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Doctoral-Level Research in Indian CFTIs: Current Status and Future Prospects

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ABSTRACT

This case study focuses on the status of doctoral-level research in top Centrally Funded Technical Institutions (CFTIs) in India. It investigates trends in doctoral thesis submissions, subject distribution, rights allocation, and completion duration by analysing 10,879 doctoral thesis contributions from nine CFTIs ranked among the top 20 universities in the National Institutional Ranking Framework (NIRF) of 2024. The findings reveal significant disparities in submission rates and subject focus across institutions, with Technology and Science being the dominant fields. Furthermore, there are notable variations in intellectual property rights policies, with some universities primarily endorsing institutional ownership, while institutions like IIT Guwahati show a higher incidence of author self-ownership. The findings might be of significance to policymakers, doctoral research programme designers, and faculty members in understanding the research focus of CFTI and niche research areas. The study concludes by offering recommendations to enhance the visibility and documentation of doctoral research and suggests reforms in institutional policies to improve ETD submission rates and optimise research dissemination.

Keywords: Doctoral research; Open access; Digital repositories; Scholarly communication; Centrally funded technical institutions

1. INTRODUCTION

The dissemination and preservation of academic research are essential for advancing knowledge and promoting innovation in the digital era. Doctoral-level research has become an essential element of the academic framework, offering a readily accessible medium for disseminating scholarly research across several fields. The significance of such research work is especially evident in extensive academic repositories, which safeguard intellectual contributions and augment their visibility and utility within the global research community. Shodhganga, an open-access repository administered by the Information and Library Network (INFLIBNET) Centre, is crucial in India's higher education framework. Founded via the University Grants Commission (UGC) initiative, Shodhganga functions as a national repository for the aggregation and curation of doctoral-level research from universities and research institutions throughout India. The repository enables the dissemination of research findings, thereby minimising redundancy and enhancing transparency in scholarly activities.

As a result of compulsory regulations established by the UGC in 2009[1], Indian universities must now submit their theses to Shodhganga, facilitating easy access to this knowledge repository for students and scholars. Since its establishment, Shodhganga has had a notable rise in doctoral theses submissions, encompassing a range of subjects and languages, thereby illustrating the diversity of India's academic community.

Centrally Funded Technical Institutions (CFTIs) occupy a significant position in the national academic framework because they focus on advanced science, technology, and engineering research. The contributions of CFTIs to Shodhganga offer essential insights on research productivity and academic collaboration patterns within India's leading technical institutions. Considering these institutes' academic rigour and substantial research output, their involvement in Shodhganga is anticipated to profoundly influence the repository's compilation of ETDs. This study examines the status of ETD submissions by CFTIs, assessing the volume and trends of thesis submissions, subject-wise distributions, and intellectual property rights management inside these institutions.

This study aims to evaluate the status of doctoral-level research work submissions from CFTIs to Shodhganga, focusing on trends in submission volume, subject distribution, and intellectual property rights management. By assessing the participation of CFTIs, this research seeks to illuminate the critical role these institutions

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play in fostering India's technical and scientific progress through their doctoral research. Although Shodhganga has been the subject of extensive research in terms of its overall growth, the unique contributions of CFTIs to the repository's ecosystem of doctoral theses have not been thoroughly explored. This study addresses this gap by conducting a case study of selected CFTIs. It provides a detailed analysis of their contributions and offers recommendations for optimising doctoral research submissions from these premier institutions.

2. LITERATURE REVIEW

The landscape of doctoral-level research in India has witnessed substantial transformation over the past two decades, primarily through centralised digital initiatives such as Shodhganga, which serves as the national repository of Electronic Theses and Dissertations (ETDs). Administered by INFLIBNET, this repository plays a crucial role in preserving, disseminating, and standardising doctoral research outputs across the country[2]. However, the participation of Centrally Funded Technical Institutions (CFTIs), despite their prominence in India's higher education ecosystem, remains underexplored within the broader ETD ecosystem.

Several studies have analysed the growth, patterns, and institutional contributions to Shodhganga. For instance, Nanthini and Varghese[3] provided an analytical overview of top-contributing universities, revealing wide disparities in participation and indicating that technical and central institutions often lag in ETD contributions. This limited scope presents a significant gap in understanding how elite technical institutions engage with national research infrastructure.

