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Human-Computer Interaction in Library Software Interfaces: A Comparative Study of SOUL 3.0, Koha, and DSpace

Archanagita Saikia

Assistant Librarian, K.C. Das Commerce College, Guwahati-781008, Assam

Contact No.: 9127373530, Email: archanagitasaikia@gmail.com

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ABSTRACT

In the constantly expanding digital library systems domain, HCI (human-computer interaction) still remains a major factor that must be taken into account and incorporated for the sake of the users who want to enjoy the services of the library together with its facilities and overall experience. Libraries of the present day use a range of integrated library management systems (ILMS), digital repositories, and discovery tools in a more organized way to make the users' access to information as smooth as possible. The main objective of this research is to measure HCI dimensions among three of the most popular library software systems- SOUL 3.0 (Software for University Libraries version 3.0), Koha, and DSpace- in a college library setting. Using a mixed-method approach involving usability testing, task performance analysis, and user feedback from 40 participants (30 students and 10 library professionals), the study compares system efficiency, satisfaction, and cognitive effort across common library tasks. The findings show that Koha has the best usability and task efficiency, SOUL 3.0 is dependable in circulation and cataloguing, and DSpace is perfect for digital repository functions but the users (library professionals) face more challenges in metadata entry and navigation due to the high cognitive demand. Based on the findings, the study proposes the User-Centered Interface Enhancement Model (UCIEM),

integrating user feedback, accessibility validation, and iterative redesign. The study concludes that upgrading of HCI in the library software interfaces is a prerequisite to the betterment of user experience, digital scholarship support, and the functional role of college libraries in the hybrid and digital environment in general getting stronger.

Introduction

"Good design starts with an understanding of psychology and technology. Good design requires good communication, especially from machine to person." (Norman, 2013, p. 8)

Libraries have long functioned as dynamic spaces where people interact with information, tools, and technologies. As academic libraries shift from traditional physical collections to hybrid and fully digital service models, interaction increasingly takes place through software systems that mediate access, retrieval, preservation, and management of information resources. In this context, human–computer interaction (HCI) provides a critical framework for understanding how effectively users- students, researchers, and library professionals, engage with these systems to accomplish their information tasks. Khan, Hussain, and Zareef (2025) define human–computer interaction as a multidisciplinary field integrating human factors, cognitive science, and computer science to design technology that supports user needs effectively. Their systematic review established that HCI improves library systems' efficiency, accuracy, and user orientation by making computer-based services more intuitive and accessible (Khan et al., 2025).

Today's academic libraries heavily rely on integrated library management systems (ILMS) like SOUL 3.0 and Koha along with digital repository platforms such as DSpace which provide both the operational and intellectual infrastructure. SOUL 3.0, the library software developed by INFLIBNET, is supportive of all library operations. Koha being an open-source ILMS is flexible and has customizable workflows. DSpace, which is extensively used in educational institutions, is so to facilitate the organization and distribution of digital academic content. These systems are widely used but still show a large difference in terms of usability, user interface, and accessibility which are the factors directly impacting user performance, satisfaction, and learning development.

Nevertheless, the usability issues are still a concern for these systems that are very sophisticated and have an extensive application. A user may have a difficult time dealing with such issues as complex navigation, inconsistent feedback mechanisms, and lack of accessibility features. HCI experts like Nielsen (1993) and Shneiderman et al. (2016) underline the fact that poorly designed interfaces are responsible for users making more mistakes, being less satisfied, and thus the system working slower than it could be. If we extend this argument to the library field, Ranganathan's user-centered paradigm is still valid, technology should meet the needs of the users in order to provide them access to information that is both fair and efficient.

With digital platforms steadily becoming the backbone of academic libraries, a careful assessment of the HCI elements of SOUL 3.0, Koha, and DSpace is needed. It is very important to know the user's viewpoint on these systems as well as their problems in order to create user interfaces that are easy to use, accessible and versatile to different kinds of users. The present study, therefore, surveys the three systems in terms of the usability characteristics, user satisfaction, cognitive load factors, and interface design gaps, and proposes a user-centered enhancement model for future improvements to be based on it.

As a matter of fact, HCI is still a long way to go in developing countries even though there are considerable global advancements (Khan et al., 2025). The point is, this is particularly true for Indian colleges where libraries mostly rely on SOUL 3.0 and Koha without performing any extensive usability testing.

