

USABILITY EVALUATION OF A PROTOTYPE MEDICAL LIBRARY WEBSITE FOR NIGERIAN FEDERAL UNIVERSITIES: A STUDY OF TIME ON TASK AND TASK SUCCESS RATE

By

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Abstract

The study conducted usability testing on a prototype medical library website for federal universities in Nigeria with a focus on time on task and task success rate. The study sought to achieve 2 objectives, while 2 research questions were formulated and answered. A mixed-research methodology was adopted for this study. The prototype was designed using user-centred approach with appropriate web development tools like HTML, CSS, and PHP. The Prototype Medical Library Website Usability and User Experience Testing Worksheet was used to record users' performance for time on task and task success rate. A total of 30 participants from six medical libraries situated within six federal-government owned teaching Hospitals comprising Ahmadu Bello Teaching Hospital, Zaria, Jos University Teaching Hospital, Jos, University of Maiduguri Teaching Hospital, Maiduguri, University College Hospital, Ibadan, University of Nigeria Teaching Hospital, Enugu and University of Benin Teaching Hospital, Benin City were studied. The data collected were analysed using mean, standard deviation, frequency counts and percentages while data presentation was done using Tables, Graphs and Bar Charts. The study found that the average mean time on task of the prototype medical library website is 16.00s, indicating fast task completion time across tasks while the average task success rate across tasks is 90.93% indicating a high task success rate. The study concluded that the prototype medical library website for federal universities in Nigeria is showed high level of efficiency and effectiveness. Based on the findings of the study, it is recommended that prototype medical library website for federal universities in Nigeria should be kept current, accurate, and relevant by the medical library website administrator so that the website can remain useful to users and assist in making task completion faster and maintaining a high task success rate.

Keywords: Usability, Medical library website, Time on task, Task success, Nigeria

Introduction

The advent of the internet and digital technologies has transformed the way medical information is accessed, disseminated, and utilised. Medical library websites have become essential platforms for providing access to a vast array of resources,

including academic articles, e-books, and online databases. These websites play a critical role in supporting the information needs of medical students, faculty, and healthcare professionals, facilitating research, education, and clinical practice. However, the effectiveness of medical

library websites in meeting the needs of their users depends on their usability.

Usability refers to the ease with which users can interact with a website to achieve their goals. A website with poor usability can lead to frustration, decreased productivity, and a negative user experience. In the context of medical library websites, usability issues can have serious consequences, such as delayed access to critical information, decreased research

productivity, and compromised patient care.

Usability evaluation involves assessing the ease with which users can interact with a website to achieve their goals. This can be done through various methods, including user testing, heuristic evaluation, and surveys. One key aspect of usability evaluation is assessing task success rate and time on task. Task success rate refers to the percentage of users who can complete a specific task using the website, while time on task refers to the amount of time it takes users to complete a task. By evaluating these metrics, website designers and developers can identify areas of the website that need improvement and make data-driven design decisions.

In recent years, there has been a growing recognition of the importance of usability in medical library websites. Studies have shown that usability evaluation can identify significant problems with website design, navigation, and functionality. For example, a study on the usability of a medical library website found that users experienced difficulties with searching, browsing and accessing online resources.

Despite the growing body of research on usability evaluation, there is still a need for more studies on the usability of medical library websites. Many existing studies have

focused on general usability issues, but there is a need for more specific studies on task success rate and time on task. By evaluating these metrics, researchers can provide valuable insights into the usability of medical library websites and identify areas for improvement.

Statement of the Problem

Despite the importance of usability, many medical library websites suffer from design flaws, navigation problems, and other issues that can hinder user experience. For example, a website with a cluttered layout, unclear navigation, or inadequate search functionality can make it difficult for users to find the information they need. Similarly, a website that is not optimised for mobile devices can be inaccessible to users who need to access resources on-the-go.

The problem of usability in medical library websites is further compounded by the diverse needs and backgrounds of users. Medical students, faculty, and healthcare professionals have different information needs, skill levels, and preferences, which can affect their experience of using a website. For instance, medical students may require guidance on searching for academic articles, while faculty members may need to access specific databases for research purposes. To address these challenges, it is essential to conduct usability evaluations of medical library websites.

