ethical, standards-related and governance considerations does the literature raise? RQ4: What model for integrating AI into digital libraries follows from this evidence?

Method

This study is a systematic literature review reported in accordance with the PRISMA 2020 statement (Page et al., 2021). No protocol was prepared or registered for this review.

Eligibility Criteria

Studies were eligible when they addressed disabled users or disability-related barriers; an AI application relevant to digital library content, interfaces or services; and a peer-reviewed journal article, conference paper or book chapter published in English between 2016 and 2025. Screening excluded preprints without a peer-reviewed version, editorials, reports, physical-library-only applications and studies without a substantive disability, AI or digital library focus. Where full-



text was inaccessible, eligibility and extractable claims were checked against the English-language publisher record and abstract, and this was recorded during extraction.

A Note on the Sources Cited

The eligibility criteria apply only to the 26 studies synthesised as review evidence, marked with an asterisk in the reference list. Other cited works establish definitions, historical background, disability theory, legal obligations, technical standards or review methods. Some are prior reviews, conceptual papers or commentaries on AI and accessibility (Almufareh et al., 2024; Chemnad & Othman, 2024; Cox & Mazumdar, 2024; Morris, 2020; Okunlaya et al., 2022), and one is a document-accessibility audit involving no AI, which is therefore ineligible (Kumar & Wang, 2024). They are cited only for definitions, frameworks, arguments and context; their claims are reported as positions, not findings, and carry no evidence register. Sources published before 2016, such as the Salamanca Statement and the CRPD, frame the review but provide no evidence about current AI tools and are not counted in the PRISMA total.

Information Sources and Search Strategy

OpenAlex and Semantic Scholar, two open multidisciplinary indexes covering IEEE, ACM and Springer computing, library and information science, and African and Asian open-access titles; the Directory of Open-Access Journals (DOAJ); PubMed; and ERIC. Google Scholar was not used because it does not support reproducible Boolean retrieval or export (Gusenbauer & Haddaway, 2020). The search combined three concept blocks with AND, and synonyms within each block with OR: an AI block, a digital library block and a disability-or-accessibility block. The query was run against titles and abstracts for 2016 to 2025 through each source's public application programming interface on 24 September 2026 (OpenAlex) and 25 September 2026 (other sources).

The full search string, as executed in OpenAlex, and its translation into the syntax of each source are given in Table B1 (Appendix B).

Selection Process

Records were merged and duplicates removed by DOI and normalised title. The author screened titles and abstracts, then assessed available full records against the eligibility criteria. An AI assistant, SciSpace (accessed September 2026), executed the queries, removed duplicates and proposed a first-pass inclusion or exclusion code for each record. It prepared but did not make decisions: the author reviewed every record, confirmed or overturned every proposed code, and made all eligibility, extraction, register and appraisal decisions. Because every classification was re-checked, not a sample, no agreement rate is reported. Figure A2 (Appendix A) reports exclusions and records that could not be retrieved.

Data Collection and Development of the Extraction Tool

An extraction form derived from the conceptual framework (Figure A1, Appendix A) recorded each study's setting, design, disability focus, AI function, library object, standards, ethical issues, participant involvement, measures and highest evidence register. Register A describes or proposes a function without evaluation; B measures a system, content, workflow or providers' views; C measures an outcome with disabled participants.

Appraisal of Included Studies

Since the corpus includes different designs, each study was appraised on five criteria adapted from Hong et al. (2018): identifiable peer-review; clear aim and method; reported data or evaluation; involvement of disabled people; and a defined accessibility, usability or participation measure. Four or five criteria indicated high, two or three moderate, and zero or one low appraisal. Ratings informed interpretation but did not exclude studies. This bespoke appraisal has not been independently validated. The criteria met least often are reported in the Results. The appraisal was not repeated after an interval, so intra-rater agreement cannot be reported.



Synthesis

Following Thomas and Harden (2008), extracted findings were coded using framework categories and emerging issues, grouped by AI function, and interpreted across evidence, standards, participation and ethics. Each claim was assigned its highest supporting register.

Results

Study Selection and Characteristics

The searches identified 1,056 records. After 429 duplicates were removed, 627 records were screened on title and abstract and 582 were excluded, most because they concerned clinical or health applications, library AI without a disability focus, or accessibility outside a library context. Of the 45 reports sought, five could not be retrieved, and 14 of the 40 assessed were excluded with reasons (Figure A2, Appendix A). Twenty-six studies were included.

Table B2 (Appendix B) describes the 26 studies: 19 appeared in 2024 or 2025, 16 were journal articles, nine conference papers and one a book chapter. Four were reviews and three conceptual, critical or historical works. Two primary studies were set in Africa: South African speech synthesis and Nigerian university librarians' readiness (Schlünz et al., 2017; Omeluzor & Nwaomah, 2025).

Visual or print disability dominated the corpus: 17 studies addressed these users and 12 focused on them exclusively. One focused on deaf and hard-of-hearing users (Rodriguez & Brown, 2023). Physical, cognitive and learning disabilities received less attention; none focused primarily on intellectual disability or deafblind users. Six studies concerned speech synthesis, four voice interaction, three document processing, two generated image descriptions, one personalisation and ten multiple functions.

The evidence registers expose the central gap. Eleven studies described or proposed functions without evaluation (Register A); 13 measured systems, content, workflows or providers' views (Register B); and two reported outcomes with disabled users (Register C). Kishore et al. (2024) and Sreedhar Kumar et al. (2025) relied on self-report, without a validated accessibility measure evident in their published accounts. Both studies met appraisal criterion one on the basis of their venues' published peer-review policies (IGI Global, n.d.; American Journal of AI Cyber Computing Management, n.d.). However, article-specific review records were unavailable, so peer-review of either study could not be independently verified. Sulaiman et al. (2025) tested a repository voice assistant with 35 students but did not report their disability status. Technical capability therefore cannot be equated with improved access for disabled users.

Appraisal placed three studies in the high category (Kavčič Čolić & Hari, 2024; Kishore et al., 2024; Shen et al., 2025), 22 in the moderate category and one in the low category. The criteria met least often were the involvement of disabled people (two studies) and an outcome defined against a named standard or measure (two studies).

