

Evolving Trends in Doctoral Research in Science: A Twenty-Year Review of RTM Nagpur University

¹Sanjay C. Raut, ²Dr. N. R. Motewar

¹Librarian / Research Scholar, Shivaji Mahavidyalaya, Knowledge Resource Centre, Gadchiroli.

²Director, University of Mumbai, Mumbai.

1. Introduction

Doctoral research represents the highest echelon of academic scholarship and serves as a vital indicator of a university's research capability, intellectual vitality, and disciplinary orientation. Ph.D. theses are not merely degree requirements; they embody original investigations that contribute to the expansion of disciplinary knowledge and often reflect broader institutional priorities, policy frameworks, and research ecosystems. Consequently, systematic analysis of doctoral theses provides meaningful insights into the research performance and scholarly culture of higher education institutions.

Scientometrics, an established subfield of bibliometrics, offers quantitative tools to evaluate research output, growth trajectories, collaboration patterns, and citation behavior. When applied to doctoral theses, scientometric techniques enable a deeper understanding of long-term research trends, supervisory leadership, gender participation, and disciplinary strengths. Such analyses are particularly relevant in the Indian higher education context, where doctoral education has expanded significantly over the last few decades in response to policy reforms, increased funding opportunities, and growing emphasis on research-driven national development.

Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU), located in Maharashtra, is among the prominent state universities with a long-standing tradition of science education and research. Serving a large academic community in the Vidarbha region, RTMNU has contributed substantially to scientific research across disciplines such as Chemistry, Botany, Physics, Mathematics, Computer Science, and allied fields. Despite its importance, comprehensive longitudinal studies examining doctoral research trends at RTMNU remain limited.

The present study attempts to bridge this gap by undertaking a detailed scientometric analysis of doctoral theses submitted in the Faculty of Science at RTMNU over a period of twenty years, from 2000 to 2020. By examining 913 Ph.D. theses, the study seeks to map disciplinary distribution, temporal growth patterns, supervisory concentration, gender participation, pagination characteristics, and citation practices. The findings are expected to provide a holistic overview of the evolution of science research at RTMNU and to offer evidence-based insights for strengthening doctoral research policies and practices.

2. Objectives of the Study

The study is guided by the following objectives:

1. To examine the subject-wise distribution of doctoral theses submitted in the Faculty of Science at RTM Nagpur University during 2000–2020.
2. To analyze year-wise and quinquennium-wise growth patterns of doctoral research output.

3. To compute and interpret scientometric indicators such as Relative Growth Rate (RGR), Doubling Time (Dt), and Annual Growth Rate (AGR).
4. To assess gender-wise participation of doctoral scholars across science disciplines.
5. To analyze research supervisorship patterns and the extent of concentration of doctoral guidance.
6. To study pagination productivity and citation behavior of doctoral theses across departments.
7. To identify key trends, major findings, and suggest recommendations for improving doctoral research output and diversity.

3. Methodology

The present investigation is based on secondary data collected from authoritative institutional sources. Data pertaining to doctoral theses awarded in the Faculty of Science at RTM Nagpur University between 2000 and 2020 were obtained from the official records of the University's Ph.D. Section and cross-verified with entries available in the Shodhganga repository maintained by INFLIBNET.

A total of 913 doctoral theses were included in the study. Bibliographic and research-related parameters extracted for analysis included subject of research, year of award, gender of the researcher, research supervisor, pagination details, and citation counts. Scientometric indicators such as Relative Growth Rate (RGR) and Doubling Time (Dt) were calculated using the model proposed by Mahapatra (1985), while Annual Growth Rate (AGR) was computed using standard growth formulas.

Data processing and statistical analysis were carried out using MS Excel and R-Studio. The results are presented in tabular form and interpreted descriptively to identify long-term trends, productivity patterns, and disciplinary differences.

4. Results and Discussion

4.1 Subject-wise Distribution of Doctoral Theses

Analysis of disciplinary distribution reveals that doctoral research at RTMNU is unevenly spread across science subjects. Chemistry emerged as the most productive discipline, contributing 223 theses (24.42%) of the total output. Botany (13.47%) and Mathematics (11.94%) followed, indicating strong research traditions in these fields. Physics and Computer Science also demonstrated comparable productivity, each contributing around one-tenth of the total theses.

At the lower end of the spectrum, Statistics and Home Science recorded minimal doctoral output. The comparatively high share of Chemistry may be attributed to better laboratory infrastructure, interdisciplinary applicability, and greater employment opportunities in both academic and industrial sectors. Conversely, lower output in Statistics could reflect limited faculty strength and narrower research scope.

4.2 Chronological Growth Trends

Year-wise analysis of doctoral submissions indicates considerable fluctuations over the twenty-year period. The highest number of theses was awarded in 2016, accounting for 7.45% of the total output, followed by 2020 with 6.85%. The lowest output was observed in 2012, with only 32 theses (3.50%).