Research Question

The following research questions were raised for answers:

1. What is the mean time on task of the prototype medical library website for federal universities in Nigeria?

2. What is the mean task success rate of the prototype medical library website for federal universities in Nigeria?

Research Objectives

The aim of this study is to investigate the usability of a prototype medical library website for federal universities in Nigeria by assessing the task success rate and time on task of users interacting with the website. The objectives of the study are to:

1. determine the mean time on task of the prototype medical library website for federal universities in Nigeria;
2. ascertain the mean task success rate of the prototype medical library website for federal universities in Nigeria;

Literature Review

Several empirical studies have been conducted to provide insight into time on task and task success rate within the context of medical library websites:

Liu and Stork (2000) measured task completion times for 20 users across five health sciences library websites. The average time to locate a full-text article was 2.1 minutes, while basic catalogue searches took around 45 seconds. The researchers reported an average task success rate of 83% in their evaluation of five health sciences digital libraries and concluded that inconsistent terminology and poorly labelled menus prolonged task duration while lower success was often linked to vague labels and poor search functionalities. Similarly, Xie and Wolfram (2002) conducted a controlled experiment comparing novice and expert users navigating a prototype academic medical library portal. Expert users completed tasks 30–50% faster, suggesting

that system learnability significantly affects efficiency. On task success rate, the researchers reported that experts achieved success rates above 90%, while novices had a success rate of 68%, highlighting the need for user-friendly design to accommodate diverse experience levels.

In a study by Murphy *et al.* (2015) the researchers evaluated an e-library platform in a teaching hospital. The average time on task to locate and download an article was 3.4 minutes. When search filters were introduced and menu categories refined, task times dropped to 1.7 minutes which indicated a 50% improvement. The study further revealed a task success rate of 85% indicating that tasks with lower success rates were those requiring use of multi-step filters or clinical decision trees.

Zaharias and Poylymenakou (2009) tested a health information portal prototype and reported that users spent excessive time searching due to inadequate visual hierarchy and poor task orientation. Average task times exceeded 4 minutes for relatively simple goals, leading to major redesigns in navigation and user prompts the overall task success rate was 74%. Tasks involving advanced search and filter functions had notably lower success than simpler browsing tasks.

In Nigeria, Omekwu *et al.* (2017) evaluated digital library usage among Nigerian medical students and found that poor interface design led to prolonged task times, sometimes exceeding 5 minutes for basic document retrieval. The researchers recommended simplified design, offline caching, and mobile-friendly layouts to reduce inefficiency.

In a usability test of Nigerian academic library websites, Adebayo and Salawu

(2018) reported average time on task of 3–5 minutes for basic tasks like accessing e-books and searching the OPAC. They found that inconsistent menus, poor categorisation, and unresponsive design significantly prolonged user tasks while over 40% of users failed to successfully complete basic retrieval tasks, largely because of inconsistent menus, broken links, and non-mobile-friendly designs.

Research Method

The study adopted mixed research methodology. According to Creswell and Clark (2017) mixed research methodology in usability studies combines qualitative and quantitative methods to investigate user behaviour, preferences, and performance. The population of this study consists of 2,290 medical students across the 16 federal doing their clinicals at teaching hospitals and sixteen medical librarians in federal universities in Nigeria as obtained from the website of Medical and Dental Council of Nigeria (MDCN) as of March 2022. Out of the 16 federal universities with fully accredited medical programmes, the researcher selected six universities using disproportionate random sampling techniques. This is to ensure that every geo-political zone is well represented in the study. The instruments used for this study consisted of the treatment instrument and the test instrument. The treatment instrument is the prototype medical library website titled Nigerian Universities Medical Library Website (NUMLW) was developed specifically for this study using appropriate Web technologies. The test instrument is the Prototype Medical Library Website Usability and User Experience Testing Worksheet (PMLWUXTW) which was designed for

the purpose of recording observations for task success/failure, task execution time. Following the development of the prototype medical library website, the researcher visited the selected medical libraries and conducted a formal usability test on the prototype website within a bespoke laboratory environment using 30 volunteers who participated in the study. During the user test, participants were required to access and assess the prototype medical library website. To stimulate the exploration of the library website, scenarios and tasks were defined, chosen to represent main activities typically performed by library users. These tasks included finding an e-resource, finding link to free medical database, finding out how to borrow a book, locating library opening/closing hours, finding library contact information, and finding link to ask for a reference librarian.

Participants were encouraged to freely explore the prototype medical library website before starting the scenarios. After task completion, the performance data of all participants such as time-on-task, and task completion rate, were recorded in the worksheet by the researcher.