Against this evidence profile, the sections that follow report, for each function, what the included studies show and at which register.

Natural Language Processing and Speech Synthesis

Natural language processing (NLP) analyses language for functions such as query interpretation, structuring and summarisation (Khurana et al., 2023). These distinct functions are relevant to different access barriers and should not be treated as interchangeable measures of accessibility.

Speech synthesis is the most mature accessibility function in the corpus and the one most closely tied to library collections. At Register A, Kalbande (2025) conceptualises AI read-aloud tools as shifting library use from reading to listening and as extending librarians' responsibilities for training and mediation. At Register B, Schlünz et al. (2017) integrated synthetic voices for South African languages into augmentative communication, screen readers and accessible e-books;



Fume et al. (2016) evaluated a system that converts plain text into DAISY talking-book content; and Songtirapunya et al. (2016) generated Thai EPUB 3 audio books at about one hundred sentences per minute, although correcting 30 synthesis errors took 90 minutes and 40 of 99 images still required human description, which took about three hours. Utne and Odu (2025) found speech synthesis markup of journal articles too labour-intensive and adopted a more compatible EPUB template, and Ramadhan and Suhirman (2024) developed an e-book reader with adjustable synthetic voices that early users reported as supportive. The pattern is consistent: synthesis makes text audible at scale, but its quality depends on human correction and on the structure of the source document, and none of these studies measured comprehension or reading outcomes with print-disabled readers.

Machine learning within NLP allows systems to improve with data and user feedback. Cox and Mazumdar (2024) argue that this can lead to more accurate and personalised assistive solutions. Text-similarity metrics such as the Bilingual Evaluation Understudy (BLEU) and Recall-Oriented Understudy for Gisting Evaluation (ROUGE) compare machine output with a human-written reference; they indicate the fidelity of generated text but are not measures of accessibility, and where they appear in the corpus they are used alongside error rates to judge formatting quality (Pitcairn et al., 2025). AI-powered chatbots extend NLP into real-time query assistance and recommendations (Cox & Mazumdar, 2024), and image recognition complements NLP by describing images for users with visual impairments (Almufareh et al., 2024). These benefits depend on transparency, freedom from surveillance and algorithmic literacy being built into library NLP deployments (Bradley, 2022).

Speech Recognition

Word error rate measures substitutions, omissions and insertions against a reference transcript; it does not alone establish accessible use (Rodriguez & Brown, 2023). In the corpus, speech recognition serves two distinct groups. For deaf and hard-of-hearing users, Rodriguez and Brown (2023) evaluated several automatic speech recognition tools for captioning and transcribing the audiovisual collections of a university repository. For users who find typing difficult, Sallaah et al. (2025) designed voice search for a digital library that combines speech recognition, NLP and machine learning, and Sulaiman et al. (2025) tested a voice assistant for an academic repository with 35 students, who reported high satisfaction; because their disability status was not reported, this result cannot be read as evidence from disabled users. Pitcairn et al. (2025) extended recognition to spoken mathematics, reporting word and character error rates for converting speech into LaTeX. All of these studies report Register B evidence; none measures caption comprehension with deaf users or task performance with physically disabled users.

Automated tools also change library work: staff must check captions, document structure and output quality, and help patrons when services fail. The Nigerian survey by Omeluzor and Nwaomah (2025) measured librarians' awareness and readiness, not improvements in access, so training and support remain institutional requirements.

Machine Learning

Machine learning (ML) personalises the user experience within digital libraries and has been proposed as a means of automating accessibility audits and compliance checks (Okunlaya et al., 2022), although automated checking detects only part of the failures that a standard defines and must be combined with manual testing using assistive technologies (see Standards and Compliance). ML also underpins adaptive interfaces: Yogapriya et al. (2025), for example, trained a gradient-boosting model to predict font size and style for partially sighted older readers of e-books, although the study evaluated model fit rather than reading performance.



The only Register C evidence in the corpus concerns ML-driven search, recommendation and assistance services. Users with visual, auditory and mobility impairments reported benefits from voice recognition, speech synthesis and AI-powered search and recommendation in library services (Kishore et al., 2024), and visually and hearing-impaired users of an academic digital library reported improved accessibility experiences alongside higher engagement and satisfaction (Sreedhar Kumar et al., 2025). These are the strongest findings in the review, yet they rest on two studies and on self-reported measures.

The Artificial Intelligence Library Services Innovative Conceptual Framework (AI-LSICF) shows how these functions can be organised for university libraries (Okunlaya et al., 2022), but stronger privacy safeguards are needed against deductive disclosure, ableism-biased datasets and the medical model of disability (Morris, 2020). Realising these gains depends on collaboration between developers, disability advocacy groups and disabled people (Almufareh et al., 2024; Clark & Lischer-Katz, 2023).

Computer Vision and Document Analysis

Computer vision, a further subset of AI, uses models trained on labelled images to classify pixel patterns and output recognised characters or candidate descriptions (Szeliski, 2022). These are statistical estimates, not perception, and fail in ways human viewers do not, so machine descriptions remain unverified until a person checks them. Applied to scanned documents, optical character recognition (OCR) converts page images into machine-readable text, the precondition for screen reading and speech synthesis of digitised collections. Kavčič Čolić and Hari (2024) assessed the digitisation workflows of 13 European libraries against 24 criteria derived from WCAG and found that partners using a commercial OCR engine and producing tagged PDF or PDF/UA output achieved the best results, which shows that OCR accuracy alone is insufficient without document structure. Document AI addresses that structure: Schmitt-Koopmann et al. (2022) proposed using AI document analysis to tag reading order, headings and mathematical formulae in STEM PDFs, and Ingram et al. (2023) proposed converting electronic theses from PDF into structured HTML with extracted figures, tables and summaries.

