

Evaluating the Impact of ICT on Library Services and User Satisfaction: A Case Study of IIT Roorkee and IIT BHU Libraries

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Abstract

The purpose of this study is to examine and compare the usage patterns of ICT-driven library services among users of the IIT Roorkee and IIT BHU libraries. It also determines the impact related to ICT resources and services. Additionally, the research investigates the level of user satisfaction within both libraries and explores problems and issues encountered by users with some suggestive measures. The study adopted a survey method with a questionnaire as a tool for primary data collection, the sample size 278 for IIT Roorkee and 277 for IIT BHU taken based on the Cochran sample size calculator with a confidence level of 95% and a margin of error of $\pm 5\%$, with a proportion of 25% of the population with a convenience sampling technique. The collected data was analysed by using Excel and SPSS software version 20. The results suggest that users at IIT Roorkee make greater use of ICT-based library services compared to their counterparts at IIT BHU (IIT Roorkee: Mean 48.17 and IIT BHU: Mean 44.91). Additionally, IIT Roorkee users report experiencing a more significant impact from ICT services than those at IIT BHU (IIT Roorkee: Mean 36.10 and IIT BHU: Mean 34.36). Furthermore, users at IIT Roorkee express higher satisfaction levels with their respective libraries in comparison to users at IIT BHU (IIT Roorkee: Mean 36.82 and IIT BHU: Mean 34.65). A common issue faced by users at both institutions, with IIT Roorkee at 30.2% (N=84) and IIT BHU at 38.6% (N=107), relates to difficulties in locating specific information. This issue is of primary concern due to its frequent occurrence.

Keywords: Impact of ICT, Library Resources and Services, IIT Libraries, ICT-based Information Services.

1. Introduction

The use of information and communication technologies has impacted every element of life and is now a fundamental component of every person's daily behaviour. These ICT tools and applications meet people's information needs and provide quick access to information through a range of communication platforms, including multimedia devices, laptops, cell phones, Wi-Fi, and the Internet (Abdullayev, 2020). A wider range of educational objectives, more beneficial learning environments, enhanced and improved work presentation, critical thinking, and research techniques are all supported by the use of ICT (Nisar et al., 2011). ICT is defined as methods and tools employed for the gathering, capturing, processing, storing, transmitting, and sharing of information (Ebijuwa, 2005). ICT has changed the way libraries

operate and provide services, creating new opportunities for reading, research, training, teaching, and learning in higher education. Information and communication technology (ICT) tools can be used to develop databases and websites that store, retrieve, distribute, and organise data. Users can now obtain information in accordance with their choices because it is available to them in both paper and electronic versions (Dar et al., 2017).

The traditional foundations of libraries provide a way to the availability of digital materials and services. Unexpectedly due to increased competition and different demands, users nowadays are more diversified and separated. Therefore, library services must continually enhance and develop new ways to supply effective and high-quality services to a larger number of users to meet their demands and preferences (Liu, 2019). Traditional approaches that were once successful are now regarded as antiquated, making it imperative to swiftly adapt to changes and incorporate them successfully into library redesign initiatives. This is necessary to update and boost the effectiveness of library services in a constrained amount of time. An emphasis on a more process-oriented viewpoint has replaced the conventional task-oriented approaches in libraries as a result of the impact of Information and Communication Technology (Kumar and Gupta, 2022). Since libraries are unable to sufficiently meet user demands in the current digital environment without having ICT resources and staff with the requisite ICT expertise, the importance of ICT concerning library services and librarianship is paramount (Agava and Underwood, 2020). Therefore, understanding, acceptance, and satisfaction with these changing resources and services are critical components of libraries' development in the twenty-first century.

2. Indian Institute of Technology, Roorkee

IIT Roorkee, originally established as Roorkee College of Civil Engineering in 1847, had a pivotal role in the early days of engineering education in India, primarily training engineers for the Ganges Canal project. Renamed Thomason College of Civil Engineering in honor of its founder, James Thomason, it evolved by adding Electrical and Mechanical Engineering departments, eventually becoming Thomason College of Engineering in 1945. Following India's independence in 1947, the institution was elevated to the University of Roorkee (UOR) in 1949, to expand its contribution to engineering education. In 2001, with the creation of the state of Uttarakhand, it was granted the status of Institute of National Importance and renamed the Indian Institute of Technology Roorkee. Today, IIT Roorkee is renowned for its wide array of undergraduate and postgraduate courses, including doctoral programs, covering a diverse range of engineering, applied science, architecture, and planning disciplines. It upholds high standards of education and research, solidifying its position as one of India's foremost technical institutions (IIT Roorkee, 2022a)

