HUMAN-CENTRIC DIGITAL LIBRARY SERVICES IN ACADEMIC INSTITUTIONS UNDER INDUSTRY 5.0

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Abstract
The rapid evolution of digital technologies has significantly transformed academic libraries from traditional information repositories into dynamic digital knowledge ecosystems. With the emergence of Industry 5.0—which emphasises human-centricity, sustainability, and collaboration between humans and intelligent systems—academic libraries are re-imagining their services to focus on personalised, inclusive, and user-driven experiences. This paper explores the concept of human-centric digital library services in academic institutions within the context of Industry 5.0. It examines emerging technologies such as Artificial Intelligence, Big Data Analytics, the Internet of Things, and immersive technologies that enhance user engagement and knowledge discovery. The study also discusses the challenges, opportunities, and prospects of implementing these human-centric services. The findings highlight that academic libraries must shift from technology-driven systems to user-oriented digital ecosystems that prioritise accessibility, personalisation, and collaborative learning.
Keywords: Academic Libraries, Libraries, Industry 5.0, Digital Libraries, User Experience, Smart Library Technologies.

Introduction:

Academic libraries have long served as vital knowledge hubs that support teaching, learning, and research within higher education institutions. Traditionally, libraries functioned as repositories of printed resources such as books, journals, and reference materials. However, the rapid advancement of digital technologies has transformed the way information is created, accessed, and disseminated. The emergence of digital libraries, online databases, and networked information systems has significantly reshaped the role of academic libraries, enabling them to provide seamless access to a vast array of digital resources and services.

In recent years, the concept of Industry 5.0 has gained prominence as a new phase in technological and industrial development. Unlike Industry 4.0, which primarily focused on automation and smart technologies, Industry 5.0 emphasises a human-centric approach that integrates advanced technologies with human creativity, well-being, and sustainability. This pattern encourages collaboration between humans and intelligent systems to create more personalised, inclusive, and meaningful experiences in library services.

Within this evolving landscape, academic libraries are increasingly adopting innovative technologies to enhance their services and improve user engagement. Technologies such as Artificial Intelligence, Big Data Analytics, Internet of Things, and immersive digital tools are enabling libraries to offer smarter and more interactive services. These technologies support personalised information retrieval, intelligent recommendation systems, automated cataloguing, and enhanced digital resource management, thereby improving the overall user experience.

The shift toward human-centric digital library services highlights the importance of understanding users' needs, preferences, and behaviours to design services that are accessible, inclusive, and responsive. In this context, academic libraries are moving beyond technology-driven systems to create user-oriented digital environments that foster collaboration, knowledge sharing, and lifelong learning. Human-centric approaches also emphasise accessibility for diverse user groups, including students, researchers, and faculty members with varying levels of digital literacy.

Despite the numerous opportunities presented by Industry 5.0 technologies, academic libraries face several challenges in implementing human-centric digital services. These challenges include technological infrastructure requirements, digital skill gaps among library professionals, data privacy concerns, and the need for continuous adaptation to rapidly changing technological environments. Addressing these challenges requires strategic planning, capacity building, and the development of policies that support innovation and user engagement.

Therefore, the integration of a human-centric approach with digital library services represents a

significant step toward the future of academic librarianship. By taking advantage of these emerging technologies and maintaining a strong focus on users' needs, academic libraries can transform into knowledge-driven ecosystems that facilitate research, encourage creativity, and support collaborative learning in the rapidly evolving digital age.

Objectives:

1. To assess the awareness of Industry 5.0 and national education policies.
2. To evaluate the perception of the library's role in institutional digital transformation.
3. To analyse current patterns of library service and technology usage.
4. To identify technical and procedural barriers in accessing advanced digital services.
5. To determine the necessity and demand for digital literacy training programs.
6. To examine the perceived correlation between modern library services and learning outcomes.
7. To investigate the library's impact on institutional sustainability and resource conservation.

Literature Review:

The transformation of academic libraries is deeply rooted in the shift from Industry 4.0's focus on automation to Industry 5.0's emphasis on human-centricity and sustainability. Early foundational theories by **Maness (2006)** described "Library 2.0," where Web 2.0 technologies first allowed libraries to move from static repositories to interactive, user-centred platforms. Building on this technological trajectory, Lasi et al. (2014) defined Industry 4.0 as the era of smart technologies and digitized manufacturing, which initially pushed libraries toward total automation. However, Breque et al. (2021) argue that the subsequent emergence of Industry 5.0 provides a necessary "corrective" to this pure automation by prioritizing the well-being of the human worker and user within the industrial and academic framework.