For images, Shen et al. (2025) reported that transformer-generated alt text reduced accessibility errors in EPUB files by 97.5 per cent in automated checking, and Hellman and Snijder (2024), having found that only 156 of 1,144 open-access EPUB books contained useful alt text, began testing machine vision and large language models for image description. The human workload reported by Songtirapunya et al. (2016) for describing images is the problem these tools address, but none of the studies has yet asked blind readers whether machine descriptions are adequate. These benefits also depend on transparent, non-discriminatory algorithms (Cox & Mazumdar, 2024).

Participation of Disabled People

Inclusive design aims to ensure that all users, regardless of disability, have equitable access to information and educational resources, and it requires diverse representation throughout the design and development process. Commentators argue that underrepresentation of people with disabilities and other marginalised groups in AI development roles can produce biased systems that fail to serve all users effectively, whereas engaging stakeholders from varied backgrounds during data collection and analysis helps identify potential problems early and results in more inclusive AI solutions (Cox & Mazumdar, 2024; Morris, 2020). Needs also vary within physical, sensory, cognitive and neurological disability, and higher-education institutions must align their definitions of disability with the CRPD to ensure that premises and information are genuinely accessible (Almufareh et al., 2024; United Nations, 2006).



Measured against that standard, the corpus positions disabled people almost entirely as beneficiaries. Only the two Register C studies involved disabled people as participants, and no included study reports disabled people or their organisations as co-designers, as CRPD Article 4(3) would require. The evidence reviewed here is consistent with the diagnosis of Clark and Lischer-Katz (2023) that accessibility is retrofitted rather than designed in, since the most common pattern is a system built and measured without disabled users and then described as enabling them.

The accessibility challenges these technologies address differ markedly by impairment type. Users with visual impairments struggle to perceive on-screen information, which screen readers, voice commands and image description address (Chemnad & Othman, 2024); users with auditory impairments struggle with audio content, which transcription and captioning address (Rodriguez & Brown, 2023; Ikwuanusi et al., 2023); and users with physical impairments struggle with keyboards, touchscreens or a mouse, which adaptive keyboards, eye-tracking and voice control address (Almufareh et al., 2024; Chemnad & Othman, 2024). The conceptual framework (Figure A1) therefore pairs personalised, standards-compliant services with inclusive design practices responsive to the diverse requirements of all users (Ikwuanusi et al., 2023; Okunlaya et al., 2022), and requires that each claim of this kind be tested at Register C before it is relied upon.

Applications Across Disability Types

For blind and print-disabled users, the included studies examine synthetic speech, audio books, document remediation, alternative text and adaptive typography (Schlünz et al., 2017; Songtirapunya et al., 2016; Kavčič Čolić & Hari, 2024; Shen et al., 2025; Yogapriya et al., 2025). A readable EPUB, a correctly structured PDF and an understandable image description each require separate checking; successful output from one tool does not establish access to the complete resource.

For deaf and hard-of-hearing users, captions and transcripts can make library audiovisual collections more usable (Rodriguez & Brown, 2023). Word accuracy is important, but timing and non-speech information also matter. Sign-language translation has been proposed for outreach content (Hariyani Putri & Adiba, 2024), although the included evidence does not establish effective use by deaf library patrons.

For users with physical impairments, voice search can offer an alternative to keyboard input (Sallaah et al., 2025; Sulaiman et al., 2025). For users with cognitive or learning disabilities, structured documents and summarisation have been proposed (Ingram et al., 2023), but user outcomes were not established. Intellectual disability and deafblindness are not directly examined in the included corpus. This uneven coverage limits how broadly the paper can speak of “individuals with disabilities.”

Standards and Compliance

Universal Design Principles hold that environments and products should be usable by everyone regardless of ability, and AI is argued to advance this goal by converting content between text, speech, and image formats as needed (Almufareh et al., 2024). Doing so responsibly requires disabled people in design and testing, to avoid ableism-biased and non-representative datasets (Morris, 2020).

The Web Content Accessibility Guidelines (WCAG) provide the central technical standard. Statutes in the United States, Europe and Kenya adopt WCAG by reference; in Kenya, section 26(3) of the Persons with Disabilities Act, 2025 and Kenya Standard KS 2952-1:2022 anchor the conformance target in national law (Republic of Kenya, 2025; Kenya Bureau of Standards, 2022). WCAG versions and these instruments are detailed in Appendix C. For documents, PDF/UA (ISO, 2014) and EPUB Accessibility 1.1 (W3C, 2023b) specify conformance for the two formats in which



most scholarly content is delivered. This review adopts WCAG 2.2 Level AA as the conformance target for digital library interfaces, and PDF/UA or EPUB Accessibility 1.1 for documents, because these are the most recent stable versions and Level AA is the level most commonly adopted in law.

Compliance nonetheless remains poor wherever it has been audited. Kumar and Wang (2024), in an audit that involved no AI and is cited as context rather than as review evidence, found that fewer than 3.2 per cent of 20,000 scholarly PDFs published between 2014 and 2023 met six basic accessibility criteria and that 74.9 per cent met none, with accessibility declining since 2019; Hellman and Snijder (2024) found that fewer than one in seven open-access EPUB books carried useful alt text. AI-based remediation offers one route to improving compliance at scale (Schmitt-Koopmann et al., 2022; Shen et al., 2025), but its outputs must themselves be tested against the standard.

Best practice combines automated accessibility checking, which detects only part of the failures that a standard defines, with manual testing using screen readers and other assistive technologies, as Kumar and Wang (2024) did to corroborate their automated results, together with ongoing staff training, awareness programmes, and structured user feedback (Tunjungsari & Suprihatin, 2024).

Table B3 (Appendix B) summarises the key findings by theme, with the highest evidence register reached and the supporting studies.

Discussion

The results show that AI functions in digital libraries are well described and often technically measured, but rarely evaluated with disabled users. The discussion considers what this means for ethics and governance, sets out an evidence-graded model for integration, draws implications for theory, practice and policy, and then acknowledges the review's limitations.