The central library at IIT Roorkee, known as the Mahatma Gandhi Central Library (MGCL), The central library has a substantial collection of materials, including around 400,000 documents comprising over 200,000 books, 60,000 textbooks, 50,000 bound volumes of journals, 50,000 departmental library books, and 10,000 reference books. In addition, it offers an extensive e-resource collection, with over 15,000 current e-journals, 200,000 back volumes of e-journals, more than 200,000 standards and patents, two million theses and dissertations, 35,000 e-books, and access to the World eBook Library (WeL). The MGCL is equipped with a centralized air conditioning system and modern ICT facilities, including RFID technology, seamless wireless internet access, and wired connectivity (IIT Roorkee, 2022b).

3. Indian Institute of Technology, BHU

The establishment of the Indian Institute of Technology (BHU) Varanasi can be attributed to Pandit Madan Mohan Malviya, a renowned figure and Bharat Ratna awardee. He laid the foundation of Banaras Hindu University (BHU). The journey of engineering education at BHU began in 1919 with the establishment of Banaras Engineering College (BENCO), followed by the creation of the College of Technology (TECHNO) and College of Mining and Metallurgy (MINMET). Eventually, in 1968, BENCO, MINMET, and TECHNO were merged to form the Institute of Technology (IT-BHU). Subsequently, on June 29, 2012, the Indian Parliament passed an Act to elevate IT-BHU to the status of an Indian Institute of Technology, and it became the Indian Institute of Technology (BHU) Varanasi (IIT BHU, 2022a).

The central library at IIT BHU, known as the Shreenivas Deshpande Library, boasts an impressive collection of printed materials covering various fields such as science, engineering, social sciences, and humanities. As of March 31, 2022, the library holds 92,740 reference and general books, 23,729 textbooks, and 8,740 books specifically for SC/ST students. Additionally, it houses 1,807 theses and dissertations and 17,925 bound volumes of periodicals. Notably, the library also preserves old bound volumes of periodicals, codes, and standards dating back to 1918. Furthermore, the library provides access to digital resources, including over 10,000 e-journals, e-books, and databases. It also maintains a collection of 1,722 CD-ROMs. An essential part of the library's offerings is the subscription to PressReader Premium, a digital newspaper distribution and technology platform. Through this subscription, users can access more than 7,000 newspapers and magazines in 60 different languages. The library also subscribes to nine newspapers in English and Hindi languages (IIT BHU, 2022b).

4. Literature Review

Research by Kumar and Gupta (2023) looked at the IIT Roorkee library's redesigned materials and services. The study's findings showed that users benefited from the reorganised resources and services, which led to an increase in their utilisation. Additionally, the reliance of library users on the library has increased, suggesting a rising trend in library usage in the future. Even though users' awareness, use, and frequency of e-resources and ICT-based services have favourably transformed. Kumar and Gupta (2022) did a similar study that has been reorganised to analyse the library resources and services at IIT Delhi. They found that users are progressively favouring electronic resources and services. ICT application resources in library information processing were examined in Nigerian academic libraries by (Olubiyo, 2022), who reveals that in this technological age, finding information resources solely through print material is insufficient; instead, one must search both print and electronic sources for the best and most recent resources. He added that it is impossible to think of disseminating information in a qualitative way without technology resources. Chitra and Kumar (2020) assessed the availability of ICT infrastructure facilities and problems encountered by librarians for automation in college libraries of the University of Mysore. The findings reveal that computers and the internet have progressively integrated into libraries to manage various functions. Additionally, the primary challenges in implementing automation were identified as a lack of budget and trained staff. Xiao (2020) emphasizes the necessity of meeting the diverse needs of users through the facilitation of information dissemination and the advancement of cutting-edge services within academic libraries in the twenty-first century. Taufiq et al., (2020) discovered that the lack of user-library interaction and the dissatisfaction of library patrons with the availability of internet-based services at libraries

