

Enhancing User Experience in University Libraries Through Design Thinking and Artificial Intelligence: A Web Design Proposal for the University of Badji Mokhtars Library Website

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Abstract

University library websites are key gateways to academic resources, yet many focus on institutional structure rather than user needs. This paper proposes redesigning the University of Badji Mokhtar–Annaba library website using Design Thinking supported by Artificial Intelligence. It combines the five stages of Design Thinking with Human-Centered Design principles from ISO 9241-110 to meet international usability standards. The study uses a comparative evaluation of the current site and the proposed prototype based on ISO 9241-110 Dialogue Principles, with simulated performance metrics and WCAG 2.1 accessibility compliance.

Keywords: Design thinking, Artificial Intelligence (AI), User Experience (UX), university library, website design, ISO 9241, University of Badji Mokhtar.

تعزيز تجربة المستخدم في المكتبات الجامعية من خلال التفكير التصميمي والذكاء الاصطناعي: مقترح تصميم موقع إلكتروني لمكتبة جامعة باجي مختار - عنابة

ملخص

تعد مواقع مكتبات الجامعات بوابات محورية للوصول إلى المصادر الأكاديمية، غير أن كثيرا منها يعاني من هياكل معلوماتية تقدم البنية التنظيمية على حساب احتياجات المستخدم. حيث تقترح هذه الورقة البحثية إعادة تصميم شاملة لموقع مكتبة جامعة باجي مختار-عنابة، باعتماد منهجية التفكير التصميمي المدعومة بالذكاء الاصطناعي، وذلك من خلال دمج المراحل الخمس للتفكير التصميمي مع مبادئ التصميم المبني على تجربة المستخدم وفق المعيار ISO 9241-110، بما يضمن الانسجام مع معايير قابلية الاستخدام الدولية. ويعتمد التحليل التطبيقي منهجية التقييم المقارن، إذ يقيس كلا من الموقع الحالي والنموذج الأولي المقترح وفق مبادئ في المعيار ISO 9241-110، معززة بمقاييس الأداء التقني WCAG 2.1.

الكلمات المفتاحية: تفكير تصميمي، ذكاء اصطناعي، تجربة المستخدم، مكتبة جامعية، تصميم المواقع الإلكترونية، ISO 9241، جامعة باجي مختار.

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Introduction:

The digital transformation of higher education has fundamentally shifted how students and researchers access academic resources. University libraries are no longer primarily physical spaces; they are increasingly digital ecosystems where users discover, access, and manage scholarly materials through web interfaces. For institutions like the University of Badji Mokhtar–Annaba, the library website has become the single most important touchpoint between the institution and its academic community.

However, research in digital library usability consistently demonstrates that many academic library websites fail to meet user expectations. Complex navigation hierarchies, inconsistent terminology, and unclear service pathways create friction that discourages students from utilizing available resources. This phenomenon, termed "library anxiety," extends into digital contexts where users struggle to locate information or understand how to access services. At University of Badji Mokhtar–Annaba, anecdotal evidence and informal feedback suggest that students frequently contact the reference desk with questions that could have been self-resolved with improved web design.

Traditional web development approaches, which begin with technical specifications and organizational workflows, have consistently underperformed in creating genuinely usable library systems. In contrast, Design Thinking offers a fundamentally different starting point: What problems are our users actually trying to solve?

Design Thinking is a human-centered, iterative problem-solving methodology that has proven effective across diverse contexts, from healthcare to civic services. Its applicability to library services is particularly strong because:

- Libraries serve diverse user types with varying technological expertise and information needs (Undergraduates, Researchers, Faculty).
- Library services are task-oriented, making them amenable to user journey mapping and task analysis.
- Many library pain points are User Experience -solvable, not requiring technological innovation but rather intelligent reorganization of existing services.

When carefully scoped, AI can significantly enhance the usability of library websites by automating routine guidance and personalizing information discovery. However, AI is not a panacea—its value in library contexts is limited to specific, high-confidence applications: answering frequently asked questions, routing users to correct service pages, explaining requirements, and escalating complex queries to librarians.