Ethical Considerations

Algorithmic bias is a central ethical concern in this review. When training data underrepresent particular groups, AI systems may perform less reliably for them, even when overall performance appears strong (Caton & Haas, 2024). For disabled users, this risk arises when datasets do not adequately reflect atypical speech, different interaction patterns or the use of assistive technologies (Morris, 2020). The integration model therefore requires libraries to examine performance by impairment group rather than rely on average results. Fairness-auditing techniques can reveal whether sensitive characteristics or their proxies affect outcomes, while involving disabled people throughout data collection, design and governance can help identify exclusions earlier (Caton & Haas, 2024; Cox & Mazumdar, 2024). Adversarial remedies may be unstable when data about protected groups are limited, particularly in transfer learning (Caton & Haas, 2024). The European Union's Artificial Intelligence Act illustrates a regulatory effort to address such risks and protect fundamental rights (European Parliament & Council of the European Union, 2024).

Privacy presents a related responsibility. Machine learning and natural language processing systems may collect or process personal information, raising questions about what data libraries and vendors retain, how they use it and who can access it (Cox & Mazumdar, 2024). Libraries should therefore ask vendors how they audit training data and favour systems whose operation, data practices and safeguards can be examined, especially when disability-related information is involved (Bubinger & Dinneen, 2021; Morris, 2020). Responsibility also extends beyond the AI tool itself. Publishers' and platforms' production decisions strongly influence whether scholarly documents are accessible and who controls the formats in which they are supplied (Kumar & Wang, 2024). Within a library's own collections, Rodriguez and Brown (2023) show how the limitations and ethical questions of AI-generated captions can be addressed openly as part of an accessibility programme.



Standards require institutions to turn these concerns into accountable practice. Users, developers and regulators should have a role in the design and governance of AI systems, supported by transparent data policies that recognise differences among people with visual, hearing, physical and cognitive disabilities (Bubinger & Dinneen, 2021). Governance approaches differ, from Australia's voluntary model to China's state-led plan and the European Union's regulation (Bradley, 2022). Libraries must therefore interpret the rules that apply in their own setting while maintaining clear responsibility for accessibility, privacy and redress. For Kenyan libraries, the CRPD and the Persons with Disabilities Act, 2025 provide the rights framework for that responsibility (Republic of Kenya, 2025; United Nations, 2006).

An Evidence-Graded Model for Integration

Figure A3 and Table B4 (Appendices A and B) present an evidence-graded five-stage model. It names responsible actors, sets gates before deployment, provides responses to failure and preserves a human-supported route. The model is derived from the synthesis and has not been tested in a live library.

The first and final model stages are supported mainly by arguments about governance and accountability (Register A). Content remediation and interaction services have stronger technical evaluation (Register B), while only two self-report studies reach Register C. Libraries can act on measured system performance, but the next step is to test whether intended users can find and use resources. Stage 4 makes this local outcome evaluation a condition of continued deployment.

Implementation requires cooperation among librarians, technologists, institutional leaders and disabled users. Human-centred design begins with the tasks people need to perform, tests the interface in context and revises it after feedback (ISO, 2019). Staff training and accessible-format support remain necessary even when AI tools are introduced (Kalbande, 2025; Omeluzor & Nwaomah, 2025). A minimum viable version of each stage, for libraries without specialist staff, is given in the note to Table B4 (Appendix B).

Monitoring requires metrics that fit the function being monitored. Speech recognition is measured by word error rate, not by precision, recall or F1 (Pitcairn et al., 2025); and conformance is established against the success criteria of WCAG, PDF/UA or EPUB Accessibility. None of these technical measures answers the question that matters under the CRPD, which is whether disabled users can find, read and use library content as effectively as others. Stage 4 therefore measures effectiveness, efficiency and satisfaction with disabled users, reported by impairment group (ISO, 2018), while collection-management forecasting measures are outside this accessibility model. Because AI systems can be retrained, every update is treated as a new deployment that must pass the gates of Stages 2 to 4 again, rather than assuming that systems improve themselves in users' interests.

Implications for Theory, Practice and Policy

Theoretically, the review distinguishes the availability of an AI function from disabled users' ability to access library resources and participate in learning; institutional preparedness helps explain the gap between the two. In practice and policy, this implies the following for policymakers, technologists and library administrators.

For policymakers, priorities include embedding ethical safeguards and transparency requirements into AI policy, minimising bias in AI systems, and fostering cross-sector collaboration in which governments provide funding and infrastructure, technology firms bring innovation, and organisations of persons with disabilities contribute insight into user needs. Policy should require conformance to WCAG 2.2 Level AA, PDF/UA and EPUB Accessibility 1.1 in library procurement, fund outcome studies with disabled users, and, in Kenya, align institutional policy with the CRPD and the Persons with Disabilities Act, 2025. Policy guidelines should remain open enough to adapt



to different AI systems and should involve all affected stakeholders, from users and civil-society organisations to regulators, legislators and industry.

For technologists, the priority is collaborative development with accessibility experts and people with disabilities themselves, so that tools such as screen readers, text-to-speech systems, and multimodal interfaces genuinely meet user needs. Compliance with WCAG should be verified against Level AA using automated checkers together with manual testing with screen readers, with particular attention to persistent barriers such as inaccessible PDFs and uncaptioned video content. Technologists should report performance by impairment group, publish error rates alongside any claim of accessibility, and label machine-generated descriptions and captions until a person has reviewed them. They should also avoid fostering dependence on automation and support user autonomy.

For library administrators, service design should favour deliberate, purposeful technology adoption over rapid, solutionist rollouts that risk excluding disabled users, building on frameworks such as AI-LSICF (Okunlaya et al., 2022) and on the five-stage model proposed here. Sustained investment in staff training and user education, including workshops, tutorials and case studies, remains essential, and should be tailored to the barriers patrons face using data on practice and insight from librarians, accessibility experts and disabled users. Administrators should also keep a non-AI route open, such as human transcription or accessible-format requests under the Marrakesh Treaty, for every function that AI is introduced to perform.