Jhamb and Samim[4] and Esh and Ghosh[5] have highlighted the role of central universities and northeastern universities, respectively, in contributing to open access repositories. Their findings point toward a growing awareness but also underscore a need for standardised policies and digital literacy among faculty and scholars to optimize repository use. Chakravarty[6] conducted a webometric analysis of Shodhganga to evaluate institutional visibility and usage patterns, yet again, CFTIs were not distinctly addressed.

Thematically, research on ETDs has explored multiple dimensions, including citation behaviour[7,8], metadata analysis[9], academic genealogy[10], and digital literacy[11,12]. Kumar[10] provided a novel academic genealogy graph using Shodhganga data, offering insights into supervisory relationships and institutional networks. However, their work, while methodologically robust, did not focus on institutional categories like the CFTIs.

Studies such as Mir and Sevukan[13] and Naveen[14] have investigated subject-specific contributions, especially in Library and Information Science, providing valuable micro-level insights. Meanwhile, regional studies[15,16,17] reinforce the idea that institutional performance in contributing to Shodhganga varies significantly across Indian states and zones.

Recent evaluations of Shodhganga[18] stress both its achievements and challenges, including a lack of uniformity in uploads, delays in submission, and inadequate training for research scholars. Chaturvedi and Srivastava[19] proposed a framework for measuring digital repository impact, which could be applied to assess CFTIs but has not yet been utilised in that context.

Importantly, while a few studies have considered doctoral contributions from specific regions[20], no comprehensive investigation exists that specifically isolates CFTIs-such as IITs, NITs, and IISERs-as a focus group for examining doctoral research dissemination, digital participation, and repository integration.

Despite being at the forefront of India's research output in STEM fields, the visibility and accessibility of doctoral theses from CFTIs in national repositories remain inadequately documented. Their distinct administrative structure, research funding models, and academic culture may influence their ETD contributions differently from general universities-an angle yet to be explored in existing literature.

3. OBJECTIVES

The primary objectives of this case study are as follows:

- To evaluate the submission status of doctoral-level research from CFTIs.
- To investigate the average time taken for doctoral research completion within CFTIs.
- To classify and analyse the subject distribution of doctoral theses submitted by CFTIs, utilising the Dewey Decimal Classification 23rd edition (DDC23).
- To analyse the distribution of doctoral research submitted by CFTIs across different subjects throughout various time periods.
- To assess the distribution of ownership rights between authors and universities for submitted doctoral research.

4. METHODOLOGY

4.1 Selection of Institutions

This study specifically examines doctoral-level research at CFTIs in India. The selection of these institutions is based on the recognition that highly ranked CFTIs are more inclined to make substantial contributions to the Shodhganga repository.

4.2 Sampling

To ensure a robust analysis, a purposive sampling method is applied based on the data type and research objectives. CFTIs ranked within the top 20 in the 2023 NIRF overall rankings were selected as a credible indicator for identifying institutions with robust research activity and notable contributions to doctoral research. This approach is consistent with the objective of the study, which is to focus on top-performing CFTIs in India.

4.3 Data Collection

Initially, a list of 101 CFTIs was created from the official website of the Ministry of Education (MoE), Government of India. From this list, a filtering criterion

was applied to include only institutions ranked within the top 20 in the overall National Institutional Ranking Framework (NIRF) 2023. This step resulted in the selection of 9 CFTIs for further analysis.

Subsequently, institutional profiles on Shodhganga were verified for these 9 CFTIs. All 9 institutions had accessible profiles on Shodhganga, and thus none were excluded at this stage. Using web scrapping, metadata was systematically extracted about the theses uploaded by from these 9 CFTIs. Out of 214 departments, the metadata of 10879 theses were obtained and stored in a comma-separated value file. This file was used as a dataset for further analysis. The data was obtained in the month of September 2024. Fig. 1 presents the workflow of data collection.

4.4 Data Analysis

The analysis is predicated on the assumption that the data from the Shodhganga repository corresponds with the actual data from the CFTIs in India. Quantitative methods were used to assess the volume of theses, subject classifications (based on DDC23), rights distribution (self *vs.* university ownership), and time-to-completion. Trends over time were also analysed to evaluate shifts in research productivity. Data validation ensured accuracy by identifying and addressing missing or incomplete metadata fields.