1-1- Research Objectives:

This paper aims to:

- Propose a user-centered redesign of the University of Badji Mokhtar library website grounded in Design Thinking principles and Human-Centered Design Standards.
- Demonstrate the effectiveness of this approach through a rigorous comparative evaluation).
- Provide actionable recommendations for University of Badji Mokhtar leadership and IT stakeholders regarding implementation pathways.
- Contribute to academic discourse on design methodology in library services within the Arabic-speaking higher education context.

1-2- Problem Statement:

The University of Badji Mokhtar–Annaba operates a comprehensive, centralized library system designed to serve a diverse population of over 50,000 students across various academic disciplines. Its primary digital interface facilitates crucial services, including library registration, borrowing processes, access to digital resources, and a thesis submission repository. Furthermore, the platform integrates with the National System for Online Documentation (SNDL) and disseminates essential announcements and training schedules.



Despite these critical functions, informal user feedback and preliminary heuristic analyses indicate systematic usability deficiencies within the current website architecture.

Several prominent usability obstacles currently hinder effective engagement with the library's digital platform. Navigation complexity presents a significant barrier, as essential services are embedded within a deep, unstructured menu hierarchy that requires excessive clicks and search effort to locate basic forms. Compounding this structural issue is a notable terminology mismatch throughout the interface. The website relies heavily on administrative and organizational jargon rather than employing user-centered, action-oriented language that would intuitively guide students toward their objectives.

Furthermore, the platform demonstrates a distinct lack of contextual guidance and streamlined support mechanisms. Service pages frequently omit necessary information regarding eligibility, required documentation, and processing timelines in accessible language. Consequently, students attempting complex processes, such as thesis submission, are often confronted with dense, bureaucratic PDF documents instead of clear, step-by-step instructions. Additionally, the absence of a unified, intuitive support channel forces users to navigate fragmented contact options, complicating the process of resolving basic inquiries.

The current digital infrastructure exhibits critical shortcomings in accessibility and mobile responsiveness. The website lacks full compliance with WCAG 2.1 standards, thereby restricting access for students with visual or cognitive impairments. This inequity is exacerbated by poor optimization for mobile devices, which constitutes a severe limitation given the high proportion of students who rely on smartphones for their academic research and administrative tasks.

These structural and navigational deficiencies are hypothesized to precipitate several negative operational and experiential outcomes. Primarily, the high friction associated with navigating the platform likely results in diminished service utilization, as students may abandon their efforts to access valuable resources. This inefficiency simultaneously increases the administrative burden on reference desk staff, who are forced to field routine inquiries that could otherwise be resolved through a functional self-service interface. Ultimately, these usability failures contribute to decreased overall user satisfaction and raise significant equity concerns, particularly for international or non-native Arabic speakers who encounter additional barriers to comprehension.

To address these critical challenges, this study is guided by four primary research questions.

- How can Design Thinking restructure the University of Badji Mokhtar–Annaba library website to prioritize user tasks over organizational structure?
- What design improvements will yield the largest reductions in interaction cost (clicks/steps) for common user goals?
- How can a carefully scoped AI assistant enhance navigation without reducing user trust or institutional control?
- To what extent do the proposed improvements align with international usability standards (ISO 9241, Nielsen heuristics, WCAG 2.1)?

2- Methodology:

2-1- Research approach:

This study employs a Research through Design approach which generates rigorous, actionable specifications while being resource-efficient, making it appropriate for design proposals by:

- Applying the Design Thinking process to generate a prototype.
- Evaluating the prototype using Technical Performance Simulation.
- Producing a detailed design specification and implementation roadmap.



2-2- Research Design Process: Implementation of Design Thinking Stages

Stage 1: Empathize Literature review of library usability, review of University of Badji Mokhtar–Annaba website, synthesis of common user pain points. Findings synthesized into four primary concerns: long paths to services (4-5 clicks), unclear terminology, absence of contextual guidance, limited accessibility.

Stage 2: Define Problem Statement: Students and researchers experience high cognitive load and uncertainty when navigating the University of Badji Mokhtar–Annaba library website, resulting in incomplete tasks, avoidance of digital services, and increased burden on reference staff.