Objectives of the Study

This study is based on the following objectives-

1. To assess and compare the usability, task efficiency, and overall user experience of SOUL 3.0, Koha, and DSpace within selected college libraries in Assam.
2. To examine the application of core HCI principles, such as usability, feedback mechanisms, navigation design, accessibility, and cognitive load in the three software systems.
3. To identify specific interface design challenges encountered by student users and library professionals during key operational and retrieval tasks.
4. To analyze patterns in user satisfaction and cognitive demand across the three systems using both quantitative metrics and qualitative feedback.

5. To propose and validate a User-Centered Interface Enhancement Model (UCIEM) aimed at improving usability, accessibility, and user engagement in academic library software interfaces.

Scope and Limitations

The evaluation of SOUL 3.0, Koha, and DSpace from the point of view of human-computer interaction was the main focus of the research. The study was restricted to desktop-based user interfaces and daily library operations performed by users like searching, circulation, cataloguing, metadata entry, and managing digital files. Mobile interfaces, backend API functions, and system performance during peak traffic hours were not subject to the study. The results are derived from a sample size of 40 respondents and hence may not be applicable to all the institutional contexts or the versions of the software. Different user trainings, past experiences, and local tweaks of the systems are other limitations. The future studies can have larger cross-institutional samples, mobile usability tests, and cloud-based ILMS platforms.

Methodology

The research incorporates a blend of qualitative and quantitative methods combining usability testing, task performance evaluation, and user feedback. A purposive sample of 40 participants (30 students and 10 library professionals) from five college libraries in Assam was chosen according to their active use of SOUL 3.0, Koha, and DSpace. The participants performed a set of predetermined tasks in each system such as cataloguing, OPAC (Online Public Access Catalogue) searching, retrieval, and circulation activities for SOUL 3.0 and Koha, and metadata entry, uploading, browsing, and downloading in DSpace.

The method of data collection involved a structured questionnaire with System Usability Scale (SUS) items and Likert-scale ratings as well as the use of semi-structured interviews to gain qualitative insights into the difficulties with the interface and the limitations of the workflow. Also, the objective usability metrics were recorded, such as task completion time, error frequency, and navigation steps. Descriptive statistics including efficiency index were applied in analyzing the quantitative data, whereas the qualitative responses were categorized thematically to determine the usability problems, accessibility gaps, and cognitive load patterns. The data from both sources contributed to the creation of the proposed User-Centered Interface Enhancement Model (UCIEM).

Findings and Discussion

1. Comparative Usability and Task Efficiency Across SOUL 3.0, Koha, and DSpace

Figure 1: Comparative Task Efficiency in SOUL 3.0, Koha and DSpace

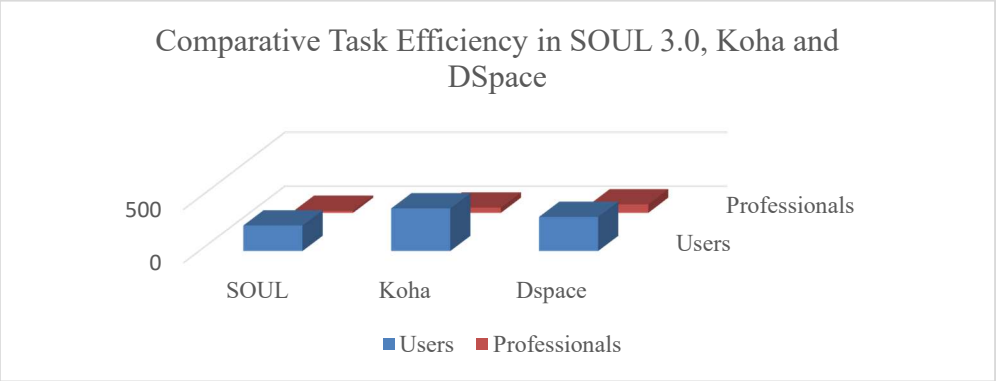


Figure 1 shows the comparative task efficiency of users and professionals in SOUL 3.0, Koha, and DSpace calculated using the Efficiency Index (EI). It indicates different patterns of usability across SOUL 3.0, Koha, and DSpace for both students and library professionals. The Efficiency Index which is calculated using the formula EI = (Tasks Completed ÷ Time Taken) × 100, is a way to quantitatively assess the operational efficiency while doing usual library tasks.