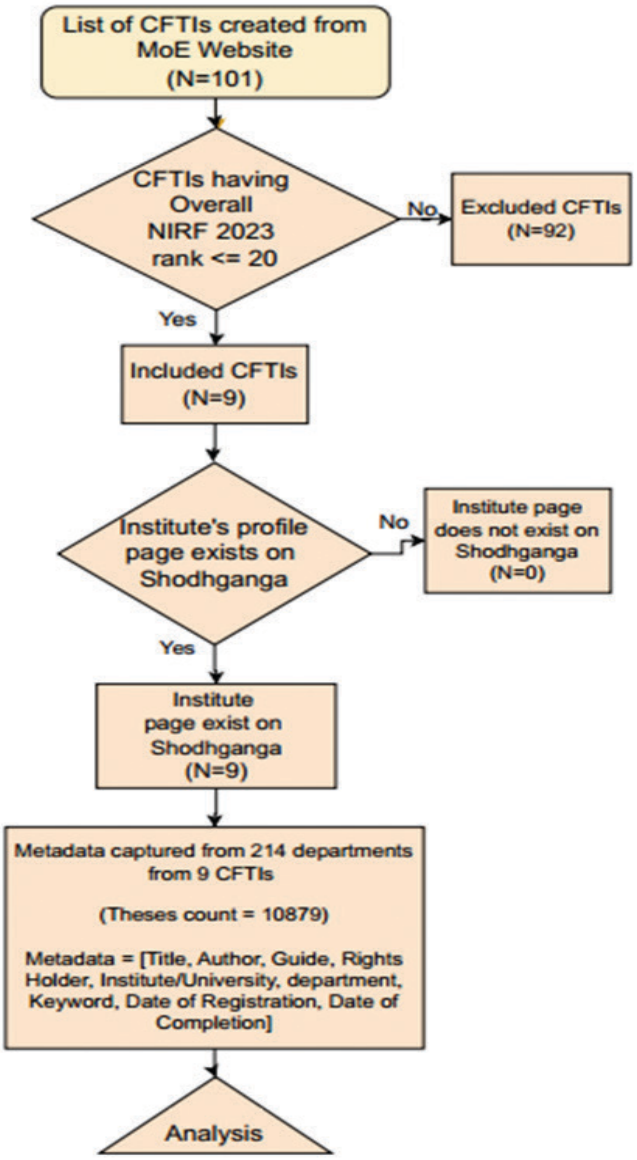

Figure 1. Data collection flowchart.

5. ANALYSIS AND RESULTS

5.1 Contribution by Top NIRF-Ranked CFTIs

Table 1 shows the distribution of a number of theses submitted by the top nine CFTIs in India. The Indian Institute of Technology Guwahati, ranked 9th in the 2023 overall NIRF, has the highest number of theses, i.e., 2626, followed by the Indian Institute of Technology Delhi, in third place with 2201 theses. There were 1516 theses submitted by the Indian Institute of Technology Madras (NIRF Rank 1) and 1400 theses produced by the Indian Institute of Science, Bangalore (NIRF Rank 2), respectively, indicating a significant level of involvement with Shodhganga. In contrast, the Indian Institute of Technology Kanpur (NIRF Rank 5) has only submitted 10 theses, which is a significant gap when compared to its counterparts. The observed discrepancy indicates variations in institutional policies concerning the submission of theses or integration with the repository.

A grand number of 10,879 theses have been submitted to Shodhganga throughout 214 departments, spanning selected CFTIs. Table 1, effectively demonstrates the extent and magnitude of contributions made by these institutions, underscoring the crucial role that high-ranking CFTIs play in the advancement and progress of the Shodhganga repository. Nevertheless, it also emphasises areas that need enhancement, especially for institutions with fewer submissions, which could impede the repository's capacity to serve as a comprehensive repository of Indian academic work.

5.2 Time Taken to Complete Theses

In order to investigate the average time taken for submission of doctoral theses in selected CFTIs, the difference between the date of registration and the date of submission is calculated. The calculation of the duration required to finalise theses relies on metadata encompassing registration and completion dates for each thesis. It is essential to note that a considerable number of theses lacked registration dates in their metadata. Consequently, these theses were omitted from the study of completion time, resulting in a reduced sum of theses analysed in this section relative to the overall number of theses submitted.