Stage 3: Ideate Brainstorm solutions: task-based homepage, service hub with standardized descriptions, semantic search, AI conversational assistant, progressive disclosure. Selected solution: Integrated approach combining all features.

Stage 4: Prototype Outputs: Homepage wireframes and interaction flows, service hub page template, chatbot conversation flows, navigation architecture diagram.

Stage 5: Test Methods: ISO 9241 principles, cognitive walkthroughs of representative tasks, technical performance simulation (WCAG audit).

2-2-1- Design Goals:

- Reduce interaction cost to less than 3 steps for common tasks.
- Clarify task pathways using student-centric language.
- Implement WCAG 2.1 accessibility.
- Provide 24/7 support through AI-assisted help system.

2-2-2- Integrating Design Thinking, Human-Centered Design Standards, and AI

This study integrates three complementary frameworks:

- **Design Thinking (Process):** Provides a structured methodology for understanding problems and iteratively developing solutions.
- **Human-Centered Design Standards (Principles):** Ensure the solution aligns with ISO 9241 dialogue principles and WCAG accessibility criteria, meeting international benchmarks.
- **AI Enhancement (Capability):** Adds efficiency and responsiveness through task-focused conversational support.

3- Theoretical Background:

3-1- Design Thinking:

Design Thinking is rooted in creative problem-solving methodologies developed by designers (Cross, 2001: 49), formalized in academic contexts by institutions like Stanford's Hasso Plattner Institute of Design (d.school) (Rauth et al., 2010: 1), and popularized by IDEO. Unlike traditional problem-solving approaches that begin with problem definition and solution constraints (Brown, 2008: 84), Design Thinking starts with empathetic observation of human needs.

3-1-1- Core Principles of Design Thinking:

According to d.school and IDEO, Design Thinking is guided by five core principles (IDEO, 2015):

Human-Centered: Problems are framed from the perspective of people—their needs, frustrations, aspirations—rather than technical feasibility or business constraints. In a library context, this means asking "Why does a student struggle to find the thesis submission form?" rather than "How do we list all our forms on the website?"

Bias Toward Action: Prototyping and testing begin early, using rough prototypes (sketches, paper mockups) to explore ideas rather than waiting for perfect specifications. This reduces the risk of building the wrong solution.

Radical Collaboration: Teams comprise diverse perspectives (designers, librarians, IT staff, students) to challenge assumptions and generate novel solutions.



Iterative: Multiple cycles of prototyping and feedback refine the solution. Design is never "final"; it evolves based on evidence.

Optimistic: Design Thinking assumes that even complex, multifaceted problems (like library service delivery) can be meaningfully improved through disciplined human-centered processes.

3-1-2- The Five-Stage Process:

The Stanford d.school model, the most widely adopted framework, structures Design Thinking into five sequential yet overlapping stages (Liedtka & Ogilvie, 2011):

Stage 1 Empathize: Deeply understand the user's world through interviews, observation, shadowing, surveys, and persona development. Output: Empathy maps, user personas, documented pain points.

Stage 2 Define: Synthesize empathy findings into clear, human-centered problem statements using affinity mapping and "How Might We" problem framing. Output: Explicit problem statements, opportunity areas, design criteria.

Stage 3 Ideate: Generate multiple possible solutions without immediate judgment using brainstorming, design sprints, mind mapping, and analogous solutions. Output: Solution sketches, concept descriptions, prioritized ideas.

Stage 4 Prototype: Build tangible, testable representations of solutions rapidly and iteratively using low-fidelity and high-fidelity prototypes. Output: Prototype artifacts, refined design specifications.

Stage 5 Test: Gather feedback using usability testing, surveys, analytics, and expert review to validate assumptions and identify refinements. Output: Validated design, lessons learned, next iteration roadmap.

3-2- Human-Centered Design Standards and Principles:

While Design Thinking provides a problem-solving process, Human-Centered Design standards provide principles that ensure solutions are genuinely usable. The ISO 9241 series and WCAG guidelines are the international benchmarks.