are important factors to take into account. Basri et al., (2018) investigated the impact of ICT on student performance in Saudi universities and it was discovered that there is a significant relationship between student performance and use of ICT. Another study conducted by Salam et al., (2017) examined the impact of ICT on students' academic performance and their findings revealed that ICT plays a significant role in boosting the educational quality and performance of the students. Furthermore, they stated that to reduce the digital gap, basic ICT infrastructure facilities should be provided in all public schools and provide training to students for developing technological skills. Aremu and Saka (2014) highlighted the importance of ICT in the library premises for its better efficiency and maximum utilization of information resources. The study also shows that technological advancement necessitates integration domains of user-oriented services and human skills. The study by Ikenwe and Adegbilero-Iwari (2014) also showed that users identified several important factors that have a negative impact on user satisfaction with public library services in Nigeria in the twenty-first century, including inadequate facilities, out-of-date information resources, and limited internet and ICT services. Singh and Rana (2015) highlighted the remarkable impact of the emergence of ICT on library and information science, fundamentally altering the conventional perception of libraries from book depositories to centers of intellectual knowledge. Egunjobi and Awoyemi (2012) investigated how automation, enabled by information and communication technology, can amplify the significance of the library within the academic community, especially concerning its relevance. Islam and Fouji (2010) investigated the link between ICT and student performance within the Bachelor of Business Administration (BBA) students body at ASA University Bangladesh. The study's results suggested a minimal impact of ICT on students' academic success. Additionally, the findings revealed that most students lacked awareness of the potential benefits that ICT could offer to their academic endeavours.

5. Objectives

1. To find the current status of ICT tools and techniques in the libraries of IIT Roorkee and IIT BHU.
2. To examine and compare the usage of ICT-based services by the users provided by the libraries.
3. To assess the impact of ICT resources and services between the users of IIT Roorkee and IIT BHU.
4. To examine the user's satisfaction regarding resources and services offered by the libraries.
5. To identify the problems and issues experienced by users when making use of library resources and services.

6. Hypotheses

The following null hypotheses were formulated.

- H1.** There is no significant difference between the users of IIT Roorkee and IIT BHU library regarding the usage of ICT-based information services.
- H2.** There is no significant difference regarding the impact of ICT resources and services between the users of IIT Roorkee and IIT BHU.
- H3.** There is no significant difference in user satisfaction among the users of IIT Roorkee and IIT BHU regarding the resources and services of the library.

7. Research Methodology

The researcher has selected two well-known IITs in the northern region of India: IIT Roorkee and IIT BHU. For the present study, investigator used a survey method. However, as a supplement, the interview method has also been applied. The researcher used a questionnaire as a tool for the primary data collection. Prior to distributing the questionnaires, the researcher obtained permission from the librarian to gather data. As a result of the COVID-19 pandemic, the researcher initiated the data collection process once the government lifted the restrictions imposed due to the pandemic. Therefore, the data collection period for this study took place between March and May 2022. Due to the impact of the Covid-19 pandemic, it was not feasible to include all users in the study. Therefore, the population was divided into just three categories: undergraduate students, postgraduate students, and full-time research scholars. According to the NIRF 2021 data, IIT Roorkee has a total of 3,455 registered undergraduate students, 1,852 postgraduate students, and 1,880 full-time research scholars. When these figures are summed, the total number of users across these three categories is 8,514. For IIT BHU, there are a total of 4,686 registered undergraduate students, 823 postgraduate students, and 1,044 full-time research scholars. When these numbers are combined, the total count of users in these three categories is 6,533. To determine the sample size, the investigator utilized a sample size calculator based on the Cochran formula (Cochran, 1977) with a confidence level of 95% and a margin of error of $\pm 5\%$. A proportion of 25% of the population was taken into consideration. Consequently, the sample size was determined as 278 for participants from IIT Roorkee and 277 for participants from IIT BHU on the basis of convenience sampling technique. The collected data was analyzed by using Excel and SPSS software version 20, to calculate, mean and percentages.

8. Data Analysis and Interpretation

8.1 Current Status of ICT Tools

Table 1: Status of ICT Tools

Hardware	IIT Roorkee	IIT BHU
Server	03	02
Desktop	75	70
Laptop	12	07
Laser Printer	04	02
Handheld Scanner	08	05
LCD Projector	02	02
Photocopy Machine	04	02
Flatbed Scanner	05	04
CCTV Cameras	30	60
Software	IIT Roorkee	IIT BHU
Operating system	MS Windows, Linux	MS Windows, Linux
Category of the Library Automation	Commercial	Commercial
Library Management Software	LIBSYS 7	LIBSYS 7
Institutional Repository	DSpace	DSpace
Content Management System	Drupal	Joomla
Remote Login	Knimbus	RemoteXs

Both the libraries at IIT Roorkee and IIT BHU have a good range of hardware and software tools to support their academic and administrative functions. However, Table 1 shows that the IIT Roorkee library has a slightly greater number of hardware tools compared to the IIT BHU library. In summary, the data emphasizes that the libraries of both IIT Roorkee and IIT BHU are dedicated to upholding advanced ICT infrastructure. It is noteworthy that the library at IIT Roorkee is integrated with Radio Frequency Identification (RFID) technology whereas in IIT BHU library this technology is not currently available.