The absence of a steady upward trend suggests that doctoral research productivity at RTMNU has been influenced by multiple factors such as changes in Ph.D. regulations, availability of research supervisors, funding

opportunities, and variations in enrolment and completion rates. Periodic spikes in output may be linked to policy transitions or batch completions under revised regulations.

4.3 Growth Indicators: RGR, Dt, and AGR

Scientometric growth indicators provide deeper insight into the dynamics of doctoral research expansion. The Relative Growth Rate (RGR) declined progressively from 0.834 in 2001 to 0.046 in 2018, indicating a gradual slowdown in cumulative growth. Correspondingly, Doubling Time (Dt) increased over the years, reaching a peak of over 15 years in 2018, which reflects reduced acceleration in doctoral output.

Annual Growth Rate (AGR) values displayed wide fluctuations, ranging from negative growth in 2004 to a sharp increase of over 65% in 2016. These variations confirm that doctoral research growth at RTMNU has been episodic rather than linear, shaped by institutional and regulatory contexts.

4.4 Quinquennium-wise Productivity

To smoothen annual fluctuations, doctoral output was grouped into four quinquenniums. The periods 2000–2005 and 2016–2020 emerged as the most productive, contributing 30.12% and 28.37% of the total theses respectively. In contrast, the quinquennium 2011–2015 recorded the lowest share (20.70%).

The observed cyclical pattern suggests alternating phases of expansion and consolidation in doctoral research. Peaks in productivity may correspond to favorable policy environments and increased research enrolments, while troughs could be associated with regulatory transitions or infrastructural constraints.

4.5 Gender-wise Distribution of Doctoral Research

Gender analysis reveals a persistent imbalance in doctoral research participation. Male scholars accounted for more than 60% of the total theses, indicating continued male dominance in science research at RTMNU. Disciplines such as Electronics, Chemistry, and Mathematics exhibited particularly high male participation.

However, certain subjects showed encouraging trends toward gender parity. Home Science recorded equal representation of male and female scholars, while Computer Science, Biochemistry, and Microbiology demonstrated near-balanced participation. These findings suggest that targeted institutional support and inclusive policies can positively influence female participation in doctoral research.

4.6 Research Supervisorship Patterns

A total of 256 research supervisors guided the 913 doctoral theses, resulting in an average of 3.56 theses per supervisor. However, supervision was not evenly distributed. A small group of highly prolific supervisors accounted for a disproportionately large share of guided theses. For instance, the most productive supervisor in Computer Science guided 24 doctoral candidates.

Nearly 96% of the theses were supervised by a single guide, indicating limited adoption of co-supervision or interdisciplinary guidance models. While single supervision ensures focused mentorship, greater encouragement of joint supervision could promote interdisciplinary research and enhance scholarly collaboration.

4.7 Pagination Productivity

Pagination analysis indicates that the cumulative length of all doctoral theses amounted to 318,772 pages, with an average of 349 pages per thesis. Considerable variation was observed across years and disciplines. Botany theses recorded the highest average pagination, while Home Science theses were relatively shorter.

Variations in thesis length may reflect differences in disciplinary research methodologies, experimental requirements, and documentation norms. Longer theses are often associated with extensive experimental work and data presentation, particularly in laboratory-based sciences.

4.8 Citation Behaviour of Doctoral Theses

Citation analysis revealed a total of 185,339 references across all theses, averaging approximately 203 citations per thesis. Microbiology recorded the highest average citations per thesis, followed by Computer Science and Electronics. Chemistry accounted for the largest share of total citations due to its high volume of theses.

Journal articles constituted the most frequently cited bibliographic form across all disciplines, underscoring the reliance on current and peer-reviewed literature. Books ranked second, while conference proceedings, reports, and electronic resources formed smaller yet significant components of the reference corpus. This pattern reflects the integration of doctoral research at RTMNU with mainstream scholarly communication channels.

5. Major Findings

- Chemistry, Botany, and Mathematics emerged as the most productive science disciplines at RTMNU.
- Doctoral research output exhibited significant year-to-year fluctuations rather than steady growth.
- Male scholars continue to dominate doctoral research, though select disciplines show improving gender balance.
- Research supervision is highly concentrated among a limited number of faculty members.
- Pagination and citation practices vary considerably across disciplines, reflecting methodological diversity.
- Doctoral research remains largely discipline-specific, with minimal interdisciplinary supervision.

6. Conclusion and Recommendations

This two-decade scientometric assessment highlights both the strengths and challenges of doctoral research in science at RTM Nagpur University. While the University demonstrates strong research capacity in selected disciplines, uneven growth patterns, gender disparities, and concentration of supervision point to areas requiring strategic intervention.

To enhance the quality, diversity, and sustainability of doctoral research, the University may consider promoting interdisciplinary and co-supervisory models, strengthening support mechanisms for female scholars, revitalizing underrepresented disciplines through targeted funding and faculty development, and continuously upgrading research infrastructure. Periodic scientometric evaluations can further assist policymakers in aligning doctoral research with emerging national and global scientific priorities.

7. References

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