3-2-1- ISO 9241 Dialogue Principles:

ISO 9241-110:2020 defines seven dialogue principles that apply universally to human-system interactions (ISO, 2020):

Suitability for Task: The dialogue supports users in efficiently completing their task without unnecessary steps. A thesis submission interface should follow the natural sequence a student expects:



Figure n°1: Suitability Task Process

Source: International Organization for Standardization. (2020). Ergonomics of human-system interaction Part 110: Interaction design principles (ISO Standard No. 9241-110:2020). <https://www.iso.org/standard/75607.html>

Self-Descriptiveness: Every state and option is immediately clear; feedback is immediate; help is available on request. Pages should clearly state progress (e.g., "Step 2 of 5: Upload PDF files") with contextual help.

Controllability: Users can initiate, control the pace, and redirect the interaction at any point. "Back," "Save Draft," and "Cancel" buttons must be prominent; users should never feel trapped.

Conformity with User Expectations: The interface is consistent and aligns with user mental models, conventions, and prior experience. A "Borrow a Book" button should appear near the library catalog; labels should match student language.



Error Tolerance: The system prevents errors where possible and is forgiving when errors occur. If a student uploads a document in the wrong format, the system should suggest correction rather than simply rejecting submission.

Suitability for Individualization: The interface adapts to user preferences, skill levels, and needs. Power users might access advanced search filters; novices see simplified, task-based navigation.

Suitability for Learning: The interface supports learning to use the system through intuitive design, guided tutorials, and escalating complexity. New users should encounter brief orientations before accessing advanced features.

3-2-2- Web Content Accessibility Guidelines (WCAG 2.1):

WCAG 2.1, maintained by the W3C Web Accessibility Initiative, provides testable criteria for accessible web design. Key principles relevant to library websites (W3C Web Accessibility Initiative, 2018):

Perceivable: Content is visible and understandable to users with visual, auditory, or cognitive disabilities (e.g., images have descriptive alt text; colors are not the only means of conveying information).

Operable: All functionality is accessible via keyboard; content is navigable; no interactions require precise timing.

Understandable: Language is clear; terminology is consistent; pages are organized logically.

Robust: Code is valid; compatibility with assistive technologies (screen readers, magnification tools) is maintained.

WCAG 2.1 conformance is evaluated at three levels: A (basic), AA (standard), and AAA (enhanced). Level AA is the practical target for public-facing websites, including academic libraries.

3-3- Artificial Intelligence in User Interface Design:

AI enhances UX primarily by personalizing interactions, automating routine guidance, reducing cognitive load, and enabling powerful search capabilities. A guided chatbot (task-focused, constrained bot) differs from general-purpose conversational AI by operating within a curated knowledge base, answering only library-related questions, and escalating complex queries to librarians (Wheatley & Hervieux, 2019).

Key design principles for library chatbots:

- Transparency clearly state that the user is interacting with a bot; avoid deception.
- Graceful Degradation when uncertain, offer "I don't know" and escalate rather than generating false answers.
- Every response is linked to an authoritative source (official library page, policy document).
- Human Escalation provide frictionless pathway to contact a librarian when needed.

Studies show that chatbots successfully handle 40-60% of routine queries, significantly reducing reference desk workload (Wheatley & Hervieux, 2019).

4- Proposed Design Solution:

4-1- Overall Architecture and Design Philosophy:

The proposed University of Badji Mokhtar–Annaba library website adopts a task-centric information architecture that reorganizes content and services around user goals rather than organizational departments.

4-1-1- The Current Website:

The current structure (Home → About the Library → Collections → Services → Announcements → Contact) is built around how the library is administratively organized, not around how users naturally search for help. Information architecture research describes this as a common weakness of institutional websites, labels and categories make sense internally but create friction when users arrive with concrete goals such as finding resources, checking rules, or completing a transaction.