8.2 Gender Wise Distribution

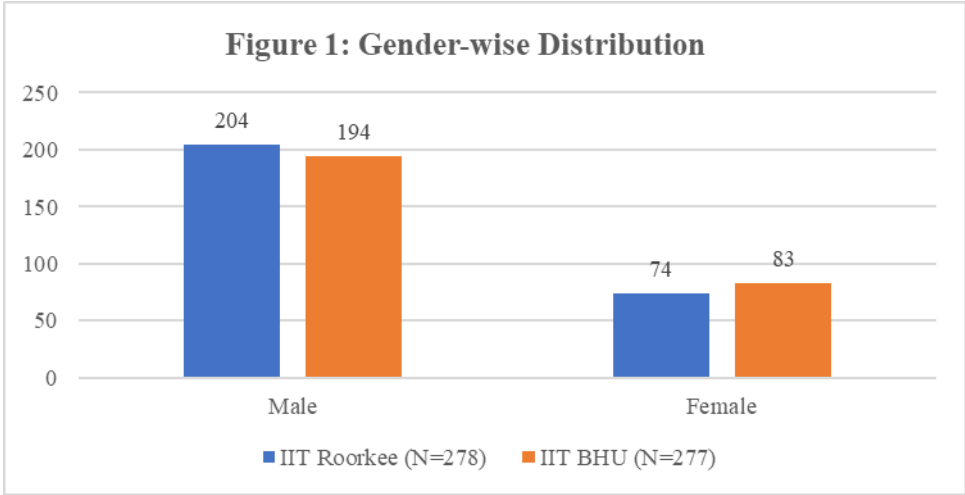


Figure 1, illustrates the gender-wise distribution among IIT Roorkee and IIT BHU. At IIT Roorkee, the users consist of 73.3% (N=204) males and 26.6% (N=74) females. On the other hand, IIT BHU exhibits a male population of 70.1% (N=194) and a female presence of 29.9% (N=83).

8.3 User Category

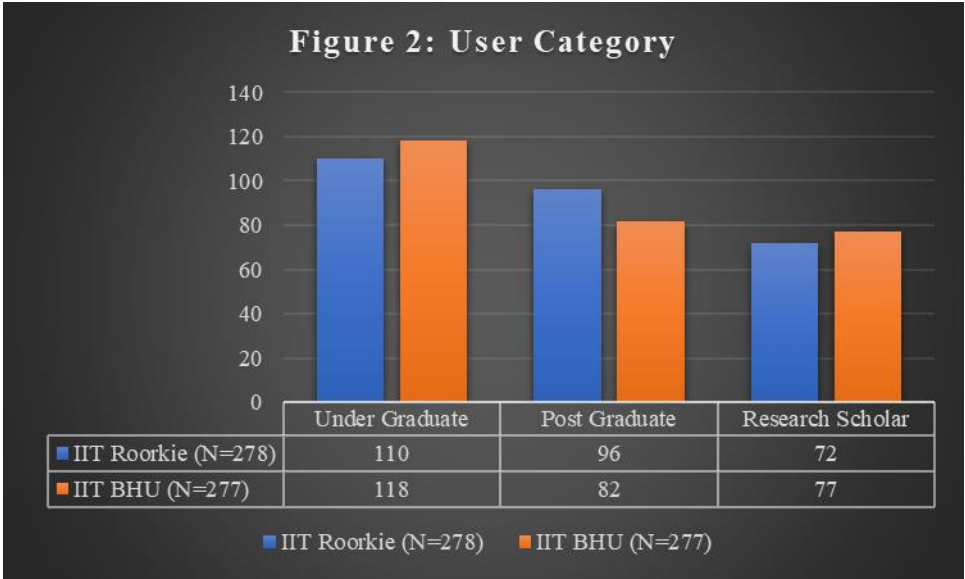


Figure 2 illustrates the user categories at both IIT Roorkee and IIT BHU. In IIT Roorkee, the majority of the user category is Undergraduate students, constituting the largest proportion at 39.5% (N=110). Following this, Postgraduate students account for 34.5% (N=96), while

Research Scholars make up 25.8% (N=72) of the total. In a similar vein, IIT BHU also sees a prominent presence of Undergraduate students, comprising approximately 42.5% (N=118) of the total users. Postgraduate students represent around 29.6% (N=82), while Research Scholars make up 27.7% (N=77) of the user population.

