

Mapping Cloud-Based Library Services through Library Websites: A Web-Based Content Analysis of Degree Colleges under the University of North Bengal (NBU)

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Abstract

The present study investigated the availability of cloud-based services for libraries of the affiliated degree colleges under the University of North Bengal (NBU), West Bengal. The study applied the content analysis method to collect the data of the 28 (54.9%) colleges with operational library websites that use cloud-based services among the 51 affiliated colleges. Besides assessing the availability of library websites, the study also examined other aspects of academic support services, availability of cloud-based and digital library systems, connection in digital library systems, Open Educational Resources (OER), newspaper webpages, consortium-based services like ONOS, and user-centric online services like interactive reference support and membership information. Frequency and percentage methods were employed to analyse the study findings, which were derived from structured Internet observation. From the study findings, it is evident that library websites with functional and user-support services are highly digitally mature with regard to e-resources, remote accessibility, academic support resources, and interactive digital services. However, some of the glaring gaps were identified with regard to Institutional repository access and consortium service exposure. Although the study found that there is an extensive use of cloud-based service delivery by digitally engaged institutions, it is evident that for digital transformation, research preservation facilities and interactive digital networking should be strategically improved.

Keywords: Cloud-based library, Library websites, Digital library, Institutional repositories, Open Educational Resources, Library consortia, User-centric digital services.

1. Introduction

The way in which the operations of the library are conducted has been impacted by the rapid development of information and communication technologies, especially through the integration of cloud computing infrastructures. This is because cloud computing is essential in ensuring that library services are provided in an affordable manner to ensure better user

engagement, efficiency, and management of digital resources (Ibrahim et al., 2025). Modern library websites have emerged as an all-inclusive digital service platform that hosts cloud-based technologies such as interactive reference services, electronic resources, remote access facilities, Integrated Library Management System (ILMS), and Online Public Access Catalogues (OPAC). Therefore, an evaluation of library websites provides an assurance of technical advancement and digital transformation in academic institutions (Shaw and Sarkar, 2020).

In this regard, the current study makes use of a structured web-based content analysis to examine the implementation and perception of cloud-based library services with regard to degree colleges affiliated with the University of North Bengal, West Bengal. It is found that by analysing the infrastructure of websites, academic support services, cloud-based operational systems, interaction with digital libraries and consortia, and online services that are user-centric, it is possible to identify trends of adoption, institutional strengths, and infrastructural shortcomings (Kayode et al., 2018). It is possible to formulate strategic policies and improve infrastructure with reference to digital library transformation with regard to affiliated colleges.

2. Objectives of the Study

The study aims to access the availability, scope, and functionality of library websites/webpages among degree colleges under the University of North Bengal, with particular focus on the online resources and services provided to their users. Accordingly, the following objectives were formulated.

- i. To identify the availability of library websites/webpages among degree colleges under the University of North Bengal.
- ii. To map the services for academic support offered through the library website, including the availability of previous year's question papers and syllabus.
- iii. To examine the presence of cloud-based and digital library services offered through library websites.
- iv. To analyse the availability of links to digital libraries, Open Educational Resources (OER) platforms, newspaper web links, and consortium-based services such as ONOS on library websites.
- v. To assess user-oriented online services presented on library websites, including membership information and interactive services like "Ask a Librarian".

3. Literature Review

A number of studies have been examined emerging technologies in academic and library contexts, with particular attention to their integration, implementation, and associated challenges. The existing literature provides a substantial body of knowledge on the adoption of cloud-based and automated library services, as well as the technological, financial and institutional factors influencing their implementation.

Islam et al. (2022) undertook an extensive empirical investigation to examine the status of cloud-based library services with regard to challenges of technology adoption in selected academic and special libraries of Bangladesh. A mixed-method approach of research design with the use of purposive sampling was adopted to collect data with the help of structured questionnaires and interviews with library professionals. The results show that although the adoption of cloud computing was found to be low, it was mainly partial and concentrated

around the adoption of the Software-as-a-Service (SaaS) delivery model. High subscription fees, online payment issues, and financial constraints were major challenges faced by libraries during the adoption of cloud computing. A scalable and replicable model of cloud computing was proposed by the authors for developing countries, with particular reference to funding and institutional policy initiatives. Research on the status of the automated college libraries was conducted by Shaw and De Sarkar (2020). The research was undertaken with the objective of providing better web-based services through an affordable cloud computing model. The research was based on the Infrastructure-as-a-Service model and the Software-as-a-Service model. The research proposed a cloud computing consortium model for the LMS infrastructures of the libraries, which would be accessed through internet or WAN connectivity. The research findings revealed the importance of a cloud computing consortium model in terms of reduced costs for infrastructures and personnel, and sharing of resources without duplication.