Out of 10879 theses, 6568 theses had metadata on both registration and completion dates. The average duration for thesis completion was approximately 6.26 years, with most students finishing their theses within a span of 5 to 7 years. One thesis had a completion duration of as much as 18 years, possibly due to exceptional circumstances or error at the data entry stage. Fig. 2 shows the distribution of a number of theses and time taken in the form of a histogram.

Table 1. Contribution to shodhganga by top CFTIs in India

Top 20 NIRF rank (overall) holding CFTIs	Overall NIRF rank (2023)	Department counts in Shodhganga	Number of theses in Shodhganga	Top departments (# of Theses)
Indian Institute of Technology, Madras	1	16	1516	Civil Eng. (161), Electrical Eng. (159), Chemistry (143)
Indian Institute of Science, Bangalore	2	39	1400	Physics (127), Centre for Nanoscience and Eng. (79), Materials Eng. (73)
Indian Institute of Technology, Delhi	3	27	2201	Dept. of Mechanical Eng. (228), Dept. of Physics (225), Dept. of Chemistry (209)
Indian Institute of Technology, Bombay	4	29	1321	Dept. of Electrical Eng. (120), Dept. of Chemical Eng. (100), Dept. of Chemistry (100) Dept. of Energy Science and Eng. (90), Dept. of Physics (90)
Indian Institute of Technology, Kanpur	5	7	10	Material Science and Eng. (3), Chemical Eng. (2), Other department (1 each)
Indian Institute of Technology, Kharagpur	7	41	980	Agricultural and Food Eng. (60), Dept. of Chemistry (55), Computer Science and Eng. (53)
Indian Institute of Technology, Roorkee	8	26	534	Dept. of Mechanical and Industrial Eng. (65), Dept. of Biosciences and Bioengineering (41), Dept. of Physics (38)
Indian Institute of Technology, Guwahati	9	16	2626	Dept. of Chemistry (387), Dept. of Mechanical Eng. (294), Dept. of Biosciences and Bioengineering (284)
Indian Institute of Technology, Hyderabad	14	13	290	Dept. of Electrical Eng. (51), Dept. of Civil Eng. (35), Dept. of Mechanical and Aerospace Eng. (35), Dept. of Chemical Eng. (29)
Total		**214**	**10879**	

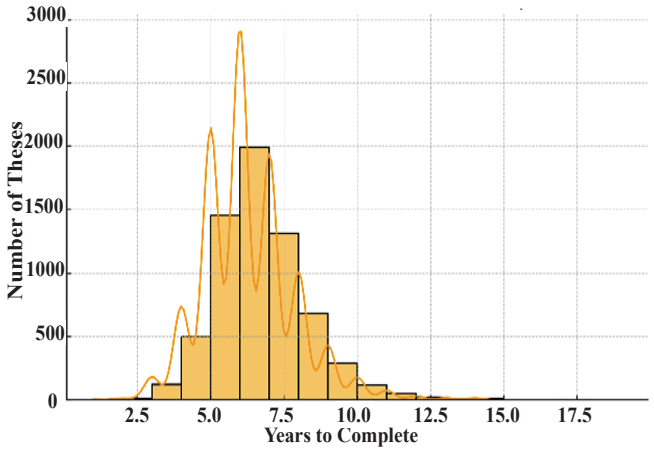

Figure 2. Distribution of year to complete doctoral-level research by CFTIs.

5.3 Distribution of Theses by Subject Keywords

In order to classify and analyse the subject distribution of doctoral theses submitted by CFTIs, utilising the Dewey Decimal Classification 23rd edition (DDC23). The study classified each thesis based on subject keywords that are available in the metadata. A significant number of theses include several topics, frequently combining study domains from many disciplines. A single thesis may be classified under more than one DDC base class. Hence, the observed total number of theses, shown in Table 2,

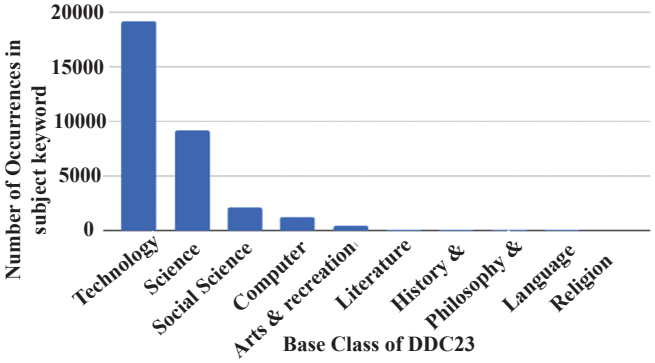

Figure 3. Distribution of occurrence of base class of DDC23.

in the analysis exceeds the true number of distinct theses because of the overlap in the subject classification.