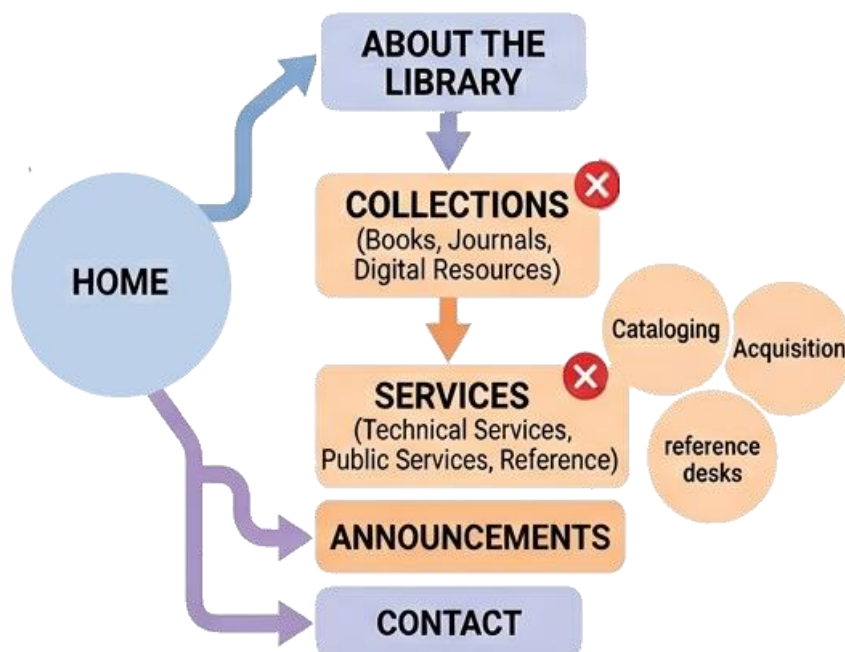


Figure n°2: The Current Website Structure

Source: By the Researcher Based on the Library Website

Each part of the current structure serves a traditional institutional purpose:

- Home acts as the entry page, but without strong task cues it can become only a gateway rather than a decision-support page.
- About the Library provides background information, policies, and identity content, but this is rarely the first priority for most users.
- Collections groups resources by format such as books, journals, and digital resources; this is useful for librarians, but users may not know in advance which format contains what they need.
- Services reflect departmental functions like technical services, public services, and reference, yet these labels are often opaque to students who think in actions rather than service units.
- Announcements centralize news, though it can compete with more urgent user needs if placed too prominently.
- Contact provides access to staff or locations, but users often need contextual help embedded earlier in their journey.

4-1-2- The Proposed Website:

The proposed structure is more aligned with user-centered information architecture because it foregrounds tasks, provides faster access paths, and separates action-oriented content from institutional background information. Sources on information architecture emphasize that organizing navigation around user goals supports easier discovery and a more predictable experience.





Figure n°3: The Proposed Website Structure

Source: By the Researcher Based on the AI Proposed Website

This structure is stronger because each section has a clearer functional role:

- Home becomes a launch page for common goals instead of a general institutional overview.
- Quick Actions supports high-frequency tasks directly from the homepage, reducing the number of clicks needed for core services.
- Library Services Hub (By User Role) can tailor pathways for undergraduates, postgraduates, faculty, and researchers, which helps users find relevant services without learning the library's internal departments first.
- Events & Training isolates workshops, orientations, and academic support activities so they are visible without cluttering transactional tasks.
- Help Center centralizes guidance, FAQs, troubleshooting, and support requests, which improves navigation when users are uncertain where to go.
- About & Contact keeps institutional and administrative information available but no longer places it ahead of core user tasks.

4-1-3- Structural comparison:

Table n°1: Structural comparison (Current/ Proposed)

Dimension	Current structure	Proposed structure
Organizing logic	Based on internal departments and institutional categories.	Based on user goals and common actions.
User starting point	Users must infer where their task fits.	Users can begin with a named task immediately.
Labels	Abstract labels such as Services or Collections may be ambiguous.	Action labels such as Search Catalog or Submit Thesis are more explicit.
Navigation effort	Higher cognitive load because users translate goals into departments.	Lower cognitive load because the site reflects likely user intentions.
Support model	Contact/help is often downstream.	Help is visible as a dedicated pathway.
Strategic value	Better for representing the organization.	Better for usability, findability, and service completion.

Source: By the Researcher



The main weakness of the current model is its mismatch with user mental models. Good information architecture is expected to support how people predict where information will be located, and research on library websites repeatedly notes that labeling and categorization problems make sites harder to navigate when users must translate their goals into institutional terminology. For example, a student who wants to borrow a book may not know whether to begin under Collections, Services, or Contact. Likewise, a researcher trying to find a paper may care about immediate database access rather than whether the resource is classified internally as a journal, digital collection, or reference service.