Students who used SOUL 3.0 were able to perform 12 OPAC searching and retrieval tasks within a time frame of 5 minutes, giving rise to an EI of 240. The staff managed to perform 2 cataloguing and circulation tasks in 10 minutes, which led to an EI of 20. Even though SOUL 3.0 seems to be less efficient for the staff, this diminished value is not due solely to interface constraints but is also a result of the nature of the cataloguing process, which is inherently time-consuming. The latter requires filling in multiple metadata fields and validating detailed item information. Such tasks do naturally prolong the time taken for their completion, even when done accurately and without any errors.

Koha showed the best overall efficiency. The students did 20 tasks in 5 minutes (EI = 400), and the staff did 5 cataloguing and circulation tasks in 10 minutes (EI = 50). Koha's best performance can be attributed to its simplified cataloguing templates, clearer workflow paths, and interface elements such as dropdown menus and auto-filled MARC fields that lower typing load and lessen navigational steps. Both groups of users performed the tasks with no mistakes, which implies that the interface design and task expectations are closely aligned.

In DSpace, the students were able to finish 16 tasks, which involved browsing and downloading, in only 5 minutes, thus obtaining an EI of 320. The completion of 3 tasks by the staff, which included metadata entry and uploading, took them 10 minutes, and their EI was 30. The lower staff efficiency in DSpace is

similar to that in SOUL 3.0 and is linked to the demanding nature of metadata entry, which requires the input of detailed descriptive, administrative, and technical metadata. DSpace gives end-users efficient retrieval, but its repository management workflows are still more taxing for staff.

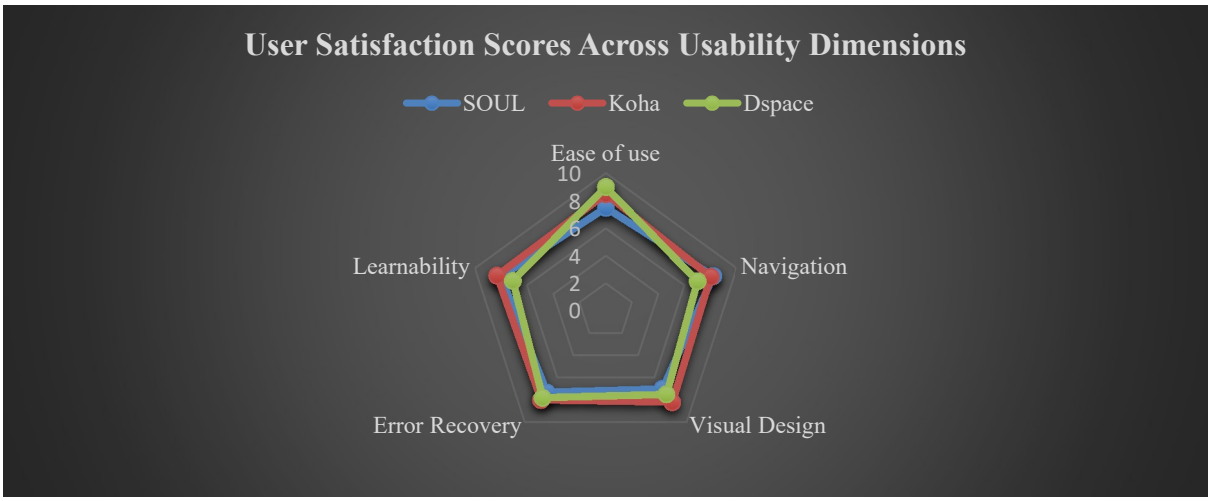
Among all the systems, Koha stands out as the most efficient solution for both students and library staff, while DSpace is the second choice for student retrieval tasks and SOUL 3.0 for basic user operations. The lower Efficiency Index values for SOUL 3.0 and DSpace staff indicate that the tasks are complex and involve a lot of metadata and cataloguing, rather than just being limited by the interface. These results reveal the variations in cognitive and operational demands on users and at the same time point out the need for simplifying the metadata workflow so that the staff efficiency could be increased.