Figure 3 indicates that Technology (base class 600 of DDC23) has the highest number of occurrences of subject keywords, totalling 19151,followed by science (base class 500 of DDC23) with 9207. The Social Sciences (base class 300 of DDC23) makes a substantial contribution with 2093 occurrences of subject keywords. Conversely, Religion (base class 200 of DDC23), Philosophy & Psychology (base class 100 of DDC23), and Language (base class 400 of DDC23) receive rather lower numbers of occurrences of subject keywords. In accordance with the technical character of CFTIs, this distribution reflects a stronger focus on STEM (Science, Technology, Engineering, and Mathematics) fields.

To understand the interdisciplinary nature of doctoral research at CFTIs further, we created a heatmap using DDC23 base classes on both axes. Each cell in the heatmap shows a number of theses that have been classified into two base classes together at that row and column. From Fig. 4, it is evident that the highest overlaps occur between Technology and Science (1788 theses), followed by Technology and Social Sciences (492 theses), and Computer Science with both Technology (727) and Science (204). The higher overlap of doctoral research among the base classes shows that technology is often connected with topics in science and social science. On the other hand, classes like Philosophy, Religion, and Literature have fewer overlaps, but they do show more connections with Art & Recreation.

5.4 Subject Wise Trend

In order to identify the shift in the subject of the submitted thesis, we calculated the year-wise trends from 1968 to 2004, as illustrated in Fig. 5. It is observed that disciplines such as Arts & recreation, History & geography, Language, Literature, Philosophy & psychology, Religion, and Social sciences saw no activity until the late 1990s, then underwent significant growth, especially after 2000. Disciplines such as Science and Technology had relative stability with minimal activity over time, which indicates a notable transition in emphasis towards technology and science disciplines in the early 21st century.

Figures 6 and 7 illustrate the trend of submitted theses across several academic disciplines from 2004 to 2024. Fig. 6 presents the Technology (yellow) and Science (red) trends. A considerable growth from around 2015 and reaching its zenith between 2020 and 2022, thereafter experiencing a substantial decline. Fig. 7 presents the trend of Literature (yellow), Philosophy & psychology (green), and History & Geography (blue), which exhibit modest growth and reach a peak around 2020 before subsequently dropping. Disciplines such as Religion continuously exhibit low levels throughout time. The data indicates a significant increase in academic output, specifically theses in Technology and Science disciplines, particularly during the COVID-19 epidemic, followed by a decline in recent years.

This increase is probably due to enhanced academic output during lockdowns, affording researchers and students additional time to finalise their work. The rise in submissions and the prominence of multidisciplinary theses indicate the pandemic's influence on research production, underscoring how the atypical conditions cultivated a concentrated and productive research atmosphere. The data analysis indicates that CFTIs predominantly emphasise technical disciplines, including Technology and Science, aligning with their fundamental objective. The allocation of rights and completion timelines indicate potential enhancements in intellectual property management and assistance for prompt thesis finalisation. These findings offer essential insights into the research environment of CFTIs and underscore potential areas for policy and operational improvements.

Table 2. Subject-wise distribution of doctoral-level research with respect to DDC23 classification

Base class from DDC23	DDC23 base class number range	Number of occurrences of subject keywords in base class
Computer science, information & general works	000 - 099	1204
Philosophy & psychology	100 - 199	51
Religion	200 - 299	4
Social sciences	300 - 399	2093
Language	400 - 499	44
Science	500 - 599	9207
Technology	600 - 699	19151
Arts & recreation	700 - 799	430
Literature	800 - 899	64
History & geography	900 - 999	52

5.5 Rights Distribution in CFTIs

The rights for each thesis were analysed into the types of rights ownership by CFTIs. The analysis revealed two main classifications of ownership: self-ownership and university ownership.