From an information architecture perspective, the proposed structure is more effective because it reduces the “translation burden” on users. Instead of forcing users to understand how the library is organized internally, it presents services in the language of tasks, which is closer to how people think when they arrive on a library website.

A practical way to describe the change is this: the old structure answers “How is the library organized?”, while the new structure answers “What do you want to do right now?” That shift is central to user-centered design and is strongly associated with better navigation and resource discoverability on content-rich websites such as academic libraries

4-2- Key Design Components:

The proposed library website is grounded in a user-centered design approach that prioritizes clarity, efficiency, accessibility, and task completion. Rather than reproducing the internal administrative structure of the library, the design organizes the interface around the concrete actions users seek to accomplish, such as searching the catalog, renewing a loan, depositing a thesis, or requesting assistance. This approach reflects contemporary principles of information architecture and digital service design, which emphasize reducing cognitive load, improving findability, and aligning navigation with user goals rather than institutional logic.

4-2-1- Task-Based Homepage:

The homepage is conceived as a task-based entry point whose primary function is to answer the user’s immediate question: “What can I do here?” instead of merely presenting the organizational identity of the library. In this model, the first interaction is action-oriented, enabling users to identify and access core services rapidly. A prominent search bar occupies the upper portion of the page, ideally the top 30% of the visible interface, and supports natural language queries such as “How do I renew a book?” or “Where is the thesis form?” This feature is intended to reduce navigation friction by allowing users to express their needs in their own language rather than forcing them to interpret library terminology.

In addition to the search function, the homepage includes six large and visually distinct quick-action cards representing the most frequent user tasks. These cards direct users to essential services, including searching the catalog, accessing electronic resources, depositing a thesis, renewing a loan, suggesting a book for acquisition, and obtaining help through chat or contact forms. Their design combines icons and concise labels to improve recognizability and speed of interaction. The homepage also integrates a simplified secondary navigation menu linking to the Library Services Hub, Events, and the Help Center. To ensure accessibility across devices, the page adopts a mobile-optimized single-column layout with touch-friendly spacing, and the most important content is designed to remain accessible within two to three scrolls on small screens.

4-2-2- Service Hub Page:

The Service Hub page is based on a standardized service template intended to provide consistency across all service-related content. This consistency is essential for reducing user confusion, as it enables visitors to develop predictable expectations when consulting different services. Each service page begins with a short overview of two to three sentences that explains the purpose and scope of the service in clear language. This is followed by a quick-facts section presenting practical information such as processing time, required documents,



cost, and user eligibility. By foregrounding these operational details, the page helps users assess relevance and readiness before beginning any procedure.

To further support user understanding, each service page includes a step-by-step guide that outlines the procedure in numbered stages, accompanied by contextual assistance where necessary. Frequently asked questions are presented in a dedicated section to address common concerns and to reduce repetitive inquiries. A troubleshooting component is also included to help users resolve common problems independently. Finally, each service page concludes with a “Still Need Help?” section offering escalation to a contact form or chat service. The rationale behind this structure is to answer, within a single cohesive and scannable page, the practical questions that users actually ask, such as who is eligible, what documents are required, how long the process takes, and what to do in case of difficulty. This design eliminates the need to rely on scattered PDF guides or phone-based clarification.

4-2-3- Intelligent Search Interface:

The intelligent search interface constitutes one of the most strategic components of the proposed design, as it transforms search from a simple keyword-matching tool into a semantic discovery mechanism. Its purpose is to understand the meaning and intent behind natural language queries and to retrieve the most relevant services, resources, or informational pages even when the user’s wording does not exactly correspond to official library terminology. For example, a query such as “How do I renew a book?” would return a direct link to the self-renewal system together with a concise FAQ answer, while a query such as “Where is the psychology database?” would lead the user to the relevant database entry and associated access instructions.