In the context of specific technologies, **Hussain (2020)** identifies Artificial Intelligence (AI) as a primary driver of a new paradigm shift, allowing libraries to offer intelligent recommendation systems and automated cataloguing that improve the overall user experience. Cox et al. (2019) further explore this "intelligent library" concept, noting that while AI presents opportunities for advanced research assistance, it requires thought leadership to manage its impact on the academic workforce effectively. This human-machine collaboration is a hallmark of Industry 5.0, as noted by **Aithal & Aithal (2023)**, who describe the paradigm as a sustainable model that integrates advanced systems with human creativity and resilience. Finally, **Kumar & Singh (2021)** highlight that while smart libraries offer significant opportunities for knowledge discovery, they also face substantial challenges, including the need for continuous technological adaptation and the closing of digital skill gaps among library professionals. Collectively, these studies suggest that the future of academic librarianship lies in creating a "knowledge-driven ecosystem" that balances high-tech infrastructure with a strong focus on inclusive, personalized user needs.

Research Methodology:

Research Design: The study adopts a descriptive research design aimed at examining the concept of human-centric digital library services and analysing the impact of Industry 5.0 technologies on academic institutions.

Data Collection Instrument: The research utilised a survey method, evidenced by the "204 responses" and "200 responses" noted in various data sections. Structured questions were used to capture both categorical data (Yes/No) and Likert-scale agreement (Strongly Agree to Strongly Disagree).

Sampling: The study involved a sample of 204 participants. Based on the demographic findings, the sample is predominantly composed of undergraduate students (73.5%), along with postgraduates and research scholars.

Data Analysis Techniques: Quantitative Analysis: The data was processed and presented using descriptive statistics.

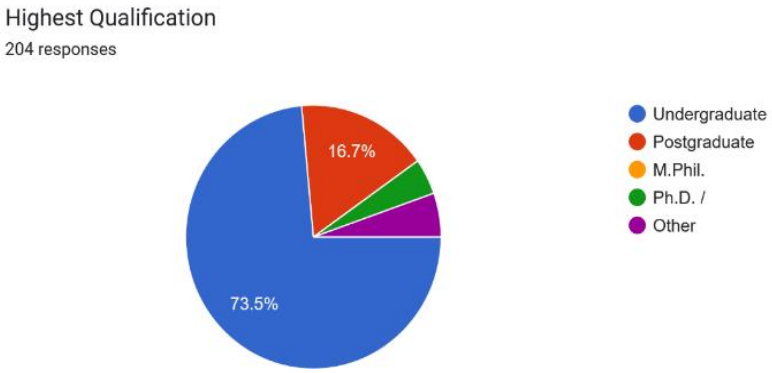
- Visualisation: Findings were illustrated through pie charts to represent percentages and distribution of responses across various parameters like awareness, usage, and perception.
- Secondary Research: The paper also incorporates a review of existing literature to establish the theoretical framework for Industry 5.0 and smart library technologies, as evidenced by the extensive reference list.

Data Analysis:

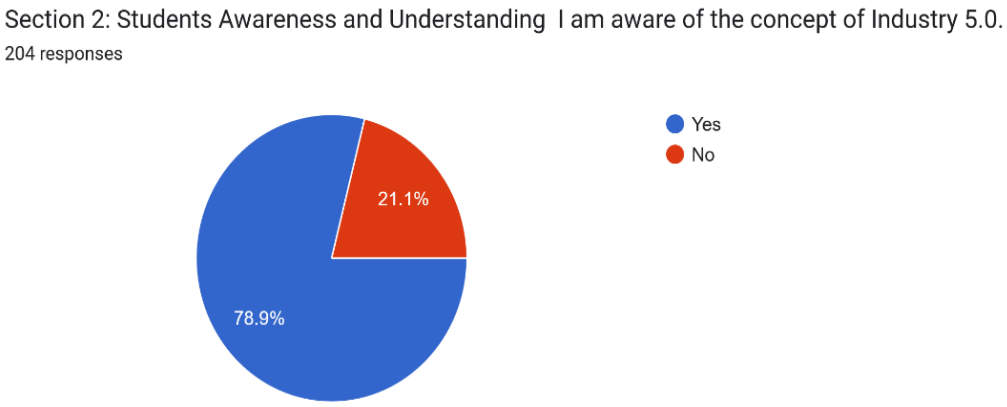
Highest Qualification:

The following pie-chart reveals that participants' educational attainment, and the data indicate a predominantly undergraduate-level sample. Specifically, 73.5% (n=150) of the 204 respondents identified as undergraduates, while 16.7% (n=34) held postgraduate degrees. Advanced research qualifications, including Ph.D. and M.Phil. levels, alongside miscellaneous 'Other' certifications, constituted the remaining minority of the sample.