Table 3 indicates that university ownership is predominant, with 8236 (75.7 %) theses falling under this category. However, a significant portion of authors, 2641 (24.36 %), retain rights to their theses. This suggests that while universities generally manage doctoral-level research submissions, a considerable number of authors exercise their rights to retain ownership. The one case of missing rights information could be an outlier or a data management issue. Further institute-wise analysis shows that self-ownership is dominant at IIT Guwahati, where 2608 theses are retained by authors, compared to only 18 under university ownership. In contrast, institutions such as IISc Bangalore, IIT Bombay, IIT Delhi, and IIT Madras show almost exclusive university ownership (Table 4). These variations suggest differing institutional policies or author preferences regarding thesis ownership across CFTIs.

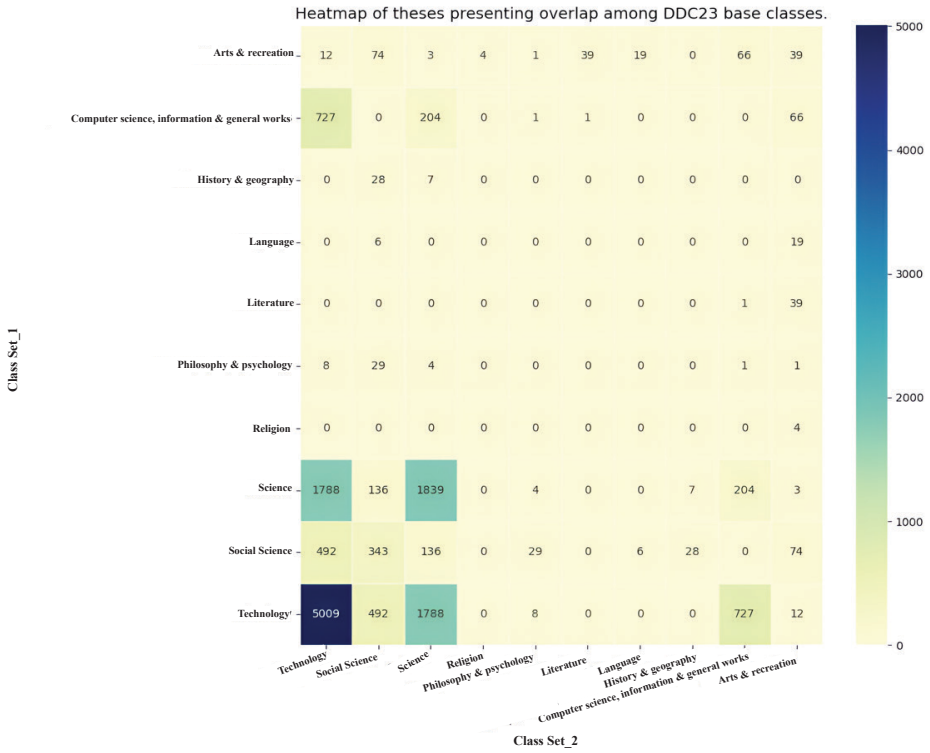

Figure 4. Heatmap presenting DDC23 base class overlaps with respect to thesis count.

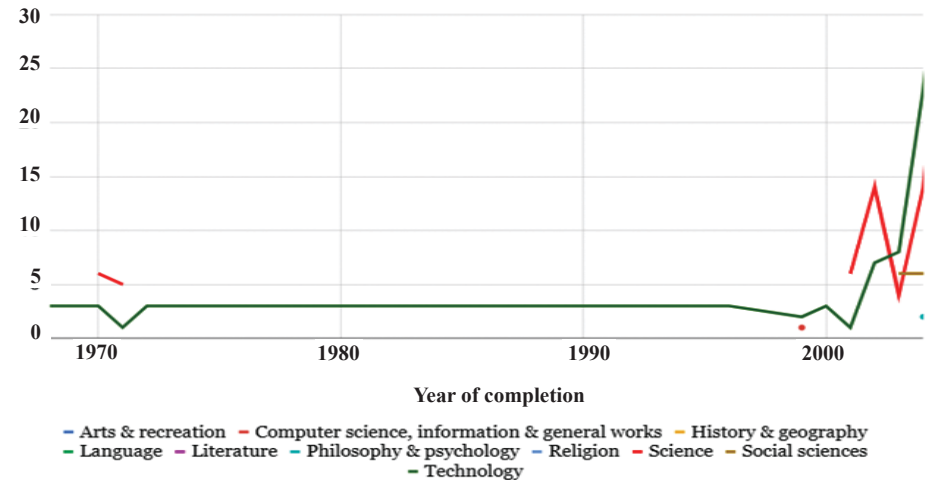

Figure 5. Subject wise trends in thesis completion before 2004.