Limitations

This review has seven limitations. A single-reviewer screened, extracted and appraised studies, so misclassification is possible despite written criteria. Restricting English-language records excluded relevant non-English scholarship, including Najafgholinejad's (2024) Persian-language study with 33 visually impaired library users. Five reports could not be retrieved, and some included studies were assessed from publisher abstracts rather than full texts, limiting appraisal and possibly understating measured outcomes. No protocol was registered, so the methods cannot be checked against a prior plan. Several sources making substantive claims about AI and accessibility sit outside the screened corpus and are cited as positions, not evidence. An AI assistant (SciSpace) proposed first-pass screening codes; the author re-checked every one, but the appraisal was not repeated after an interval, so intra-rater agreement is unknown. Finally, the integration model has not been tested in a library. A future update should use two reviewers, broader language coverage and full-text retrieval, then evaluate the model with disabled university library users, including in African settings.

Conclusion

Artificial intelligence offers digital libraries ways to address barriers faced by users with visual, hearing and physical impairments. Speech synthesis, natural language processing, speech recognition, machine learning and computer vision can help make content audible, captioned, structured and described at scale. The evidence for improved outcomes is much weaker: only two of the 26 studies measured outcomes with disabled users, and both relied on self-report. This review therefore cannot conclude that these technologies have improved users' access, independence or confidence.

Realising AI's potential requires libraries to address algorithmic bias, protect sensitive disability-related information and evaluate accessibility throughout implementation. The five-stage model proposed in this review connects interface design, accessible content, standards and ongoing evaluation, but it has not yet been tested in a library. Future research should test it with disabled people and their organisations, from design to evaluation.



The potential for AI to transform digital libraries into more accessible and inclusive environments is substantial. Realising it depends less on introducing new tools than on designing and evaluating services with disabled people from the outset. Used thoughtfully and ethically, AI can support more equitable access to information and educational resources, enrich the library experience and contribute to a more informed and engaged society.

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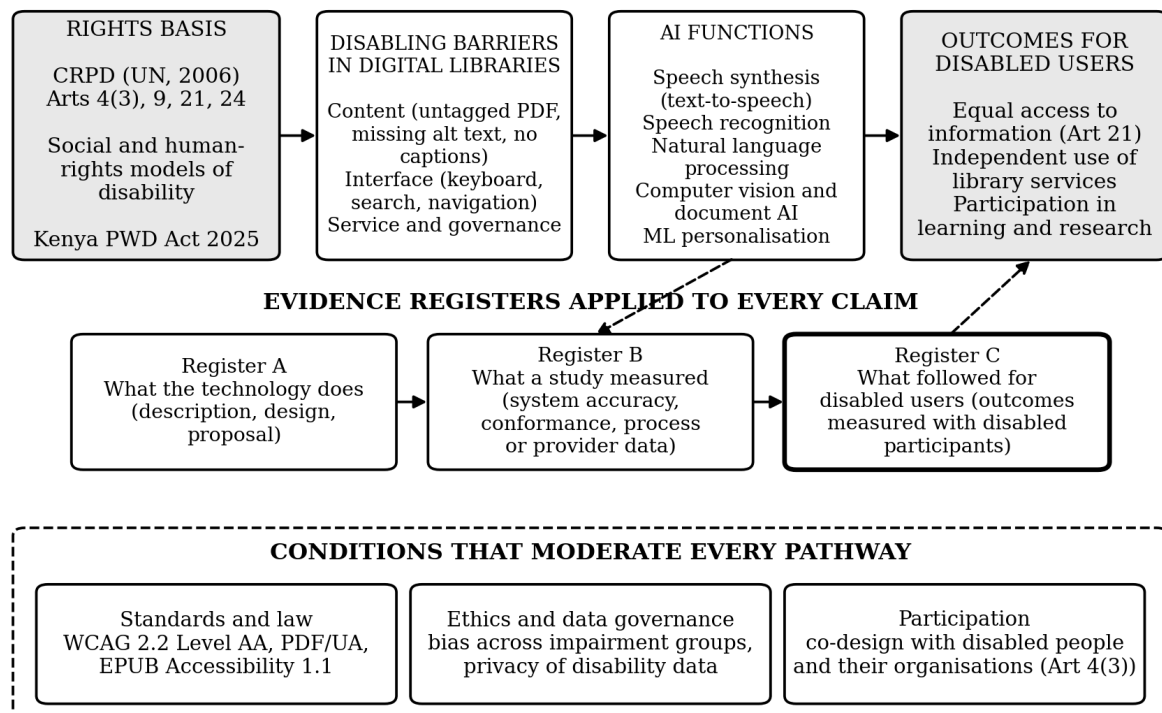
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Appendices