Table 1: Efficiency Index Values

System	Group	Tasks Completed	Time (minutes)	Efficiency Index
SOUL 3.0	Students	12	5	240
SOUL 3.0	Staff	2	10	20
Koha	Students	20	5	400
Koha	Staff	5	10	50
DSpace	Students	16	5	320
DSpace	Staff	3	10	30

2. User Satisfaction and Perceived Usability Dimensions

Figure 2: User Satisfaction Scores Across Usability Dimensions



The radar chart (Fig. 2) presents a comparative visualization of user satisfaction scores for SOUL 3.0, Koha, and DSpace across five usability dimensions, Ease of Use, Navigation, Visual Design, Error Recovery, and Learnability, rated on a 1–10 scale. The chart clearly shows that each system demonstrates a distinct usability profile aligned with its design philosophy and operational focus.

SOUL 3.0 has a usability rating that is in the moderate to high range and the best characteristics of the system are Navigation with a score of 8.2 and Learnability with a score of 8. These numbers suggest that once the users get the hang of the system, they will be able to maneuver and comprehend the operations with not so much effort. On the other hand, the scores for Visual Design (7) and Error Recovery (7.3) are quite a bit lower and this indicates that there are certain aspects of the interface like beauty and among them, the system's response when users make mistakes is not very clear. Ease of Use (7.5) is placed in the middle of the scale and this points out that although SOUL 3.0 is already working, it might still need to be fine-tuned in order to give a more user-friendly experience during the first use.

Koha showcases the most balanced and the strongest usability pattern with high scores across all dimensions. The radar graph, in fact, shows not only high scores for Ease of Use (8.5), Visual Design (8.2), and Learnability (8.3) but also reflecting users' perception of Koha as intuitive, visually coherent, and easy to master. Navigation (8) and Error Recovery (8) received equally strong scores, thus implying a good structure of pathways and reliable system feedback. Koha's consistency across dimensions gives the impression of being the top user-friendly and well-rounded system among the three.

DSpace reveals a different pattern of strengths and weaknesses, where its top score was in Ease of Use (9), the highest among all factors, this indicates that the system is very user-friendly for the basic actions of browsing and downloading. Nevertheless, the radar graph points out lower scores for Navigation (7) and Learnability (7.1), which demonstrate that the users had difficulties with the hierarchical repository structures, visibility of the metadata, and the organization of the content. The ratings for Visual Design (7.5) and Error Recovery (7.8) denote average satisfaction, implying that although DSpace is capable of supporting the users in their basic information retrieval tasks quite well, its interface becomes less friendly when the operation is more complicated or when the user makes mistakes.

Hence, the radar chart attests that Koha offers the best and the most consistent usability experience, DSpace really good in terms of ease of use but also needs to pay attention to navigational clarity and learning support, while SOUL 3.0 guarantees reliable functionality but at the same time should consider

upgrading visual design and error-handling tactics. The identified patterns give a well-defined basis for system-oriented interface enhancement suggestions.

3. Interaction Design Characteristics and HCI Loop Analysis

Table 2: HCI Loop Comparison Between SOUL 3.0, Koha, and DSpace

Features	SOUL 3.0	Koha	DSpace
Interaction Type	Staff-mediated	Hybrid (guided + self-service)	Self-service
User Autonomy	Low	Moderate	High
Number of Feedback Points	Few	Moderate	Multiple
Cycle Complexity	Simple	Moderate	Complex
Decision Points for Users	Minimal	Some	Many
Task Orientation	Transaction-focused	Balanced	Information retrieval-focused
Guidance Provided	High (staff support)	Moderate	Low

The user interaction design patterns displayed in Table 2 reveal significant distinctions in the user-system workflows of SOUL 3.0, Koha, and DSpace. These distinctions have a direct impact on the efficiency of the tasks performed, the level of satisfaction, and the amount of cognitive effort required.

SOUL 3.0 relies on a linear interaction loop with limited feedback points, mediated by staff. This structure is ideal for predictable, transaction-based activities but not suitable for complex workflows as it offers less flexibility. The high Navigation (8.2) and Learnability (8) scores imply that users are able to use the system correctly only after they are familiar with it, while the lower Visual Design (7) and Error Recovery (7.3) show a lack of interface support. The staff regular Efficiency Index of 660 is mainly affected by the detailed metadata requirements of cataloguing and not by the failure of the interface.

Koha is based on a hybrid loop, which gives users freedom but still provides them with proper guidance, which is further supported by a moderate feedback and a clearer workflow structure. This is in accordance with its sustained excellent ratings in all categories (Ease of Use 8.5; Learnability 8.3) and

the highest Efficiency Index for students (2400) and staff (1266.67) as well. Koha's design makes it easier for the user to find their way through the system, thus, speeding up the task completion and reducing the cognitive load.