The completion task success rate was recorded by assigning a binary value of '1' if the test participant manages to complete a task and '0' if he/she does not while time on task was computed with the following formula:

$$\text{Time on Task (ToT)} = \text{TeT} - \text{TsT}$$

Where TeT = Task end time

TsT = Task start time

Mean, standard deviation, frequency count and percentages were used for data analysis while data presentation was done using tables, graphs and bar charts.

Results **library website for federal universities in Nigeria**
Research Question 1: What is the mean time on task of the prototype medical ?

Table 1.0: Time on Task (in seconds) of Prototype Medical Library Website for Federal Universities in Nigeria

Participants	TskTime 1	TskTime 2	TskTime 3	TskTime 4	TskTime 5	TskTime 6
P1	20.00	20.00	13.00	20.00	15.00	35.00
P2	17.00	8.00	20.00	20.00	13.00	5.00
P3	30.00	20.00	30.00	20.00	15.00	11.00
P4	30.00	11.00	14.00	5.00	5.00	11.00
P5	7.00	5.00	11.00	18.00	7.00	13.00
P6	15.00	12.00	13.00	14.00	10.00	15.00
P7	14.00	15.00	16.00	18.00	14.00	18.00
P8	10.00	17.00	18.00	25.00	12.00	19.00
P9	10.00	20.00	14.00	30.00	10.00	21.00
P10	12.00	23.00	20.00	22.00	10.00	9.00
P11	12.00	21.00	25.00	28.00	15.00	8.00
P12	11.00	11.00	31.00	25.00	13.00	10.00
P13	17.00	10.00	17.00	26.00	17.00	11.00
P14	16.00	12.00	15.00	15.00	19.00	11.00
P15	15.00	30.00	14.00	18.00	24.00	13.00
P16	10.00	32.00	15.00	18.00	12.00	15.00
P17	8.00	15.00	14.00	20.00	19.00	13.00
P18	10.00	18.00	8.00	22.00	15.00	17.00
P19	11.00	15.00	10.00	24.00	15.00	14.00
P20	10.00	13.00	16.00	25.00	26.00	18.00
P21	18.00	14.00	16.00	30.00	28.00	12.00
P22	12.00	10.00	12.00	23.00	20.00	10.00
P23	14.00	11.00	8.00	32.00	18.00	11.00
P24	9.00	25.00	12.00	40.00	30.00	11.00
P25	20.00	22.00	10.00	31.00	12.00	18.00
P26	15.00	18.00	9.00	25.00	14.00	19.00
P27	17.00	13.00	11.00	28.00	11.00	12.00
P28	12.00	15.00	12.00	23.00	16.00	14.00
P29	12.00	10.00	13.00	20.00	11.00	16.00
P30	11.00	13.00	15.00	15.00	10.00	18.00
Mean Time $\bar{X}$	14.00	16.00	15.00	23.00	15.00	14.00
Standard Deviation μ	5.48	6.26	5.59	6.66	5.87	5.43

See Appendix C for Task List

N= 30

Table 1.0 showed the mean time on task and standard deviation of the prototype medical library website for federal universities in Nigeria. The results revealed that for the number of iterations conducted (N=30) on six tasks (T1 – T6) the mean time on task for T1 and T6 is 14.00s, T2 is 16.00s, T3 and T5

is 15.00s while T4 returned a time on task of 23.00s. The standard deviation for the time on task for T1-T6 is 5.48, 6.26, 5.59, 6.66, 5.87, and 5.43 respectively. This implies that T1 and T6 had the least time on task of 14.00s while T4 has the highest.