The use of cloud-computing in the provision of Web-based services in academic libraries in Kwara State in Nigeria was investigated by Kayode et al. (2018), focusing on the usability and convenience of use. Frequency analysis and Pearson Product Moment Correlation analysis were used in the study of 35 librarians. The results revealed a positive correlation between the usability of cloud computing, user-friendliness, and the adoption of cloud computing. Data as a Service and Infrastructure as a Service are the two models of cloud computing that are in application because of the benefits such as flexibility, time saving, improvement in task performance, and backup recovery. Challenges affecting the effective implementation of cloud computing are power supply instability, poor ICT facilities, inexperience, financial constraints, and lack of institutional support. Nazir et al. (2025) investigated use of cloud computing in Pakistani university libraries in Punjab Province. The main issues found in this study included implementation issues, librarian awareness of cloud computing, and ICT infrastructures. The study revealed that the most widely used model of cloud computing was SaaS after conducting a quantitative study of 65 university libraries in Pakistan using SPSS. The majority of librarians in Pakistani university libraries had little knowledge of cloud service providers, particularly those libraries that had adequate ICT infrastructures. The authors proposed an empirical framework for the successful adoption of cloud computing in academic libraries due to major barriers identified in the study. The barriers included poor internet connectivity, expensive membership and renewal fees, and security and privacy issues.

Information needs are changing day by day, Yuan (2025) adopted a combined model of the technology acceptance model and the technology-organization-environment framework for the study of CBS in academic libraries in China. The research adopted a quantitative approach and polled 277 senior library professionals in the university libraries in China. The study found the intention of CBS in academic libraries in China was heavily influenced by organizational factors, policy support, and technological readiness. To assist the library administrators and legislators in the implementation of CBS and building intelligent and forward-thinking learning centres, a validated approach was proposed in the study. A descriptive survey method was adopted by Aiyebilehin et al. (2020) to study the knowledge and use of cloud computing services among librarians, focusing on a population of 132 professional and para-professional librarians in some colleges in Edo State, Nigeria. The findings indicated that cloud technologies were greatly utilized in collection development, cataloguing, and administrative work, as well as a high level of knowledge of cloud services such as OCLC, World Cat, and Google Docs among librarians. Some of the advantages identified were cost-effectiveness, universal accessibility, time efficiency, enhanced collaboration, and unlimited storage capacity. However, poor internet connectivity, lack of a

stable electricity supply, as well as lack of finance, were identified as major challenges to the effective use of cloud computing in university libraries.

Dadhich et al. (2021) undertook an examination of the organizational, financial, technological, and environmental factors to understand the factors that influence the adoption of Library Cloud Computing (LCC) in Indian colleges. EFA, CFA, and SEM-ANN methods were used in the research to examine the data obtained from 510 respondents in 26 states across India. All the factors, namely organizational, financial, technological, and environmental, had a significant influence on the adoption of LCC, with the technological factors being the most important predictors of LCC adoption, such as scalability, technological readiness, and backup facilities. The importance of cloud computing in the strategic role of promoting sustainable digital transformation and the development of intelligent academic libraries was also underscored by the financial, organizational, and environmental benefits that accrued from it. The factors affecting the acceptance of cloud computing in university libraries was critically examined in a study done by Ibrahim et al. (2025). The authors examined the factors for improving the services of digital preservation in the face of new technological developments. The authors identified major factors related to technology, organizations, and people, such as staff attitude towards technology, support of the library management, migration plan, compatibility, reliability, and preparation of the library, as major factors influencing the success of cloud computing acceptance. In order to facilitate the acceptance of cloud computing in university libraries, especially in developing countries, a useful paradigm for cloud migration was proposed in the study.