DSpace uses a self-service and decision-making interaction loop that consists of several steps, and while this is very effective for simplest retrieval tasks, it nevertheless raises the user's cognitive load when it comes to metadata entry. This is the reason why students have a very high rating for Ease of Use (9) but lower ratings for Navigation (7) and Learnability (7.1). On the one hand, staff efficiency (400) is impaired because of the repository workflows that are demanding in nature, requiring very detailed and precise metadata input which corresponds to making the interaction loop more difficult. In short, Koha provides the most evenly distributed and most user-friendly interaction loop, SOUL 3.0 is somewhat functional but quite inflexible, and DSpace is great in terms of retrieval but quite complicated for staff-facing tasks. The mentioned differences are a clear indication that there is a necessity for interface improvementsที่especially focus on metadata-heavy operations.

4. Accessibility Constraints and Cognitive Load Variations

The three systems SOUL 3.0, Koha, and DSpace show considerable variations in accessibility support and cognitive workload associated with the completion of tasks. These differences are strongly related to the interaction design patterns described above and reflect how interface structure influences user workload.

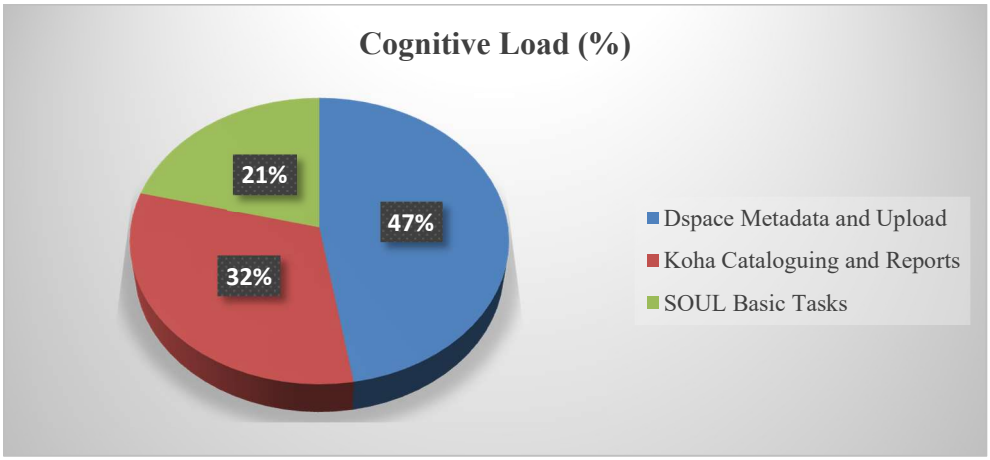
i. **DSpace:** DSpace presents the highest cognitive load, especially during the operations of the staff themselves, such as metadata entry and file uploading. Users felt that the large number of form fields, the number of hierarchical navigation pathways, and the number of decision points increased mental effort. This is reflected in the general lower scores recorded by DSpace: Learnability-7.1, Navigation-7, and a low staff Efficiency Index-400. While well-suited for retrieval, the system's complexity during administrative tasks hinders novice and intermediate users.

ii. **SOUL 3.0**: In the case of SOUL 3.0, simple operations require the least cognitive effort. Having structured workflows and predictable sequences of tasks allows users to perform functions with minimum confusion. This is reflected in high scores of Learnability (8) and Navigation (8.2). However, SOUL 3.0 lacks key accessibility features such as high-contrast modes, screen-reader

compatibility, and customizable interface settings. These limitations may disadvantage users with diverse accessibility needs even though the system is cognitively light for routine tasks.

iii. **Koha:** Koha provides a cognitive load that is properly balanced. The majority of the tasks are intuitive and are being performed with the help of visual cues, dropdown lists, and guided input forms, which clearly contribute to the very high scores of Ease of Use (8.5) and Learnability (8.3). On the other hand, advanced operations like cataloging and report generation still demand the attention of the staff who need to be familiar with MARC structures, thus imposing moderate cognitive demands on them. Still, Koha's hybrid design cuts down on the number of decision points and this in turn leads to the smoother performance of the tasks.

Figure 3: Cognitive Load Distribution Across Tasks



However, these results reflect only partial alignment with WCAG 2.1 principles, particularly in the areas of perceivability and operability, and highlight persistent gaps in adaptability for users with disabilities.