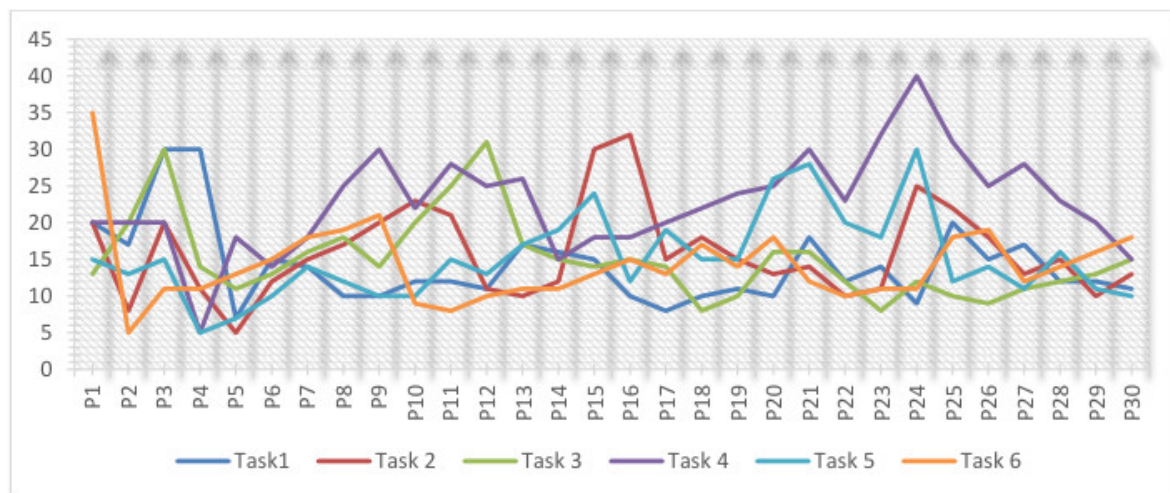


Figure 1.0: Comparison of Time on Task of the Prototype Medical Library Website for Federal Universities in Nigeria

Figure 1.0 is a graphic depiction of the comparison of time on task (y axis) against respondents (x axis). The individual tasks (T1-T6) are colour coded and included in the legend. The time series graph showed that T5 presented less challenge to users with a lowest dip at P4 with a value of 5 seconds and peaked at p24 with a value of 30 seconds. On the other hand, T4 was more challenging to most users than T1, T2, T3, T5 and T6.

The graph showed that more participants spend more time on T4 as observed at P9, P11, P13 and the highest at P24 with a value of 40 seconds. This implied that the website needs optimisation to accommodate the lapses resulting in high time on task for T4.

Research Question 2: What is the mean task success rate of the prototype medical library website for federal universities in Nigeria?

Table 2.0: Task Success Rate of Prototype Medical Library Website for Federal Universities in Nigeria

Participant s	TskCmp 1	TskCmp 2	TskCmp 3	TskCmp 4	TskCmp 5	TskCmp 6	Total Task Completed per participant
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P1	0	1	1	1	1	0	4
P2	1	1	1	1	1	1	6
P3	1	1	1	1	1	1	6
P4	0	1	1	1	1	1	5
P5	1	1	1	1	1	1	6
P6	1	1	1	1	1	1	6
P7	1	1	1	1	1	1	6
P8	1	1	1	1	1	1	6
P9	1	1	1	0	1	1	5
P10	1	1	1	1	1	1	6
P11	1	1	1	1	1	1	6
P12	1	1	0	1	1	1	5
P13	1	1	1	1	1	1	6
P14	1	1	1	1	1	1	6
P15	1	0	1	1	1	1	5
P16	1	0	1	1	1	1	5
P17	1	1	1	1	1	1	6
P18	1	1	1	1	1	1	6
P19	1	1	1	1	1	1	6
P20	1	1	1	1	1	1	6
P21	1	1	1	1	1	1	6
P22	1	1	1	1	1	1	6
P23	1	1	1	1	1	1	6
P24	1	1	1	0	0	1	4
P25	1	1	1	1	1	1	6
P26	1	0	1	1	0	1	4
P27	0	0	1	1	0	1	3
P28	1	1	1	1	1	1	6
P29	1	1	0	1	1	0	4
P30	1	1	1	1	1	1	6
Total							
Success	27	26	28	28	27	28	
Rate per task	(90.0%)	(86.7%)	(93.3%)	(93.3%)	(90.0%)	(93.3%)	
N=30							

See Appendix C for Task List

Table 2.0 presented results of task successfully completed by each participant.

Tasks completed successfully are represented by “1” while tasks not completed are represented with “0”. Tasks 3, 4, and 6 have the highest success rate with 28

participants successfully completing the tasks, while Tasks 2 had the lowest success

rate with 26 participants completing the tasks out of 30.