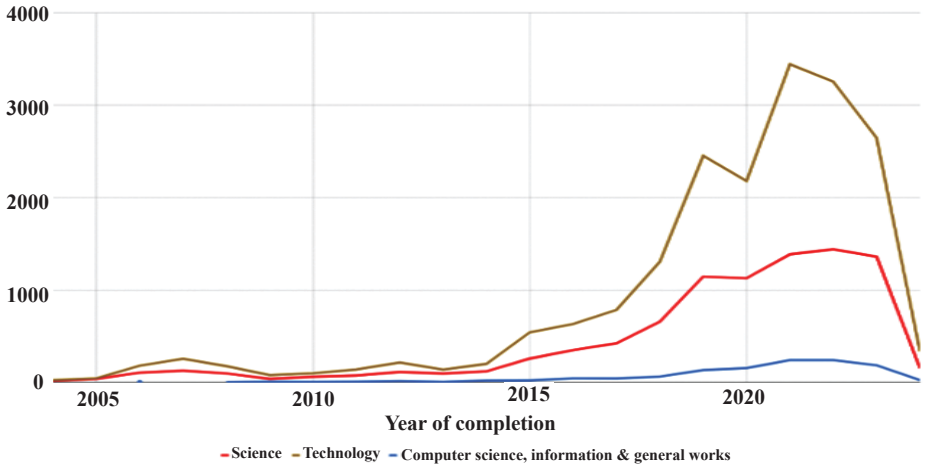

Figure 6. Subject wise trends in thesis completion for 20 years after 2004 for science, technology, and computer science, information & general works.

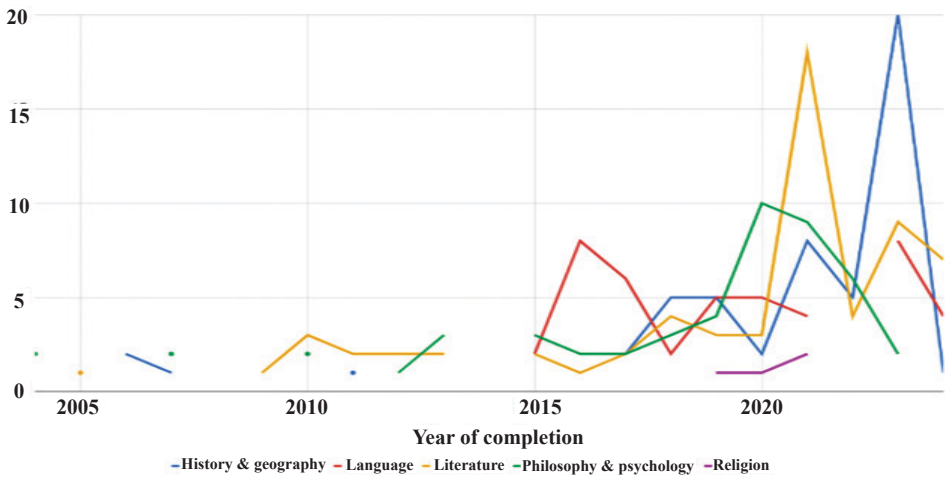

Figure 7. Subject wise trends in thesis completion for 20 years after 2004 for history & geography, literature, philosophy & psychology, language, and religion.

Table 3. Rights distribution in CFTIs

Rights holder	Number of theses	Percentage
Self	2,641	24.36%
University	8,236	75.7%
Blank	1	0.0%

Table 4. Institute wise rights holding distribution in top CFTIs

Institute	Count of theses where author hold the rights	Count of theses where university hold the rights
Indian Institute of Science, Bangalore	29	1371
Indian Institute of Technology, Bombay	0	1320
Indian Institute of Technology, Delhi	0	2201
Indian Institute of Technology, Guwahati	2608	18
Indian Institute of Technology, Hyderabad	0	290
Indian Institute of Technology, Kanpur	4	6
Indian Institute of Technology, Kharagpur	0	980
Indian Institute of Technology, Madras	0	1516
Indian Institute of Technology, Roorkee	0	534

6. FINDINGS

The findings confirm that doctoral research in CFTIs is heavily concentrated in STEM disciplines particularly Technology and Science, reflecting the core academic focus of these institutions. However, the study reveals substantial disparities in thesis submission practices among institutions. For example, while IIT Guwahati has submitted over 2,600 theses, IIT Kanpur has contributed only 10, suggesting inconsistencies in repository integration and institutional policy enforcement.