Proposed User-Centered Interface Enhancement Framework (UCIEM)

For a long time, the paradigm of human-computer interaction (HCI) in library systems has given more attention to system efficiency and task performance than to inclusivity and diversity of users, thus the neglect of the latter two aspects. The User-Centered Interface Enhancement Model (UCIEM), proposed in this paper, fills this void by participating user, validating accessibility, and redesigning iteratively during all stages of the development of the interface. Based on the empirical results of the study on usability, task efficiency, and cognitive load in SOUL 3.0, Koha, and DSpace, the UCIEM is an organized, evidence-based framework for the modernization of library software interfaces. Its primary

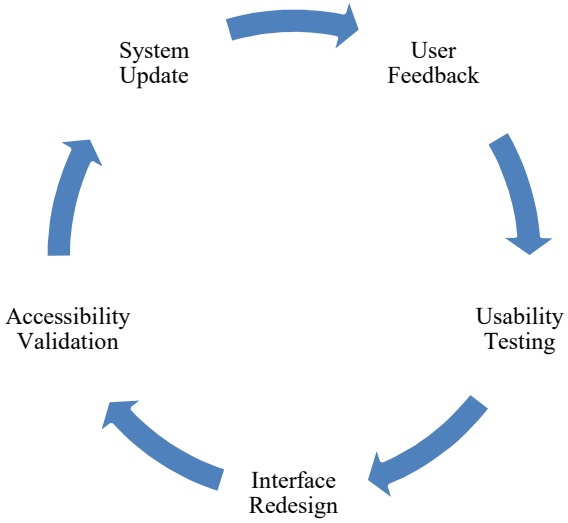
aim is to keep the interface improvements in tune with, inclusive of, and flexible to the ever-evolving user demands and changes in the tech frontier.

The outlined framework is made up of five enduring stages that interrelate and loop continuously through the cycle of reassessment and refinement (Figure 4):

a. **Feedback Gathering from Users:** Users and staff of the library share their views on the system's usability, workflows limiting accessibility, and the whole area of accessibility. Collection of data can be via surveys, interviews, usability logs, or by conducting observational studies. This step guarantees that the design priorities are determined by the actual experiences of the users instead of mere assumptions.
b. **Usability Tests:** The targeted testing sessions assess the system's effectiveness, efficiency, and satisfaction levels. The analysis of the quantitative metrics (task completion time, error rate, and success rate) and the qualitative feedback provides a list of the redesign or simplification areas.
c. **Redesign of the Interface:** Certain parts of the interface are changed to improve the navigation flow, to make the visuals clearer, and to make the interface more accessible based on the test results. The simplification of the metadata entry procedures, the introduction of consistent channels for feedback, and the design of the interface for cognitive ease are some of the things included in this work.
d. **Accessibility Testing:** The interface that has been redesigned will be checked against the accessibility criteria of WCAG 2.1, for example, and it will be certified as being compliant. Such validation guarantees that the users with different capabilities including the ones using assistive technologies remain incorporated in the group of users. Periodic user review is recommended to ensure that the updates in question are still capable of addressing the various accessibility needs.
e. **Deployment and Monitoring of the System:** The upgraded interface is rolled out in the actual environment. The monitoring after deployment assesses user satisfaction, operational performance, and the emergence of usability issues. Feedback from this phase is looped back into the next iteration of the UCIEM cycle of the, thus guaranteeing continuous enhancement.

The UCIEM's iterative characteristic makes it possible that the improvement of usability is no longer a single event but rather an ongoing institutional process, which brings library software development closer to users' changing needs and tech updates.

Figure 4: Proposed User-Centered Interface Enhancement Model (UCIEM)



Implications for College Library Management

The findings of the study clearly demonstrate that usability and interface design are not peripheral technical issues but core strategic elements that directly influence how effectively a college library functions. When HCI principles are embedded into routine system design and evaluation, libraries benefit not only at the operational level but also in terms of service quality, staff productivity, and user satisfaction. Each of the three systems- SOUL 3.0, Koha, and DSpace shows that well-designed interfaces reduce friction in everyday workflows and create smoother, more intuitive pathways for users and librarians alike.

One of the most important managerial implications is the reduction in staff dependency. Systems with intuitive layouts, clear labels, and guided steps allow students and new users to perform basic tasks independently, such as OPAC searches, item renewals, or downloading repository files. This shift frees staff from repetitive front-desk duties and enables them to focus on specialized work like metadata refinement, digital resource curation, and user education.