8.4 Usage of ICT based Services

Table 2: Usage of ICT-based Services

ICT-Based Library Services	IIT Roorkee (N=278)	IIT BHU (N=277)
	Mean	Mean
Circulation	4.01	3.89
CAS	3.74	3.52
SDI	1.33	1.12
OPAC and Web OPAC	3.93	4.19
Access to e-resources	4.05	3.95
Institutional Repository	3.25	2.68
Online databases	3.99	3.71
e-alerting service	3.71	3.34
Electronic document delivery service	3.39	3.14
Digital Reference Service (DRS)	3.38	3.06
QR code access to resources	3.94	3.56
Remote access service	3.64	3.38
Academic Support service.	4.03	3.54

Scale Used: Never (1), Rarely (2), Sometimes (3), Very Often (4), Always (5).

Table 2 presents a comparison of the frequency of ICT-based library service utilization among users from IIT Roorkee and IIT BHU. Mean values are calculated to determine the usage frequency of these services by the respective user groups. The data reveals that at IIT Roorkee, the usage frequency of ICT-based library services is notably high for access to e-resources with a mean value of 4.05. Following closely are academic support services, with a mean value of 4.03 and circulation services at 4.01. Online databases, QR code access to resources and OPAC and Web-OPAC services also show significant usage, with mean values of 3.99, 3.94 and 3.93 respectively. On the other hand, the service least utilized by IIT Roorkee library users is SDI, with a mean value of 1.33. While at IIT BHU, the utilization of ICT-based library services is particularly prominent for OPAC and Web OPAC, showcasing a mean value of 4.19. Following this, circulation services display a considerable usage frequency with a mean value of 3.89, while access to e-resources exhibits a mean value of 3.95. Notably, the least utilized service by IIT BHU library users is SDI, with a mean value of 1.12. The findings revealed that IIT Roorkee library consistently received higher mean scores in most of the services, indicating a higher frequency of library service usage among its users. Conversely, IIT BHU showed lower mean scores for these services, suggesting that its users utilized the library services less frequently in comparison to IIT Roorkee library users.

Furthermore, the one-way analysis of variance (ANOVA) test was applied to compare the means of the two groups, as shown in Table 3. The mean usage frequency of ICT-based services by IIT Roorkee users is 48.1789 was found to be significantly higher than that of IIT BHU users is 44.9164, and the p-value was below 0.05 in each case. This indicates that there are statistically significant differences in the usage of ICT-based information services between the users of IIT Roorkee and IIT BHU libraries. Additionally, it was observed that

research scholars (RS) consistently had the highest mean usage in both IITs, followed by PG and UG users. As a result, the null hypothesis H1 is rejected.

Table 3: One Way ANOVA Results (Usage of ICT-Based Services)

	User Category	N	Mean	Std. Deviation	F	Sig. (2-tailed)
ICT Services (IIT Roorkee) (N=278)	UG	110	35.2727	8.70823	414.916	.000
	PG	96	48.7500	2.88371		
	RS	72	60.5139	2.33161		
ICT Services (IIT BHU) (N=277)	UG	118	30.7288	8.13209	479.000	.000
	PG	82	47.0854	1.95758		
	RS	77	56.9351	4.73047		

8.5 Impact of ICT Resources and Services

Table 4: ICT Impact of ICT Resources and Services

ICT Resources and Services	IIT Roorkee (N=278)	IIT BHU (N=277)
	Mean	Mean
e-books/e-journals/e-thesis	4.03	3.84
Online Databases	3.86	3.74
OPAC/Web-OPAC	3.43	3.18
CAS/New Arrivals	3.73	3.48
Audio and Video Resources	3.64	3.55
Electronic document delivery	3.40	3.35
Web 2.0	3.95	3.80
Institutional Repository	3.28	3.03
Digital reference services	3.41	3.13
Academic support services	3.32	3.18

Scale Used: Not at All (1), To a Small Extent (2), To Some Extent (3), To a Moderate Extent (4), To a Large Extent (5)