Appendix A. Figures

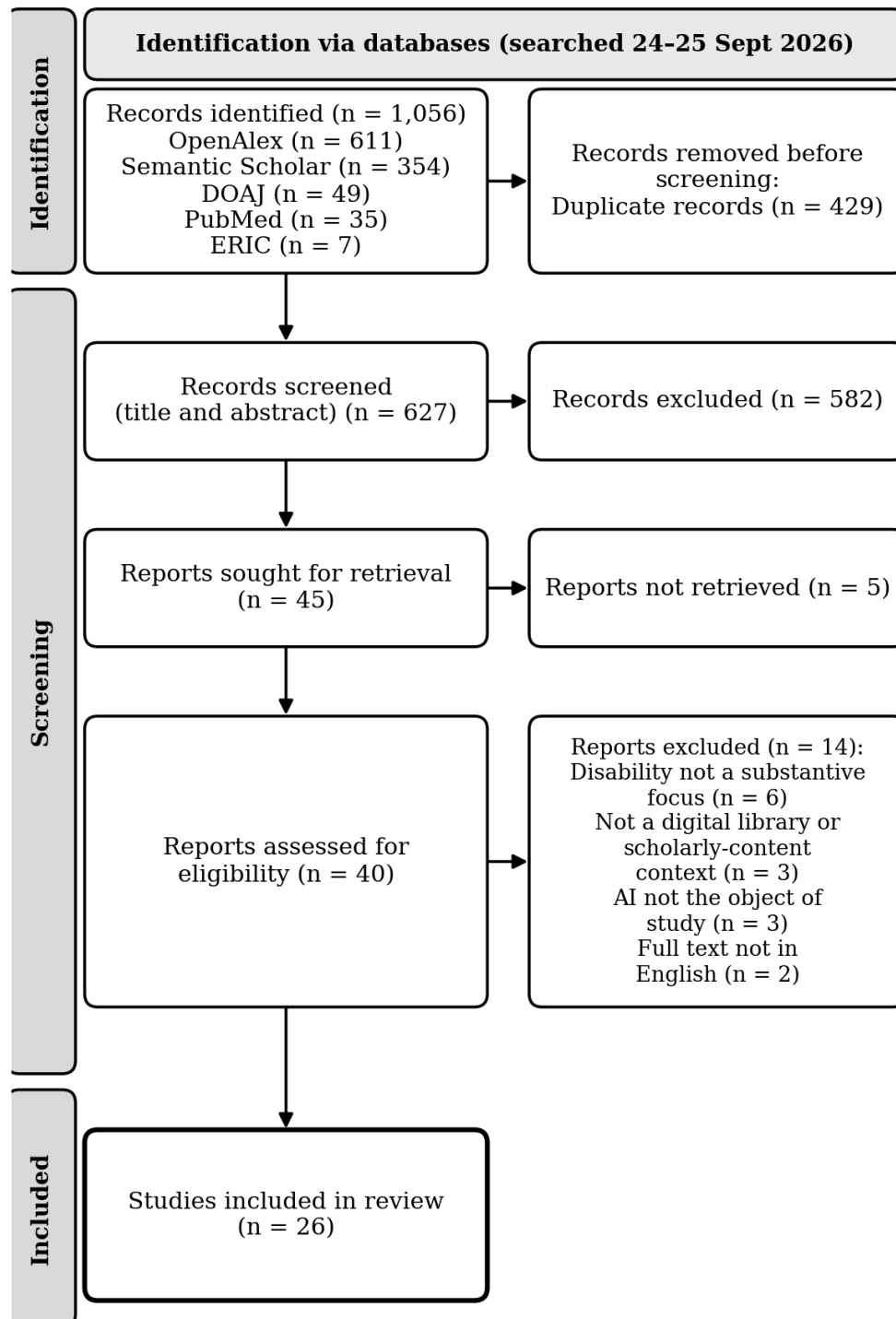
Figure A1: Conceptual framework: rights basis, barriers, AI functions and three registers of evidence



Source: Author, derived from Oliver (2013), Degener (2016), United Nations (2006) and Clark and Lischer-Katz (2023).



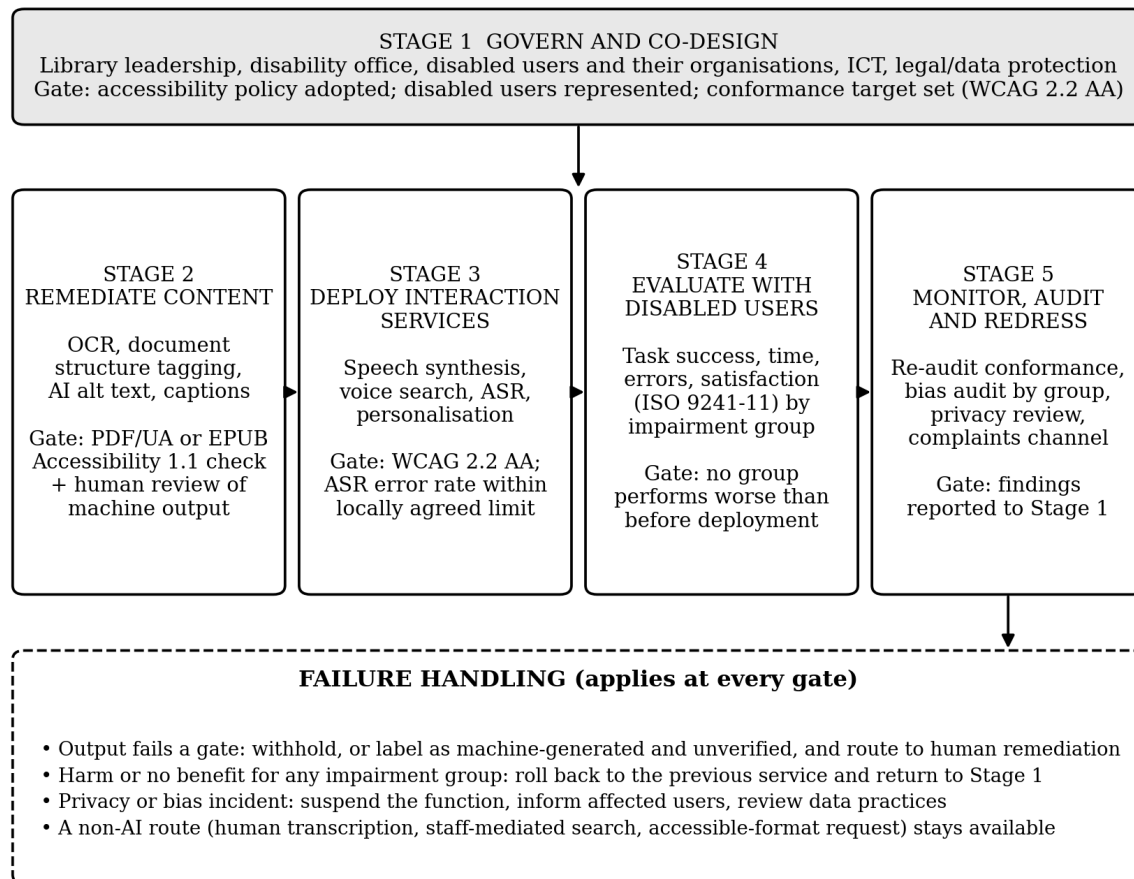
Figure A2: PRISMA 2020 flow diagram of study identification, screening and inclusion



Source: Author, adapted from Page et al. (2021).



Figure A3: Evidence-graded model for integrating AI into digital library accessibility



Source: Author, derived from the synthesis.