The study conducted by Ezell et al. (2022) investigated the extent of information provided to users regarding the facilities provided for users related to accessibility, a detailed content analysis of the accessibility web pages of 85 academic library websites in four library consortia in the United States. The results of the survey showed that libraries have enhanced their efforts to serve users with different kinds of functional needs, and the content of the web pages is mainly focused on facilities, services, and technologies provided for users with special needs. Public institutions provided more information compared to private institutions, even though there were significant differences in the extent, depth, and content of information provided to users. This shows that information should be more visible, transparent and timely to encourage user engagement and communication. The research conducted by Maina and Muthee (2020) focused on the readiness of academic libraries in Kenya to adopt cloud computing technologies. The research focused on Jomo Kenyatta University of Agriculture and Technology Library in particular. The authors of the study used a descriptive study design, and the sample population for the study consisted of 40 librarians. The findings of the study showed that the main findings of the study were that the academic libraries in Kenya face infrastructural challenges, insufficient bandwidth, insufficient ICT facilities, and insufficient advanced knowledge among the staff. The main findings of the study were that the main barriers to the adoption of cloud computing in the library were the resource barrier, insufficient manpower, and insufficient power supply. The study recommended that government and institution-based funding be put in place for the effective implementation of cloud computing technology in the library.

4. Methodology

The target population of the present study were degree colleges affiliated under the University of North Bengal (NBU), West Bengal. For the data the study used the content analysis method where content analysis is a scientific and flexible approach to conducting research that seeks to identify patterns, themes, and meanings in recorded communication.

According to the data available on the NBU website, there are 51-degree colleges affiliated. Therefore, the target population was 51-degree colleges. However, after visiting the library websites it has been observed that there are only 28 college libraries have their own library websites where remaining colleges have no separate library websites. From the screening, it was found that 28 out of the 51 institutions, accounting for 54.9%, had library websites that offer cloud-based services, making them the effective sample for the study since the objectives of the study are specifically focused on services offered through the web platform.

A separate excel sheet was prepared and the webpage services of each college are listed in that excel file. The investigators visited each colleges website one by one and thoroughly checked and collected the data and codified what was the cloud-based library services they are provided. To identify trends, advantages, and disadvantages of the implementation of cloud-based library services, data collection was done and then analysed by using statistical methods like frequency and percentage distribution. User satisfaction, technical aspects, and financial aspects are beyond the scope of this study; it is limited to the availability of services displayed on the websites.

5. Results

5.1 Distribution of Cloud-Based Adoption

Based on the website of colleges, it is clear that among the affiliated colleges under the University of North Bengal (NBU), 28 colleges from a total of 51 represent the digitally active category. Therefore, it is from this category that the statistical analysis below is based, representing their composition, accessibility, and overall scope of cloud-based library services. The analysis does not represent the remaining 23 colleges that do not have web-enabled digital service platforms.

5.2 Status of Adoption at Affiliated Colleges

The present status of the adoption of cloud-based services in all the 51 affiliated colleges of the selected university, along with the research participants, is presented in table 1. More than half of the colleges under NBU are found to be utilizing cloud-based technologies for the management of digital resources, the provision of online services, data storage, and access from a remote location. Among the universities surveyed, 28 colleges (54.9%) are found to have integrated cloud-based services into their library systems. On the other hand, 23 universities (45.1%) are found not to have adopted cloud-based services, indicating a high level of dependency on traditional technologies.

Table - 1: Adoption Status among Affiliated Colleges

Category	Number of Colleges	Percentage
Colleges with Cloud-Based Services	28	54.9
Colleges without Cloud-Based Services	23	45.1
Total Affiliated Colleges	51	100.0

5.3 Infrastructure for General Websites

The availability of library websites of the colleges under consideration that offer digital or cloud-based services is presented in Table 2. From the above table, it is clear that only one college (3.6%) did not have its own library website, while 27 colleges (96.4%) had their own

library website. This shows that the importance of having a unique online presence for library operations is well understood. To enhance the accessibility of users, all 28 colleges (100%) ensured that users could access their library website through the main website. Further, all of the colleges (100%) ensured that their library website was up to date and effective. This indicates that they are maintaining their library websites properly. Additionally, all of the library websites (100%) had contact information, which is important for promoting transparency. Overall, these observations reveal that the universities considered in this study had an effective online presence, as they had ensured the availability of basic web infrastructure.