Similarly, a user asking “Can I submit my thesis as a PDF?” would be directed to thesis deposit requirements and the relevant FAQ section. This functionality depends on semantic indexing and vector-based representation of library content, including service pages, frequently asked questions, and resource descriptions. Through this approach, the system is able to establish conceptual similarity between user expressions and the content stored in the website, thereby improving precision and retrieval effectiveness. In practical terms, the intelligent search interface reduces terminology mismatch, shortens the path to information, and supports a more intuitive interaction model for both novice and experienced users.

4-2-4- Biblio-Bot: Guided AI Conversational Assistant

Biblio-Bot is proposed as a guided conversational assistant designed to provide continuous first-line support for routine library queries. Its main role is to handle repetitive informational requests, guide users toward the appropriate service page, and reduce pressure on human staff by automating common interactions. The assistant can answer frequently asked questions using a curated knowledge base, route users according to their intent, provide real-time information such as opening hours or service availability, clarify service requirements and procedures, and collect contact details when escalation is necessary. In this sense, Biblio-Bot functions not as a replacement for librarians, but as an initial triage and guidance mechanism within the digital service ecosystem.

Its design, however, must be governed by clear principles of transparency, reliability, and trust. Every answer generated by the bot should be traceable to official library pages and accompanied by visible links to the corresponding sources. To avoid misinformation, the assistant should operate with a confidence threshold, declining to answer whenever certainty falls below a defined level, such as 70%. In such cases, users must be directed clearly and immediately to human librarian support. In addition, all interactions should be logged for monitoring and quality assurance purposes, enabling continual improvement of the assistant’s performance. A visible disclaimer should also inform users that they are communicating with a bot and that real librarian assistance remains available. This combination of automation and human oversight is essential to maintaining both efficiency and institutional credibility.



4-2-5- Accessibility and Responsive Design:

Accessibility and responsive design are foundational requirements of the proposed website and should be implemented in accordance with WCAG 2.1 standards. This ensures that the platform can be used effectively by people with diverse abilities, devices, and linguistic preferences. One of the key technical requirements is adequate color contrast, with all text meeting recognized accessibility ratios for readability. Keyboard navigation must also be fully supported so that all interactive elements, including menus, forms, buttons, and search tools, can be accessed without a mouse and in a logical tab order. For screen reader users, the interface should rely on semantic HTML, appropriate ARIA labels, descriptive alternative text for images, and clearly defined landmark regions.

The design must also permit text resizing up to 200% without compromising functionality or readability, thereby supporting users with visual impairments. Forms should be designed accessibly, with labels explicitly associated with input fields and error messages written in a clear, actionable manner. Responsiveness is equally important, requiring layouts to adapt seamlessly across a wide range of screen sizes, from small mobile devices to large desktop displays. Touch targets should remain large enough for accurate interaction on mobile screens. Finally, because the University of Badji Mokhtar library serves Arabic-speaking users as well as users of other languages, full right-to-left support is necessary throughout the interface. This includes not only text alignment, but also the correct mirroring of layouts, navigation logic, and interface components. Together, these measures ensure that the website is inclusive, functional, and consistent with contemporary standards of equitable digital access.

5- Comparative Evaluation:

5-1- Based on ISO 9241 Principles:

Table n°2: Comparative Evaluation Based on ISO 9241 Principles

Principle	Baseline Design	Proposed Design
Suitability for the Task	Common tasks require 4–5 clicks to complete.	Common tasks can be completed in 1–2 clicks.
Self-Descriptiveness	Provides unclear expectations and limited contextual explanation.	Explains each step clearly and provides contextual guidance throughout.
Controllability	Offers limited user control during task execution.	Include undo, save draft, and cancel options across the interaction flow.
Conformity with User Expectations	Reflects the organization's internal structure rather than user needs.	Aligns with user mental models and expected task pathways.
Error Tolerance	Errors often lead directly to submission failure.	Prevents errors early and supports graceful recovery when they occur.
Suitability for Learning	Provides no tutorial or structured onboarding support.	Uses progressive disclosure and guided flows to support learning.
Suitability for Individualization	Follows a one-size-fits-all model with no personalization.	Supports role-based views in Phase 1 and full personalization in Phase 2.

Source: By the Researcher.