Appendix B. Tables

Table B1: Sources, Syntax, Dates and Yields of the Database Searches

Source	Field, syntax and limits	Date searched	Records
OpenAlex	title_and_abstract.search; Boolean AND/OR with quoted phrases; publication_year 2016–2025	24 Sep 2026	611
Semantic Scholar	paper/search/bulk (title and abstract); + for AND, for OR; year 2016–2025	25 Sep 2026	354
DOAJ	Article search; Boolean AND/OR; bibjson.year:[2016 TO 2025]	25 Sep 2026	49
PubMed	[tiab] field tags; truncation (); 2016:2025[dp]	25 Sep 2026	35
ERIC	API search; Boolean AND/OR; publicationdateyear:[2016 TO 2025]	25 Sep 2026	7
Total			1,056

Note: All searches limited to publication years 2016–2025

Search string as executed in OpenAlex (translated into the syntax of each source as shown in Table B1):

("artificial intelligence" OR "machine learning" OR "deep learning" OR "natural language processing" OR "speech recognition" OR "text-to-speech" OR "speech synthesis" OR "computer vision" OR "optical character recognition" OR "alt text" OR "image captioning" OR "chatbot") AND ("digital library" OR "digital libraries" OR "academic library" OR "academic libraries" OR "university library" OR "library services" OR "library website" OR "library websites" OR "institutional repository" OR "scholarly documents" OR "scientific documents" OR "e-books" OR "ebook" OR "EPUB") AND (disability OR disabilities OR disabled OR "visually impaired" OR "visual impairment" OR blind OR "print disabilities" OR deaf OR "hard of hearing" OR "assistive technology" OR "screen reader" OR accessibility)

Table B2: Characteristics, Evidence Register and Appraisal of the Included Studies (n = 26)

Study	Type; setting	Impairment focus	AI function	Register	Appraisal
Clark & Lischer-Katz (2023)	Critical essay; USA	Disabled users (general)	Several (AI, XR)	A	Moderate
Čuković & Blagojević (2025)	Descriptive-historical; Montenegro	Visual	Several	A	Moderate
Dixit (2024)	Comparative review; India	Physical, visual	Several	A	Moderate
Fume et al. (2016)	Conference; n.s.	Print disability (DAISY)	Speech synthesis	B	Moderate
Hariyani Putri & Adiba (2024)	Qualitative observation; Indonesia	Disabled users (general)	Several (sign language, audio description)	A	Moderate
Hellman & Snijder (2024)	Conference; audit of OAPEN e-books	Blind, print disability	Computer vision, generative alt text	B	Moderate
Ikwuanusi et al. (2023)	Narrative review	Visual, hearing	Several	A	Low
Ingram et al. (2023)	Conference poster; USA	Visual, cognitive, learning	NLP, computer vision (document AI)	A	Moderate



Study	Type; setting	Impairment focus	AI function	Register	Appraisal
Kalbande (2025)	Conceptual	Disabled users (general)	Speech synthesis	A	Moderate
Kavčič Čolić & Hari (2024)	Evaluation; 13 European libraries	Blind, partially sighted	OCR, document structure	B	High
Khumalo et al. (2025)	Systematic review	Students with disabilities	Several	A	Moderate
Kishore et al. (2024)	Mixed methods; book chapter	Visual, auditory, mobility	Several (voice, TTS, search, recommendation)	C	High
Omeluzor & Nwaomah (2025)	Survey of librarians; Nigeria	Visual, hearing	Several	B	Moderate
Pitcairn et al. (2025)	Conference; technical evaluation	Users of spoken mathematics	Speech recognition, LLM	B	Moderate
Ramadhan & Suhirman (2024)	System development; Indonesia	Disabled users (general)	Speech synthesis	B	Moderate
Rodriguez & Brown (2023)	Technical evaluation; USA	Deaf, hard of hearing	Speech recognition (captions)	B	Moderate
Sallaah et al. (2025)	System design	Physical (typing difficulty)	Speech recognition, NLP, ML	A	Moderate
Schlünz et al. (2017)	Conference; South Africa	Print disability, speech impairment	Speech synthesis	B	Moderate
Schmitt-Koopmann et al. (2022)	Conference (doctoral); Switzerland	Visual	Document AI	A	Moderate
Shen et al. (2025)	Conference; technical evaluation	Visual	Generative alt text	B	High
Songtirapunya et al. (2016)	Conference; Thailand	Blind	Speech synthesis	B	Moderate
Sreedhar Kumar et al. (2025)	Mixed methods; India	Visual, hearing	Several (search, recommendation, assistant)	C	Moderate
Sulaiman et al. (2025)	System and usability study (n = 35)	Not reported	Speech recognition, NLP	B	Moderate
Tunjungsari & Suprihatin (2024)	Systematic review	Disabled users (general)	Several	A	Moderate
Utnes & Odu (2025)	Case study; Norway	Print disability	Speech synthesis	B	Moderate
Yogapriya et al. (2025)	Conference; model development	Partially sighted older readers	ML personalisation	B	Moderate

Note: Register A = describes, designs, proposes, reviews or argues; B = measures system, content, workflow or providers; C = measures an outcome with disabled participants. Appraisal: high = 4–5 criteria met, moderate = 2–3, low = 0–1. n.s. = not stated in the published record.



Table B3: Key Findings by Theme, with Evidence Register (2016–2025)

Theme	Key finding	Highest register	Representative studies
Speech synthesis and NLP	Synthesis makes library text audible at scale and NLP structures documents and interprets queries; quality depends on human correction and on source structure.	B	Schlünz et al. (2017); Songtirapunya et al. (2016); Utne & Odu (2025); Ingram et al. (2023)
Speech recognition	Automatic speech recognition captions audiovisual collections for deaf and hard-of-hearing users and enables voice search for users who find typing difficult; accuracy is reported as error rates.	B	Rodriguez & Brown (2023); Sulaiman et al. (2025); Pitcairn et al. (2025)
Machine learning	ML personalises typography, search and recommendation; the only outcome evidence with disabled users concerns these services and is self-reported.	C (two studies)	Kishore et al. (2024); Sreedhar Kumar et al. (2025); Yogapriya et al. (2025)
Computer vision and document AI	OCR, structure tagging and generated alt text address the most common document failures; human review remains necessary.	B	Kavčič Čolić & Hari (2024); Shen et al. (2025); Hellman & Snijder (2024)
Impairment coverage	Evidence concentrates on blind and print-disabled users; deaf, physically disabled and cognitively disabled users are thinly covered and intellectual disability is absent.	A–B	Table B2
Standards and compliance	Audited conformance of scholarly documents is poor; WCAG 2.2 Level AA, PDF/UA and EPUB Accessibility 1.1 provide the targets.	B	Kavčič Čolić & Hari (2024); Hellman & Snijder (2024)
Participation and ethics	Disabled people appear as beneficiaries, not co-designers; bias, privacy and technocratic adoption are raised but not tested in library settings.	A	Clark & Lischer-Katz (2023); Ikwuanusi et al. (2023); Khumalo et al. (2025)