Table 4 depicts the comparison of the ICT impact related to different information resources and services on users at IIT Roorkee and IIT BHU. Mean values were computed to ascertain the extent of ICT impact regarding various information resources and services on the user groups of IIT Roorkee and IIT BHU. IIT Roorkee's library users experienced a significant impact of ICT, with the highest mean value of 4.03 attributed to e-books, e-journals, and e-theses, followed by next Web 2.0 tools which include social media platforms such as Twitter (Now called X), Facebook, YouTube, LinkedIn, Instagram, etc. with a mean value 3.95 and online databases with a mean value 3.86. This indicates that ICT has a substantial impact on the users from both the IIT libraries. CAS/New Arrivals and audio-video resources have some extent of noticeable impact, with mean scores of 3.73 and 3.64, respectively. On the other hand, IIT BHU library, users experienced a significant impact of ICT. The most substantial impact was observed with e-books, e-journals, and e-theses, scoring a mean value of 3.84, closely followed by web 2.0 tools at 3.80 and online databases at 3.74. It's important to highlight that users from both institutions had the least extent of impact concerning the institutional repository (IIT Roorkee: Mean 3.28 and IIT BHU: Mean 3.03). The results show that users at IIT Roorkee experience ICT impact slightly higher than IIT BHU users as the mean scores for resources and services were higher at IIT Roorkee.

Moreover, a one-sample t-test was conducted to compare the extent of ICT impact of various resources and services of libraries between users of IIT Roorkee and IIT BHU as shown in Table 5. The mean score for users at IIT Roorkee was 36.1043 with a p-value less than 0.05 indicating a statistically significant difference in the extent of ICT impact on users at IIT Roorkee. Similarly, for IIT BHU users, the mean score is 34.3646, with a p-value less than 0.05. The analysis reveals strong evidence to reject the null hypothesis H2, suggesting a significant difference regarding the extent of ICT impact on various resources and services between the users of IIT Roorkee and IIT BHU.

Table 5: One-Sample T-Test (Extent of ICT Impact)

	Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1 (IIT Roorkee)	36.1043	278	11.78936	51.061	277	.000
Pair 2 (IIT BHU)	34.3646	277	12.07137	47.380	276	.000

8.6 User Satisfaction

Table 6: User Satisfaction

Users Satisfaction	IIT Roorkee (N=278)	IIT BHU (N=277)
	Mean	Mean
The library has an adequate number of modern ICT equipment	4.01	3.31
High Internet access speed	3.42	3.29
The library has sufficient staff to assist the users	3.56	3.08
The behaviour of staff is good and cooperative	3.69	3.53
The library has a good collection of e-resources on my discipline area	3.70	3.54
A library website functions well and has proper links to collection and services	3.91	3.71
Delivery of Information in a short span of time	3.51	3.39
ICT-based services are impressive and efficient for my academic work	3.77	3.53
Frequently organizes training programs for better usage of ICT resources	3.41	3.35
Overall, I find the ICT service in this library is good and useful to me	4.09	3.88

Scale Used: Very Dissatisfied (1), Dissatisfied (2), Neutral (3), Satisfied (4), Very Satisfied (5)

Table 6 shows a comparison of user satisfaction regarding different ICT resources and services provided by the libraries at IIT Roorkee and IIT BHU. The mean values are calculated for each statement to know users' satisfaction or dissatisfaction with these aspects. As depicted in Table 5, the statement, "The Library has an adequate number of modern ICT equipment" (IIT Roorkee: mean 4.01 and IIT BHU: mean 3.31), indicates that users at IIT Roorkee view the library's modern ICT equipment as more satisfactory compared to users at IIT BHU, this difference is due to library annual expenditure budget of IIT Roorkee library is higher than IIT BHU's library (NIRF, 2022), that enables IIT Roorkee to spend more on purchasing and upkeep of cutting-edge technology, which could enhance user experiences and results. Similarly, another statement, "A library website functions well and has proper links to collection and services" (IIT Roorkee: mean 3.91, and IIT BHU: mean 3.71). This

suggests that users at IIT Roorkee are a little bit more satisfied with their library website, implying that it is more user-friendly and better maintained compared to IIT BHU.