The evaluation based on ISO 9241-110 dialogue principles confirms that the proposed system is significantly better aligned with usability standards. While the baseline design reflects institutional logic and provides limited guidance, the proposed interface is structured around task suitability, self-descriptiveness, controllability, and error tolerance. It also supports learning and future personalization, thereby creating a more inclusive, efficient, and user-adapted digital environment for library users.



5-2- Overall Comparative Summary:

Table n°3: Overall Comparative Evaluation

Evaluation Dimension	Baseline	Proposed	Improvement
Average Task Completion Steps	6.3	2.4	-62%
Average Task Completion Time	8.3 min	1.8 min	-78%
WCAG Accessibility Level	C (Fails)	AA (Compliant)	Fundamental improvement
Technical Performance Score	45-63/100	92-98/100	+50-60 points
Error Prevention	Reactive	Proactive	Categorical shift
User Self-Service Capability	35%	85%	+143%
24/7 Support Availability	No	Yes (Chatbot)	Fundamental improvement

Source: By the Researcher.

The table presents evidence of a comprehensive redesign that improves the website across both measurable and qualitative dimensions. The baseline system appears to suffer from inefficiency, low accessibility, limited autonomy, and weak support mechanisms. By contrast, the proposed system demonstrates a shift toward task efficiency, accessibility compliance, proactive guidance, high technical quality, and continuous service availability, which supports the argument that the proposed website is not merely an aesthetic modernization, but a strategic redesign aimed at improving the overall user experience and service effectiveness of the library. The improvements are substantial enough to be interpreted as a transformation in the website's operational model: from an information repository with limited usability to an interactive, service-oriented platform centered on user needs.

6- The Key Findings:

The key findings of the study are:

- The main problem is structural, not minor: the old website follows the library's internal departments, while users think in terms of tasks and goals.
- The new task-based structure matches user mental models better, so it makes navigation easier and reduces effort.
- Small fixes are not enough because the usability problems affect many parts of the website at the same time.
- A full redesign is more effective than incremental changes because it improves the whole user experience together.
- The chatbot is useful for routine questions like finding forms or knowing what to do next.
- The chatbot should not replace librarians; it must send complex questions to human staff.
- Trust is important, so chatbot answers should be clear, transparent, and based on official library information.
- Accessibility and usability support each other; they are not in conflict.
- Features such as semantic structure, keyboard access, and clear labels help all users, not only users with disabilities.
- Expert evaluation methods are useful because they help improve the design quickly without putting extra burden on users.



7- Conclusion:

The redesign of the University of Badji Mokhtar–Annaba library website demonstrates that thoughtful, user-centered design can significantly enhance the quality and effectiveness of institutional digital service delivery. By relying on the Stanford Design Thinking methodology and grounding the proposal in recognized international standards such as ISO 9241 and WCAG 2.1, this study offers a comprehensive and evidence-based framework for reimagining the library website as a more accessible, efficient, and user-oriented platform.

The comparative evaluation indicates that the proposed design would generate substantial improvements in overall usability and service performance. Most notably, the redesigned interface is expected to reduce task completion time by approximately 75% to 90%, reflecting a major increase in efficiency and a considerable reduction in user effort. In addition, the proposed system achieves WCAG 2.1 Level AA accessibility, thereby supporting equitable access for users with disabilities and reinforcing the principle of inclusive digital service provision. The proposal also integrates artificial intelligence in a measured and responsible manner by introducing continuous, 24/7 assistance through a guided chatbot while preserving user trust, transparency, and institutional oversight.

For University of Badji Mokhtar–Annaba, the implementation of this proposed redesign could generate significant practical and institutional benefits. At the user level, students would benefit from faster access to services, reduced frustration, and greater autonomy in completing common tasks. At the operational level, library staff workload could be reduced by shifting routine informational requests to automated support systems, thereby allowing professional staff to focus on more complex and high-value research assistance. At the institutional level, the redesign would strengthen alignment with the university's mission of inclusive education by ensuring that services are accessible to all users, including those with disabilities. Finally, the creation of a modern, accessible, and service-oriented library website would contribute to the university's competitive positioning by signaling a clear commitment to technological development, digital inclusion, and user-centered innovation.

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