The high proportion of undergraduate participants suggests that the study's findings may be particularly representative of [insert target demographic, e.g., early-career professionals or students], which should be considered when generalising the results



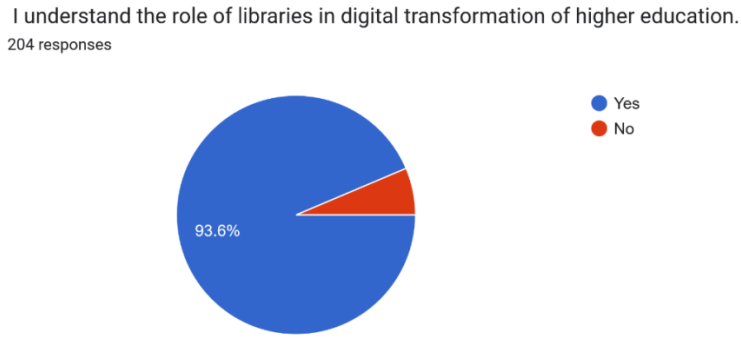
Awareness of Industry 5.0



Pie Chart Showing Awareness of Industry 5.0 Among Students

Data regarding student awareness levels revealed that a substantial portion of the cohort is familiar with the Industry 5.0 framework. Out of the 204 participants surveyed, **78.9%** responded affirmatively to being aware of the concept, while **21.1%** indicated they were not. This suggests a high level of conceptual penetration within the student body, likely influenced by current academic curricula or external digital literacy trends.

Understanding the role of the libraries in digital transformation:

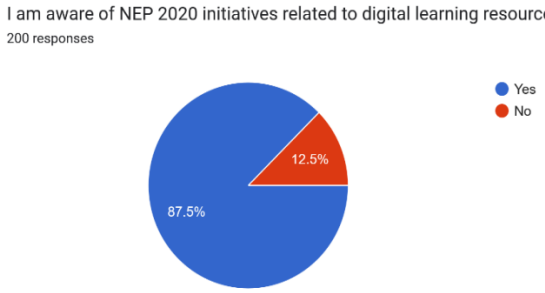


Pie Chart Showing Students' Understanding of the Role of Libraries in Digital Transformation

When surveyed on the institutional pillars of digital change, an overwhelming majority of participants (**93.6%**) affirmed their understanding of the role of libraries in the digital transformation of higher education. This high level of consensus indicates that students view libraries not merely as book repositories

but as central hubs for digital resource management *and academic support.* Only a small fraction of the respondents (**6.4%**) expressed uncertainty regarding this institutional role.

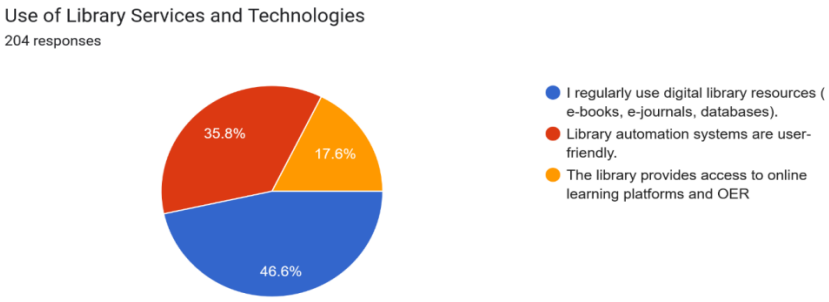
Awareness of National Education Policy 2020:



Pie Chart Showing Awareness of National Education Policy 2020 Digital Learning Initiatives

The above pie charts express a high degree of policy literacy among the participants. Specifically, **87.5%** of the respondents affirmed their awareness of NEP 2020 initiatives regarding digital learning resources. This indicates that the government's efforts to disseminate policy information through academic institutions and digital platforms have been largely effective within this demographic. Only **12.5%** of the 200 respondents expressed a lack of awareness, representing a small but relevant gap in policy outreach.