Note: Dimension addressed by each finding (see Defining the Object of Study): speech synthesis and NLP, conformance of technical output only; speech recognition, conformance (caption accuracy) and, in Sulaiman et al. (2025), usability with participants whose disability status was not reported; machine learning, usability as self-reported by disabled users; computer vision and document AI, conformance; impairment coverage, inclusion; standards and compliance, conformance; participation and ethics, inclusion. No finding in the corpus addresses all three dimensions.

**Table B4: Specification of the Integration Model: Actors, Functions, Gates, Failure Handling and Current Evidence**

Stage	Actors	AI function	Gate (threshold to proceed)	Failure handling	Current evidence
1. Govern and co-design	Library leadership; disability office; disabled users and their organisations; ICT; legal and data protection	None (governance)	Accessibility policy adopted; disabled users represented in decisions (CRPD art. 4(3)); conformance target set at WCAG 2.2 Level AA	No procurement or deployment until the gate is met	A only (Clark & Lischer-Katz, 2023; Khumalo et al., 2025)
2. Remediate content	Digitisation and metadata staff; vendors; accessibility specialist	OCR; structure tagging; generated alt text; captions	Documents pass PDF/UA or EPUB Accessibility 1.1 checks and a manual screen-reader check on a sample; every machine description of a complex image reviewed by a person	Withhold, or label as machine-generated and unverified; route to human remediation	B (Kavčič Čolić & Hari, 2024; Shen et al., 2025; Hellman & Snijder, 2024)
3. Deploy interaction services	ICT and systems librarians; vendors	Speech synthesis; voice search; speech recognition; personalisation	Interface conforms to WCAG 2.2 Level AA; speech-recognition word error rate within a limit agreed with deaf and hard-of-hearing users; a starting point of 5 per cent or less, the upper end of the 1.3 to 4.5 per cent averages reported by Rodriguez and Brown (2023), is a floor for discussion, not a standard; voices available in users' languages	Disable the function for the affected content or language; keep the human alternative	B (Rodriguez & Brown, 2023; Sulaiman et al., 2025; Schlünz et al., 2017)
4. Evaluate with disabled users	Disabled users, by impairment group; researchers; disability office	All deployed functions	Effectiveness, efficiency and satisfaction (ISO 9241-11) measured by impairment group; no group performs worse than with the previous service; measured on core tasks (finding a known item, reading its full text, navigating to a section, requesting an accessible format) by completion rate, time on task and the System Usability Scale (Brooke, 1996), with at least five participants	Roll back to the previous service and return to Stage 1	C, two self-report studies (Kishore et al., 2024; Sreedhar Kumar et al., 2025)



Stage	Actors	AI function	Gate (threshold to proceed)	Failure handling	Current evidence
			per impairment group (Nielsen & Landauer, 1993)		
5. Monitor, audit and redress	Library leadership; data-protection officer; users	All	Periodic re-audit of conformance; bias audit by impairment group; privacy review of disability data; complaints resolved and reported to Stage 1	Suspend the function; inform affected users; review data practices	A only (Ikwuanusi et al., 2023; Tunjungsari & Suprihatin, 2024)

Note (minimum viable version): The model assumes an accessibility specialist, a data-protection officer, a disability office and disabled testers; many university libraries in the region have at most two. A minimum viable version is therefore specified. Stage 1: the library committee adopts an accessibility statement, with a seat for a disabled students' representative or local organisation of persons with disabilities. Stage 2: remediation starts with new and high-demand items, checked with free tools (PAC for PDF/UA, Ace by DAISY for EPUB) and a staff screen-reader check of a sample using NVDA. Stage 3: functions are deployed only where a human alternative exists, and vendors supply conformance reports and error rates. Stage 4: five volunteers per impairment group are recruited through the disability office or student associations. Stage 5: existing university data-protection and complaints procedures serve, with an annual re-audit. As these tools are free, the main costs are staff time and fair compensation for disabled testers.

Appendix C: Accessibility Standards and Legal Instruments

WCAG 2.0 was published by the World Wide Web Consortium (W3C) in 2008, WCAG 2.1 on 5 June 2018 and WCAG 2.2 on 5 October 2023; each version is built around four principles, summarised by the acronym POUR: perceivable, operable, understandable, and robust, and defines testable success criteria at three conformance levels, A, AA and AAA (W3C, 2018, 2023a). Statutes generally adopt WCAG by reference rather than naming a version in the statute itself. In the United States, the revised Section 508 standards issued under the Rehabilitation Act of 1973 incorporate WCAG 2.0 Level AA (U.S. Access Board, 2017), and the Department of Justice's 2024 rule under Title II of the Americans with Disabilities Act of 1990 adopts WCAG 2.1 Level AA for the web content of state and local governments (U.S. Department of Justice, 2024). In Europe, the European Accessibility Act, applicable from 28 June 2025, covers e-books and dedicated reading software (European Parliament & Council of the European Union, 2019). In Kenya, section 26(3) of the Persons with Disabilities Act, 2025 requires information for the public, including online, in accessible formats (Republic of Kenya, 2025), and Kenya Standard KS 2952-1:2022, gazetted in May 2022 and drawing on EN 301 549 and WCAG, sets accessibility requirements for ICT products and services (Kenya Bureau of Standards, 2022). Together they anchor the conformance target adopted in the Standards and Compliance section in Kenyan law.