Another major advantage relates to metadata consistency and accuracy. Guided templates, structured forms, and automated input prompts, particularly visible in Koha help staff avoid errors and maintain uniformity across cataloguing records. Higher metadata quality strengthens discovery, enhances interoperability, and supports long-term preservation of digital resources.

The findings also show that improved usability significantly enhances user engagement. When interfaces are visually coherent and easy to navigate, users spend more time interacting with digital collections, exploring the repository, and accessing open-access resources. This is especially relevant in hybrid learning environments where students depend heavily on digital materials for coursework and research.

Besides, HCI-driven improvements provide broader institutional benefits by supporting open research and digital scholarship. Inclusive, accessible, and user-friendly systems are essential for enabling equitable access to knowledge, lowering learning barriers, and ensuring that libraries can serve diverse users, particularly first-generation learners, students with varied digital skills, and users with disabilities.

Based on these findings, the study suggests that usability evaluation should become an established practice in library management practices, interface performance should be regularly assessed via feedback, analytics, and heuristic reviews as part of system maintenance cycles, and periodic interface audits, user-centered redesign workshops, and accessibility validations should be considered part of digital transformation, not add-ons for libraries using SOUL 3.0, Koha, or DSpace. Incorporating HCI into policy planning will help college libraries keep their digital infrastructures flexible, accessible, and relevant to contemporary academic communities.

Recommendations

a. Conduct periodic usability assessments for SOUL 3.0, Koha, and DSpace based on user feedback and heuristic evaluation.

b. Collaborate with INFLIBNET and open-source communities to develop customizable and accessible interface templates.

c. Organize capacity-building workshops on HCI principles, accessibility standards, and digital content management for library staff.

d. Promote participatory design by involving students and librarians in interface redesign discussions to ensure practical relevance.

e. Integrate analytics dashboards in all systems to track user behavior, workflow patterns, and emerging usability challenges.

Conclusion

The comparison of SOUL 3.0, Koha, and DSpace reveals that human-computer interaction is the main factor that determines the success of library automation, affecting both user satisfaction and institutional productivity. The research clarifies that Koha allows for the most balanced and user-friendly experience, SOUL 3.0 is the best in structured circulation workflows, and DSpace gives advanced repository management but at the cost of higher cognitive effort.

The User-Centered Interface Enhancement Model (UCIEM) proposed in this paper is the one that gives proper systematic approach for the whole process of improvement with user feedback, usability testing, accessibility validation, and redesign. For the library policymakers and developers, this framework strengthens the position that digital library management in an eco-friendly manner demands continuous evaluation, staff training, and co-design practices based on HCI principles.

Future studies should be done regarding cloud-based ILMS, mobile usability evaluations, and inter-institutional analyses to make the model's applicability more robust in terms of validation. After all, the improvement of HCI in library software systems means that digital technology will always be a facilitator of knowledge discovery, equitable access, and meaningful learning experiences in academic libraries.

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References

- Bansal, H. & Khan, R. (2018). A review paper on human computer interaction. *International Journals of Advanced Research in Computer Science and Software Engineering, 8*(4), 53-56
- INFLIBNET Centre. (2018). SOUL 3.0 3.0: Library automation software user manual. Gandhinagar: INFLIBNET.
- Joo, S., & Lee, J. (2022). Usability evaluation of digital library systems: A review and framework. *The Journal of Academic Librarianship, 48*(3), 102–118.

- Khan, A., Hussain, A., & Zareef, M. (2025). The use of human–computer interaction in libraries: A systematic literature review. *Global Knowledge, Memory and Communication, 74*(3/4), 864–882. https://doi.org/10.1108/GKMC-07-2022-0167

- Kumar, R., & Reddy, S. (2021). Comparative usability of DSpace and EPrints in Indian universities. *DESIDOC Journal of Library & Information Technology, 41*(6), 349–356.

- Nielsen, J. (1993). Usability Engineering. San Francisco: Morgan Kaufmann.

- Norman, D. (2013). The Design of Everyday Things (Revised ed.). New York: Basic Books., 282-285p.

- Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmqvist, N., & Diakopoulos, N. (2016). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Pearson Education.
- *Web content accessibility guidelines (WCAG) 2.1*. (2025, May 6). https:www.w3.org/TR/WCAG21/