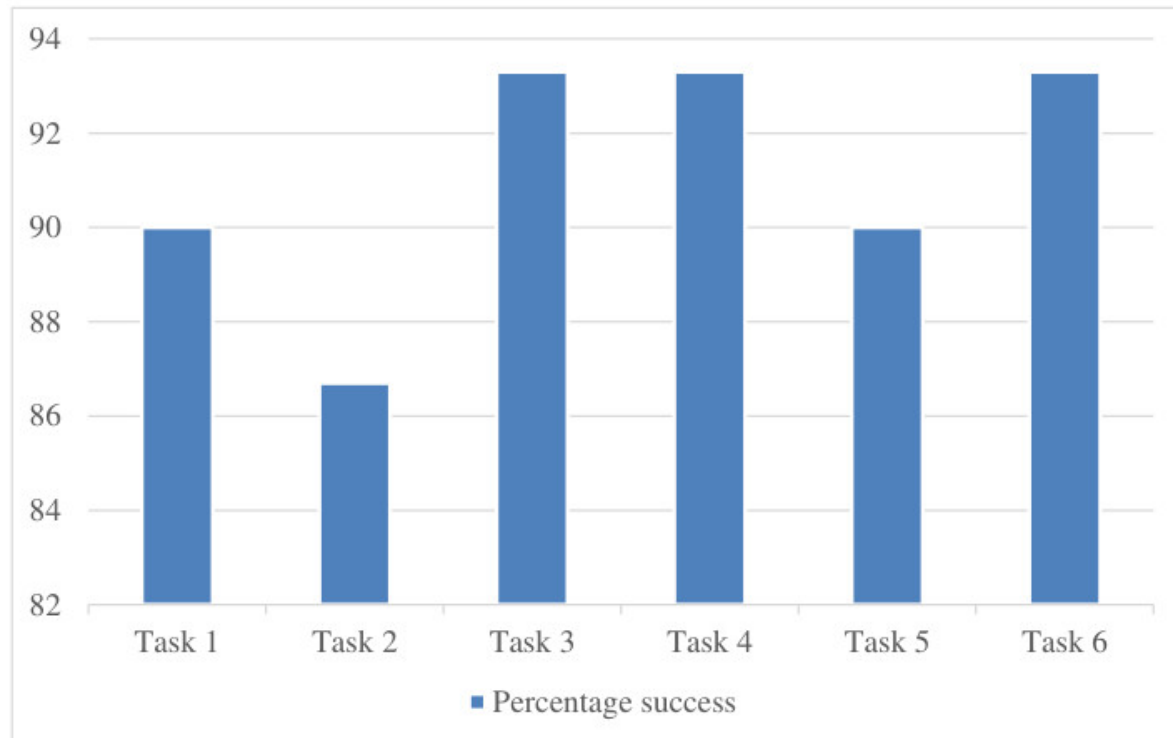


Figure 2.0: Percentage of Task Success Rate

Figure 2.0 presented a bar chart showing the summary of task completion rate in percentage. T1 has a success rate of 90.0%, T2 recorded a success rate of 86.7%, T3, T4, and T5 had 93.3% completion rate, while T6 had 90.0% success rate. This indicated that the overall task completion rate is high at > 90.0% with only T2 recording < 90.0%. The high completion rate could be because of a combination of several factors including the website's user-friendliness, level of computer literacy among the participants and availability of better Internet access at some locations.

Discussion

The usability evaluation of the prototype medical library website, based on 30

iterations across six tasks (T1–T6), revealed insightful trends in task efficiency, a critical dimension of usability (ISO 9241-11, 2018). The mean time on task ranged from 14.00 seconds (T1 and T6) to 23.00 seconds (T4), with standard deviations indicating moderate variability (5.43–6.66 seconds). These results suggest that while some tasks were intuitively designed and easily completed, others may present usability challenges requiring further refinement.

The fact that T1 and T6 recorded the shortest mean times (14.00 seconds) implied that these tasks aligned well with users' expectations and cognitive models. In usability research, faster task completion often reflects a clear, straightforward interface and alignment with users' mental

models (Nielsen, 2020). For example, T1 and T6 involved common functions such as searching for a medical resource or navigating to the homepage, their efficiency may indicate that users found the site's search and navigation tools familiar and intuitive. This is supported by studies indicating that effective search functionalities and clear site architecture are vital for medical library websites (Murphy *et al.*, 2020).

Conversely, T4 showed the highest mean time (23.00 seconds), suggesting that users encountered difficulties or confusion. Given that T4 also displayed the highest standard deviation (6.66 seconds), there is evidence of inconsistent user performance, possibly due to unclear instructions, ambiguous labels, or complex multi-step processes. According to Zahabi *et al.* (2015), in the context of health information systems, such variability often points to design elements that fail to support users' information-seeking behaviours efficiently. For example, if T4 involved advanced features such as filtering search results by publication date or accessing full-text resources, the interface may not have provided sufficient cues or guidance.