Likewise, another statement “ICT-based services are impressive and efficient for my academic work” (IIT Roorkee: mean 3.77 and IIT BHU: mean 3.53) and “The library has a good collection of e-resources on my discipline area” (IIT Roorkee: mean 3.70 and IIT BHU: mean 3.54). This indicates that IIT Roorkee users are slightly more satisfied regarding ICT-based services collection of e-resources as compared to users at IIT BHU. Due to the higher budget allocated to the IIT Roorkee library compared to that of IIT BHU, IIT Roorkee invests more in its ICT infrastructure and collection development, resulting in an enhanced user experience. Further, statements like “The behaviour of the staff is good and cooperative” with a mean value (IIT Roorkee: mean 3.69 and IIT BHU: mean 3.53), “library has sufficient staff to assist the users” (IIT Roorkee: mean 3.56 and IIT BHU: mean 3.08), “frequently organizes training program for better usage ICT resources” (IIT Roorkee: mean 3.41 and IIT BHU: mean 3.35). and “delivery of information in a short span of time” (IIT Roorkee: mean 3.51 and IIT BHU: mean 3.39). In the final statement "Overall, I find ICT service in this library is good and useful to me" (IIT Roorkee: mean 4.09, and IIT BHU: mean 3.88). The findings from this table demonstrate that while both IIT Roorkee and IIT BHU provide valuable library resources and services, IIT Roorkee seems to have an edge over IIT BHU in terms of user satisfaction. This superiority is due to higher funding, better allocation of resources and using the latest technology to enhance the overall user experience.

In addition to this, a one-sample t-test was implemented to assess the differences in mean user satisfaction levels between IIT Roorkee and IIT BHU, as demonstrated in Table 7. The results indicate that the users of the IIT Roorkee library achieved a mean score of 36.8273, with a p-value below the 0.05 significance level. This mean score stands out as notably higher than the mean of 34.6534 observed for users of the IIT BHU library, with a p-value less than 0.05 as well. As a result of this analysis, the null hypothesis H3 was rejected, signifying that users at IIT Roorkee display a higher level of satisfaction with the library compared to their counterparts at IIT BHU.

Table 7: One-Sample T-Test

	Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1 (IIT Roorkee)	36.8273	278	9.49971	64.637	277	.000
Pair 2 (IIT BHU)	34.6534	277	10.01389	57.595	276	.000

8.7 Problems and Issues

Table 8: Problem and Issues

IIT Roorkee (N=278)			
Problems and Issues	Responses	Percentage	Rank
Difficulty in locating specific information within your respective field	84	30.2	1
Insufficient familiarity with ICT tools	60	21.5	2
Poor internet connectivity	48	17.2	3
The institution does not have access to the full text of the required online journals	36	12.9	4
Inadequate ICT infrastructure	32	11.5	5
Uncooperative staff members	30	10.7	6

Inadequate upkeep of ICT equipment	23	8.2	7
Languages and cultural differences	18	6.4	8
The library is incapable of addressing your particular issue effectively	18	6.2	9
Interruptions in power supply	12	4.3	10
IIT BHU (N=277)			
Problems and Issues	Responses	Percentage	Rank
Difficulty in locating specific information within your respective field	107	38.6	1
Insufficient familiarity with ICT tools	96	34.6	2
Poor internet connectivity	94	33.8	3
Inadequate ICT infrastructure	87	31.4	4
The institution does not have access to the full text of the required online journals	77	27.7	5
Languages and cultural differences	57	20.5	6
The library is incapable of addressing your particular issue effectively	43	15.5	7
Uncooperative staff members	38	13.7	8
Inadequate upkeep of ICT equipment	34	12.2	9
Interruptions in power supply	20	7.2	10

The comparative analysis of problems and issues encountered by library users at IIT Roorkee and IIT BHU, as depicted in Table 8. The problem "Difficulty in locating specific information within your respective field" is secured rank 1st in terms of frequency of occurrence according to users' responses. Notably, IIT BHU's library users 38.6 % (N=107) exhibited a greater concern as compared to IIT Roorkee's library 30.2 % (N=84). Addressing this issue can be effectively done through the implementation of information literacy programs, tutorials and workshops regarding the enhancement of search tools and the provision of personalized assistance by librarians. Furthermore, a common 2nd ranked concern for both libraries users is the problem of "Insufficient familiarity with ICT tools". This problem is highlighted by the observation that, in comparison to their counterparts at IIT Roorkee 21.5 % (N=60), users at IIT BHU 34.6 % (N=96) exhibit a more marked lack of familiarity with contemporary ICT tools. Another similar common 3rd ranked marked by users from both IITs is "Poor internet connectivity", Notably, IIT BHU users express a higher level of concern at 33.8% (N=94), while IIT Roorkee users report a lower percentage of 17.2% (N=48). The 4th ranked problem in IIT Roorkee marked by users "The institution does not have access to the full text of the required online journals" with a relatively low concern level of 12.9% (N=36), In contrast, IIT BHU users have marked "Inadequate ICT infrastructure" as their fourth-ranked problem, with a significantly higher percentage of 31.4% (N=87). This issue of inadequate ICT infrastructure problem in IIT Roorkee users marked 5th with 11.5 % (N=32) and IIT BHU users marked 5th ranked issue The institution does not have access to the full text of the required online journals 27.7 % (N=77). The next problem was marked by IIT BHU users as it ranked 6th with 20.5 % (N=57) while users IIT Roorkee marked with a low percentage at 6.4 % (N=18) having 8th ranked. Fostering open channels of communication, engaging in diverse cultural activities, and providing platforms for cross-cultural interaction can contribute to the establishment of a more inclusive and harmonious environment. The other issues such as "Inadequate upkeep of ICT equipment",