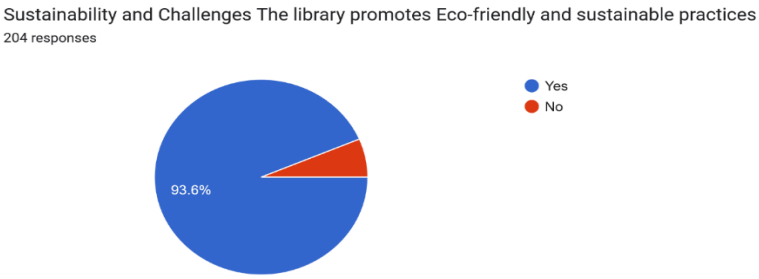
Pie Chart Showing Usage of Library Services and Technologies:



Pie Chart Showing Usage of Library Services and Technologies

Engagement with library technologies was categorized into three distinct areas of service. Nearly half of the respondents (**46.6%**) reported regular usage of digital e-resources, making it the most utilised service. Furthermore, **35.8%** of the sample found library automation systems to be user-friendly, reflecting a positive reception of the digital infrastructure. Finally, **17.6%** of participants utilized the library specifically for its access to online learning platforms and Open Educational Resources (OER)

Library's Role in Promoting Sustainable Practices:

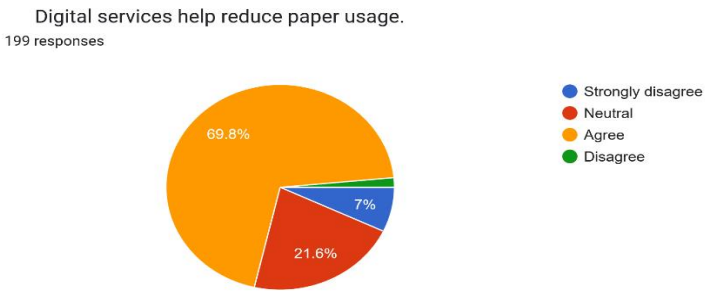


Pie Chart Showing Library's Role in Promoting Sustainable Practices

The perception of the library as a socially and environmentally responsible entity was exceptionally high among the participants. Out of 204 responses, **93.6%** affirmed that the library promotes eco-friendly and sustainable practices. This suggests that the institution's environmental initiatives—ranging from digital

archiving (reducing paper waste) to energy-efficient facility management—are highly visible and recognized by the student body. Only **6.4%** of respondents felt that these sustainability efforts were either absent or insufficiently communicated.

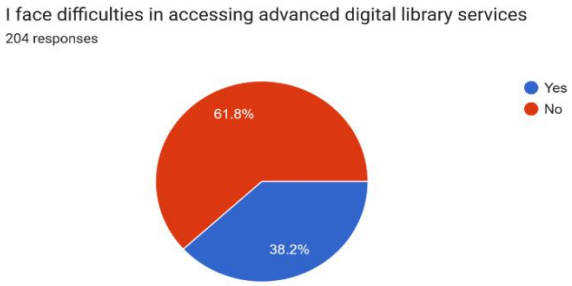
Impact of Digital Services on Paper Usage:



Pie Chart Showing the Impact of Digital Services on Paper Usage

The survey results indicate a strong positive perception regarding the environmental benefits of digitization. Out of 199 respondents, **69.8%** agreed that digital services play a vital role in reducing paper usage. This finding aligns with the high adoption rates of e-resources noted earlier in this study. However, a notable **21.6%** of the sample maintained a neutral position, while a combined **8.5%** expressed disagreement, indicating that for a small segment of the population, the transition to digital has not yet translated into a perceived reduction in physical resource dependency.

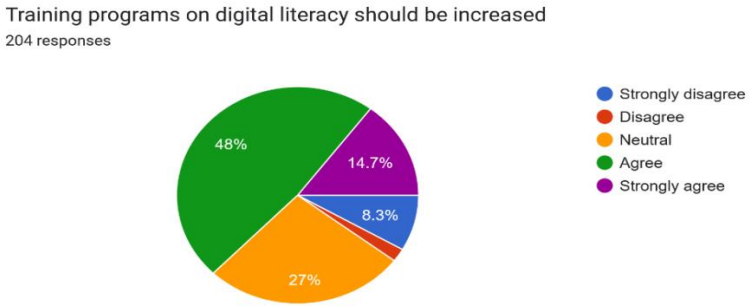
Difficulties in Accessing Advanced Digital Library Services



Pie Chart Showing Difficulties in Accessing Advanced Digital Library Services

Despite high awareness of digital transformation, a notable portion of the student body continues to face technical or procedural hurdles. Data analysis shows that 38.2% of respondents have difficulty accessing advanced digital library services. While the majority (**61.8%**) navigated these services without issue, the fact that nearly four out of ten users struggle with advanced tools indicates a significant gap in service accessibility or user training.