Table 5. Summary of the findings

Theme	Key findings
Submission volume	Total of 10,879 theses submitted by top NIRF-ranked CFTIs. Highest contributions from IIT Guwahati (2626), followed by IIT Delhi (2201). IIT Kanpur submitted only 10 theses.
Subject distribution	Research is heavily concentrated in Technology (19,151 occurrences) and Science (9,207), as per DDC23 classification. Social sciences and humanities are minimally represented.
Multi-disciplinary research	technology is often connected with Science and Social Science topics. Philosophy, Religion, and Literature have fewer overlaps, but they do show more connections with Art & Recreation
Completion time	based on 6,568 theses with complete metadata, the average time to complete a PhD is 6.26 years. Majority completed between 5–7 years.
Trend over time	sharp increase in thesis submissions between 2020–2022, likely due to increased research productivity during COVID-19 lockdowns.
Institutional disparities	significant differences in repository contributions among CFTIs suggest varying institutional policies or operational inefficiencies.
Ownership rights	75.7% of theses are under university ownership; 24.36% are self-owned. IIT Guwahati stands out with 99% self-owned theses.
Repository metadata	some records lack crucial metadata such as registration dates, affecting analysis accuracy. Highlights need for better data curation.

The findings of the study are in line with observations made by Gupta and Sharma[21], who analysed citation patterns in social science theses from Haryana's state universities. Their work similarly identified challenges in documentation quality, inconsistent bibliographic practices, and underutilisation of repository infrastructure-issues that continue to affect scholarly communication across Indian institutions. Table 5 presents the summarised findings of the study.

7. CONCLUSIONS

This case study provides a comprehensive analysis of doctoral-level research submissions from India's top CFTIs to the national ETD repository, Shodhganga. The study highlights trends in submission volume, subject-area distribution, time-to-completion, and intellectual property rights, offering insights into the institutional practices that shape research visibility and dissemination in technical higher education.

Intellectual property rights management also varies widely. Most CFTIs favour institutional ownership, but IIT Guwahati stands out, with the majority of its theses self-owned by authors. This divergence points to a broader need for policy clarity and standardisation, balancing institutional stewardship with academic autonomy.

A key limitation of the study is the incompleteness of metadata in the Shodhganga repository. Out of 10879 theses analysed, 4311 records (approximately 39.6 %) lacked essential metadata, such as registration dates. These records were excluded from the analysis of thesis completion time, which may have introduced bias and affected the reliability of longitudinal trends.

Future studies can include a larger number of institutions for a better understanding of doctoral research trends at CFTIs. Similar case studies may be conducted to study the characteristics of specialised institutions such as law, pharmacy, medicine and management.

For increasing the research visibility and impact of doctoral-level research output, the study proposes the following recommendations:

1. All CFTIs should adopt strict metadata entry protocols for thesis submissions to Shodhganga, ensuring that fields like registration and completion dates are consistently documented. This will improve the accuracy of analytics and enable better research planning.
2. Institutions must align with UGC regulations by enforcing mandatory and timely submissions of all doctoral theses to Shodhganga, eliminating discrepancies in institutional participation.
3. A nationally recommended framework for thesis ownership should be considered, one that allows flexibility for author rights while maintaining institutional accountability. IIT Guwahati's approach could serve as a progressive example.
4. Establish structured academic support systems, including milestone tracking, writing assistance, and early intervention programs, to reduce delays in thesis completion and support research quality.
5. Regular audits of repository entries should be undertaken to correct errors, fill metadata gaps, and assess compliance with institutional and national standards.

By implementing these recommendations, CFTIs can strengthen their research ecosystems and contribute more systematically to national academic infrastructure, ensuring that doctoral research achieves both visibility and impact.

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