“The library is incapable of addressing your particular issue effectively” and “Interruptions in power supply” were reported by smaller percentages of respondents in both libraries.

9. Discussion

The findings of the present study shed light on the ICT infrastructure in the libraries of IIT Roorkee and IIT BHU. Notably, both libraries have good hardware and application software, with IIT Roorkee exhibiting a slightly more extensive array of hardware tools, due to its comparatively higher budget. This supports the findings of Mahanta (2019) research, which confirms that college libraries in Assam have adequate hardware and software resources. However, the status of ICT infrastructure is not the same as in all kinds of libraries as a study by Egoeze et al. (2014) found the ICT infrastructure in Nigerian universities is inadequate and its utilisation is comparatively low.

The use of ICT-based services by users is also explored in this study. It is evident that users gained substantial benefits from these information services, leading to enhanced access to information and increased utilisation. The results of the research conducted by Kumar and Gupta (2022, 2023) align with the findings of the current study. In examining the impact of ICT, the study reveals a substantial impact on various information resources and services for the user groups at IIT Roorkee and IIT BHU. This is supported by research by Singh and Rana (2015), Salam et al., (2017) and Khan et al., (2023), which highlight the influence of ICT plays in enhancing management capacities, improving user performance, and speeding up the utilisation of library resources.

Another important finding from the study is regarding user satisfaction. Most of the users from the libraries of IIT Roorkee and IIT BHU are satisfied with the resources and services that are offered. This aligns with what Munshi and Faizan (2019) found. However, a contrary viewpoint is shown in the work of Taufiq et al., (2020), where users are dissatisfied with the accessibility of internet-based services. The study also highlights the problems and issues that users confront, compared to IIT Roorkee, IIT BHU has more limits because of its smaller funding. Although users from both institutions shows that they are aware of ICT tools and services, some of the users concerns and feel that in order to improve their usage of ICT-based resources and services, they should get training programs. This aligns with the findings of Islam and Fouji (2010) and Ikenwe and Adegbilero-Iwari (2014), which highlighted the problems such limited funding, inadequate facilities, and a lack of ICT understanding.

10. Conclusion

This research aims to distinguish and compare the present state of information and communication technology (ICT) infrastructure and usage of ICT-based services in libraries while evaluating the impact of ICT regarding various resources and services, as perceived by users at IIT Roorkee and IIT BHU. The results indicate that both libraries possess admirable collections and ICT infrastructure, effectively catering to the users' information requirements within the current network environment. Moreover, the frequency of ICT usage among users at IIT Roorkee surpasses that of users at IIT BHU. The significant impact of ICT services and resources has improved both institutions' user experiences. However, a lack of ICT expertise and difficulty finding specific information within their respective disciplines have been recognised as similar issues among users from both libraries with a lower percentage. The outcomes of hypothesis testing definitively shows that, when it comes to the utilization of ICT-based services, users at IIT Roorkee's library scores a higher frequency than those at IIT BHU. Moreover, IIT Roorkee library users express slightly higher level of satisfaction

compared to their counterparts at IIT BHU with respect to both library resources and services. Effective strategies including planning digital literacy seminars, incorporating digital skills into the curriculum, delivering individualised training, and providing online tutorials to address these issues are advised to promote increased use of ICT resources and services. Furthermore, the notable impact of ICT resources and services on users, their levels of satisfaction, and the challenges they encounter have been emphasized.

This study is confined to the libraries of IIT Roorkee and IIT BHU. Consequently, it is imperative to conduct additional research to explore the impact of ICT on library resources and services in other IITs, as well as other higher technical and management institutions. Expanding the scope of this investigation to include a broader range of academic libraries has the potential to provide valuable insights into the transformative effects of ICT on library services, materials, and its influence on the academic performance of users.

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