Table - 2: General Websites Infrastructure

Indicator	Yes	No	Yes %	No %
Dedicated Library Website	27	1	96.4	3.6
Accessible from Main Website	28	0	100.0	0.0
Functional & Updated	28	0	100.0	0.0
Contact Information Available	28	0	100.0	0.0

5.4 Services for Academic Support

As depicted in Table 3, it is evident that there is a significantly high number of academic support materials available in the libraries or institutional websites of the evaluated colleges. All the 28 colleges (100%) offer access to the exam questions of the previous years, implying that the institutions are committed to helping students prepare adequately for the exams. In addition, all the colleges have full access to exam-related resources. This suggests that all the colleges have full digital support for academic exam standards. The importance of openness and ease of access to curriculum information is valued by almost all the institutions, as depicted by the fact that 27 colleges (96.4%) offer updated syllabi, while only one college (3.6%) does not offer the same. Based on the results, it is evident that the institutions are effective in the use of the digital platform to improve students' academic preparedness and ease of access to the resources provided.

Table - 3: Academic Support Services

Indicator	Yes	No	Yes %	No %
Previous Year Question Papers	28	0	100.0	0.0
Syllabus Availability	27	1	96.4	3.6
Examination Resources	28	0	100.0	0.0

5.5 Cloud-Based and Digital Library Services

The cloud-based library services offered in the libraries are presented in the table 4. As may be noted, the level of digital integration in the majority of the dimensions of the examined services is high. The level of automation in the processes of bibliographic control and library management is also significant, considering the fact that 26 colleges (92.8%) have already adopted the cloud-based services of Cloud OPAC and Cloud ILMS, while 2 colleges (7.2%) still do not use these services. At the same time, all 28 colleges (100%) are already using the cloud-based services of e-books and e-journals, indicating a strong institutional commitment in the supply of such resources and the development of digital collections. It was noted that cloud-based reference services are available in all libraries (100%), which indicate a strong institutional commitment in the provision of virtual user engagement.

Table - 4: Cloud-Based and Digital Library Services

Indicator	Yes	No	Yes %	No %
Cloud OPAC	26	2	92.8	7.2
Cloud ILMS	26	2	92.8	7.2
E-Journals & E-Books	28	0	100.0	0.0
Remote Access	28	0	100.0	0.0
Cloud Reference Service	28	0	100.0	0.0
Institutional Repository	0	28	0.0	100.0
Discovery Tool	27	1	96.4	3.6

In order for unified search and information retrieval to be possible, 27 out of the total institutions (96.4%) have already implemented discovery tools. The above statistics indicate that the institutions have a high uptake of discovery tools. The fact that none of the colleges have implemented institutional repositories (0%) indicates a major gap in the institutions. The major gap in the institutions in the aspect of facilitating academic communication, increasing the visibility of research output, and ensuring long-term digital preservation is the lack of repository infrastructures. The above statistics indicate that the institutions have a high uptake in the implementation of operational and user-centric cloud services; however, it also indicates the need to develop frameworks for the institutional repository infrastructures.

5.6 Digital Libraries and OER Integration

The presence of links for opening and digital learning resources on the websites of the colleges included in the assessment is presented in Table 5. The table shows a high level of integration with the digital learning resources available at the national level, where 27 colleges (96.4%) have provided the link for the National Digital Library, and only one college (3.6%) has not. In a similar context, 25 colleges (89.2%) have provided the linkage for the digital libraries available worldwide, and 3 colleges (10.8%) have not. Therefore, the level of integration with the digital learning resources available worldwide is a little lower than the level of integration with the resources available in the country. Only one college (3.6%) does not have the link for the OER platforms compared to 27 colleges (96.4%). In the context of the subject-specific open resources available on the internet, the same trend is observed. Specifically, 27 colleges (96.4%) have provided the relevant link, and 1 college (3.6%) has not. The results show that most colleges are actively providing the link for the opening of the resources available on the internet.

Table - 5: Integration of OER and Digital Libraries

Indicator	Yes	No	Yes %	No %
National Digital Library Links	27	1	96.4	3.6
International Digital Library Links	25	3	89.2	10.8
OER Platforms	27	1	96.4	3.6
Subject Open Resources	27	1	96.4	3.6

5.7 Membership and Consortium Services

Table 6 shows the transparency of the membership and policy information of the websites of the colleges under study. It can be noted that a significant amount of transparency in the regulation of users through registration is exhibited by all the colleges under study. All the 28

colleges (100%) had provided in-depth information about their membership and had clearly stated their membership restrictions. Additionally, a significant number of colleges, i.e., 27 out of 28 (96.4%), had clearly stated their regulations for accessing e-resources, while only 1 college out of 28 (3.6%) had failed to do so. This trend indicates a positive attitude towards helping users use the resources in an ethical and appropriate manner. This is a positive move that indicates colleges' efforts to ensure that users are assisted in using e-resources in an ethical and suitable way. However, access to consortium information, including programs like ONOS (One Nation One Subscription), is available at only 8 (28.6%) of the colleges, while the majority of 20 (71.4%) do not. It is evident that basic administrative and policy information is available at all institutions; however, consortium-based service visibility is still relatively low, necessitating awareness and integration of digital resource initiatives.