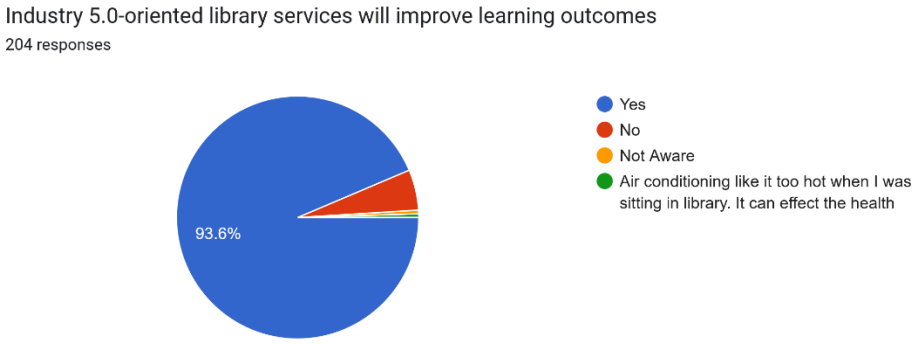
Need for Digital Literacy Training Programs:



Pie Chart Showing the Need for Digital Literacy Training Programs

The data reveals a clear mandate for enhanced educational support regarding digital tools. A significant majority of the 204 participants (**62.7%**) expressed a desire for increased digital literacy training programs. Within this group, **48%** agreed with the necessity of such programs, while **14.7%** strongly advocated for them. Conversely, **27%** of the respondents held a neutral stance, and a small minority (**10.3%**) did not see a need for increased training initiatives.

Impact of Industry 5.0-Oriented Library Services on Learning Outcomes



Pie Chart Showing Perceived Impact of Industry 5.0-Oriented Library Services on Learning Outcomes

A high level of student optimism regarding the future of library services. An overwhelming **93.6%** of participants affirmed that Industry 5.0-oriented library services would improve learning outcomes. This near-unanimous consensus suggests that students recognise the potential of advanced technologies—such as AI-driven research assistance and personalised digital repositories—to directly benefit their academic journey. Minor segments of the population were either sceptical or unaware of these benefits, while a negligible percentage highlighted the importance of physical infrastructure (e.g., climate control) as a factor in their overall health and learning efficiency.

Findings:

Demographics and Awareness

- **Educational Profile:** The study was primarily representative of the undergraduate population, which constituted 73.5% (n=150) of the 204 respondents. Postgraduates made up 16.7% (n=34), with the remainder being PhD, M.Phil., or other qualifications.
- Industry 5.0 Awareness: There is a high level of conceptual penetration among students, with 78.9% reporting awareness of Industry 5.0.
- **Policy Literacy:** A significant majority (87.5%) of participants are aware of NEP 2020 initiatives related to digital learning resources, indicating effective government and institutional dissemination of policy information.
- **Role of Libraries:** Students largely view libraries as central hubs for academic support and digital resource management rather than simple book repositories, with 93.6% affirming they understand the library's role in digital transformation.

Service Usage and Technology Engagement

- **Primary Services:** Usage is divided into three main categories:
    - Regular use of digital e-resources like e-books and journals (46.6%).
    - Engagement with user-friendly library automation systems (35.8%).
    - Access to online learning platforms and Open Educational Resources (OER) (17.6%).
- **Sustainability:** Libraries are perceived as environmentally responsible entities by 93.6% of respondents. Furthermore, 69.8% agree that digital library services play a vital role in reducing paper usage.

Challenges and Educational Needs

- **Access Barriers:** Despite high general awareness, 38.2% of respondents reported facing difficulties when trying to access advanced digital library services.
- **Demand for Training:** There is a clear mandate for more institutional support, as 62.7% of participants expressed a desire for increased digital literacy training programs to bridge the existing skills gap.

Future Outlook

- **Learning Outcomes:** There is overwhelming optimism regarding technological integration; 93.6% of students believe that Industry 5.0-

oriented library services (such as AI-driven assistance) will directly improve their learning outcomes.

- **Holistic Experience:** Beyond digital tools, the findings suggest that physical infrastructure, such as climate control and a "human-centric" environment, remains a factor in overall learning efficiency and health.

Conclusion:

The synthesis of participant suggestions reveals a strong desire for a library that balances high-tech efficiency with high-touch human care. While the demand for AI-driven personalization and digital accessibility is clear, users remain equally concerned with basic physical infrastructure and the need for structured guidance. The transition toward an Industry 5.0 library model therefore necessitates a dual-track strategy: upgrading the technological discovery layer while simultaneously investing in human-centric physical spaces and comprehensive digital literacy programs.

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