The standard deviation values, while moderate, further highlight where consistency in task performance could be improved. For tasks like T2 and T4, with higher deviations (6.26 and 6.66 seconds respectively), design inconsistencies or unclear pathways might have contributed to varying user strategies (Peter, 2022). This variability can negatively affect overall user satisfaction and trust, which are critical in medical contexts where timely access to information is essential (Zahabi *et al.*, 2015). These findings underscore the need to refine task flows, especially for complex operations

represented by T4. Techniques such as heuristic evaluations, cognitive walkthroughs, and additional user testing could help pinpoint specific interface elements contributing to delays (Nielsen, 2020). Furthermore, implementing user-centered design principles, including iterative prototyping and direct user feedback integration, would likely enhance efficiency and reduce time on task variability (Peter., 2022).

While the prototype demonstrates strengths in basic navigation and search tasks (T1, T6), there is a clear opportunity to optimise more complex functions (T4) to ensure consistent and efficient user experiences. These improvements are essential for supporting medical professionals and students who rely on quick, reliable access to information (Murphy *et al.*, 2020).

The findings on task success rate for the prototype medical library website revealed that participants achieved 93.3% success rate on tasks three, four, and six while 86.7% success rate was recorded for task two. The analysis of task completion rates on the prototype medical library website provides valuable insight into the system's usability. In this study, task completion was binary-coded: a successful completion was assigned a "1" and failure a "0". The results showed that Tasks 3, 4, and 6 had the highest success rates, with 28 out of 30 participants completing these tasks successfully.

In contrast, Task 2 recorded the lowest success rate, with 26 out of 30 participants achieving successful completion. While these figures represent relatively high levels of task success overall, the variance between tasks highlights important areas for further investigation and interface refinement. Successful task completion is a core measure

of usability because it reflects the extent to which users can achieve their goals effectively within a system (ISO 9241-11, 2018). The high success rates for Tasks 3, 4, and 6 suggested that these tasks were well-aligned with user expectations and that the website provided clear affordances and pathways for accomplishing them. For example, if these tasks involved common actions such as searching for a resource, accessing electronic journals, or navigating the homepage, the results indicate that these functionalities are designed in a way that supports efficient and successful user interaction (Murphy *et al.*, 2020). This aligns with findings by Zahabi *et al.* (2015), who noted that clear visual cues, predictable navigation structures, and well-labelled links contribute to high task success rates in health information systems.

The slightly lower success rate for Task 2, where 26 participants completed the task successfully, merits closer scrutiny. While a success rate of 87% (26/30) is not alarming, it does suggest that certain design or functional elements may be sub-optimal. According to Peter (2022), even small usability obstacles such as ambiguous terminology, hidden options, or unclear task flows can significantly impact task completion rates, especially in high-stakes environments like medical libraries. Furthermore, minor usability issues can be amplified in medical libraries due to the nature of their users. Medical students, clinicians, and researchers often operate under time constraints and require seamless access to reliable information (Murphy *et al.*, 2020). Any barriers to task completion not only frustrate users but can also compromise their ability to retrieve critical information promptly. As Zahabi *et al.* (2015) argue,

usability shortcomings in health information systems may have real-world consequences, such as delays in decision-making or reduced trust in the system.

To address these concerns, it is advisable to conduct further user testing focused on Task 2, employing methods such as cognitive walkthroughs or think-aloud protocols to uncover where users encounter friction (Nielsen, 2020). These methods can reveal whether the difficulty arises from interface design, terminology, or navigation structures. In addition, applying iterative design principles where feedback from users directly informs refinements to the interface can help ensure that subsequent versions of the website support higher success rates across all tasks (Peter, 2022).

The generally high task completion rates for the prototype medical library website are promising, indicating that its core functions are usable for most participants. However, the relatively lower success rate on Task 2 points to specific opportunities for improvement. Addressing these issues will not only enhance overall usability but also support the critical information needs of medical library users. The high task success rates suggested that these tasks were well-designed, allowing users to complete them successfully without any challenges. This could also be due to clear navigation, simple task requirements requiring minimal cognitive load, or effective feedback mechanism such as clear error messages or confirmation messages helping participants stay on track.

Conclusion

The results of this study collectively point to the prototype medical library website's high level of usability and effectiveness in

supporting users' information-seeking behaviour in a medical library context. The success of the prototype underscores the value of integrating usability testing early in website development and maintaining user-focused design practices. Furthermore, it highlights the importance of continuous

content management and system updates to ensure sustained relevance, efficiency, and user satisfaction. The prototype stands as a viable model for future medical library websites in Nigeria, capable of enhancing academic and clinical information access through improved user experience.

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