Table - 6: Services for Membership and Consortiums

Indicator	Yes	No	Yes %	No %
Membership Details	28	0	100.0	0.0
Membership Rules	28	0	100.0	0.0
Consortium/ONOS Information	8	20	28.6	71.4
E-Resource Access Policy	27	1	96.4	3.6

5.8 User-Oriented Online Services

The effectiveness of a comprehensive digital support system can be seen in Table 7. This table indicates the provision of different online support services for users of the libraries of the colleges included in the study. It is found that all of the 28 colleges included in this study (100%) provide an online query form. This means that users can easily submit their queries through different web-based platforms. In a similar way, all people have access to email-based reference support services. This means that people can always receive support and expert advice through remote means. The Frequently Asked Questions section has been included in all of the college websites (100%), which means that different issues of users can be addressed through this section. Overall, the results indicate a strong commitment of the institutions towards providing different online reference services.

Table - 7: Online Services Focused on Users

Indicator	Yes	No	Yes %	No %
Online Query Form	28	0	100.0	0.0
Email Reference Support	28	0	100.0	0.0
FAQs Section	28	0	100.0	0.0

5.9 Statistical Analysis

The range of 100 percentage points was established through the statistical analysis of the 29 service indicators. The minimum adoption rate was established as 0%, while the maximum was established as 100%. The institutions that have adopted the cloud-based library infrastructure comprise 28 institutions. The level of deployment of digital services in these institutions was established through the mean adoption rate of approximately 89.6%, median adoption rate of 96.4%, and modal value of 100%. These figures affirm the level of digital maturity in the systems and services provided in the institutions. The areas of interactive support mechanisms, academic resources, and remote access facilities are some of the areas that have been highly developed. The range established through the analysis indicates that

there are significant structural differences. This was mainly due to the absence of institutional repositories and poor integration of consortiums. However, the fact that infrastructures for studies as well as collaboration in digital networking still lie in their development stage in the sampled colleges accentuates the necessity for balanced and all-encompassing development.

6. Suggestions for Improvement

Based on the result of the present study, the researchers have articulated some important suggestions which are:

- i. It has been observed that out of 51 affiliated degree colleges there are only 28 colleges have their own library websites where it is strictly recommended to the remaining college librarians to create their own library websites as the user accessibility is completely changes.
- ii. It is recommended that a detailed policy structure for college libraries should be developed, keeping in view of the findings of this study. This would enable all 51 affiliated colleges to gradually move towards a cloud-based infrastructure for digital libraries.
- iii. The Institutional Repositories should be given special emphasis for enhanced institutional visibility, preservation of research, and communication.
- iv. To ensure easy access of digital information, as well as to reduce financial hurdles through collective procurement, colleges should be motivated to take part in digital library projects like ONOS, which are based on the concept of consortium.
- v. To ensure the enhancement of knowledge on cloud technologies, digital library management, and web-based service delivery for the library staff, capacity-building programs and technical workshops should be conducted for the library staff.
- vi. Digital audits of library websites should also be conducted on a regular basis to ensure quality, adaptation, and uniformity of library websites throughout colleges.
- vii. A balanced and sustainable digital transformation in library services can be ensured for affiliated colleges through a holistic approach that encompasses operational efficiency, research archiving, and digital networking.

7. Conclusion

The study found that many colleges under the University of North Bengal had incorporated cloud-based library services on their websites. The high level of digital maturity of the colleges in terms of basic digital infrastructural facilities, academic facilities, cloud-based operational facilities, and user-centric facilities is reflected in the high adoption rate of the basic facilities provided by the colleges. The structural issues with the digital infrastructure are evident from the absence of Institutional Repositories and consortium-based services. The results obtained from the study have revealed that while service-based and access-driven cloud-based library services are well established, collaborative-based digital integration and research-based preservation are absent. Therefore, to achieve a comprehensive digital transformation that includes research-based services, it is essential that institutional plans are made.

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