

CONTRIBUTION OF PH.D. RESEARCH IN PHYSICS: A STUDY WITH SPECIAL REFERENCE TO THE SAVITRIBAI PHULE PUNE UNIVERSITY

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ABSTRACT

This paper examines the contributions of Ph.D. research at Department of Physics, Savitribai Phule Pune University, Pune particularly in the areas of physics subject and interdisciplinary subjects. There were 517 Ph.D. theses submitted in the Department of Physics during 1953-2013. Those are classified with the help of Dewey Decimal Classification (DDC) 23rd edition. Out of these 318 Ph.D. these are of the subject physics (Physics, Classical Mechanics, Fluid Mechanics, Pneumatics (Gas Mechanics), Sound and related Vibrations, Light and related Radiation, Heat, Electricity and Electronics, Magnetism, Modern Physics) while 199 are on interdisciplinary research (Astronomy and allied sciences – Astrophysics, Chemistry and allied Sciences, Earth Sciences-Meteorology, Geophysics, Biophysics, Engineering and allied Operations – Applied Physics). Total 96236 citations were appended in 517 theses with an average citation 186.14 per theses.

Key words: Citation Studies, Doctoral Research, Ph. D. Research, Ph.D. theses, Physics, Research Output, Research productivity, Theses.

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1. INTRODUCTION

The Department of Physics, Savitribai Phule Pune University (formerly University of Pune), Pune started its activities in 1950. The department has always taken a dynamic attitude towards acceptance of innovative concepts in higher education and research. The department

made a mark at the international level, which is reflected in the publications, quality of research students, research infrastructure and research collaboration at national as well as international level. The department has always encouraged and supported interdisciplinary research. Today department is an active beehive of research being carried out in a wide variety of frontier areas. [1]

The richness and variety of the literature of physics is confusing. It becomes more difficult to delimit the 'literature of physics'. In one direction we go into chemistry, in another into mathematics and the practical connection with engineering in both directions. The physics is that subject which has a strong internal intellectual structure. The literature of physics is not like a biological 'family tree' but it is internally connected, and capable of classification in many orthogonal dimensions. It is an astonishing fact about modern physics that the whole of our knowledge of the physical universe is interrelated. [2] The subject Astronomy and allied sciences includes the astrophysics and a significant difference between astrophysics and other branches of physics is reflected in their respective literatures. Whereas most other branches of physics is oriented towards laboratory experimentation, astrophysics depends on object-oriented observation. [3] Crystallography supplies results which are essential to other branches of science, such as chemistry, biology, and physics. [4] There is exponential growth of scientific literature, interdisciplinary nature of research and trend in the direction of specialization have posed many problems both to the researchers/scientists and librarians. [5] The present study focuses on the contribution of Ph.D. research work and their citations, at the department during the period 1950-2013.

Citations provide the bibliometric data about the used documents. Citation analysis is used as an indicator of the impact, influence or quality of scholarly work. It is most often used for measuring the quality of research and facilitating collection development in libraries. [6].

2. REVIEW OF LITERATURE

Number of studies has been conducted and those are based on citation analysis and to measure the research output of universities, research institutions, etc.

Singh [7] has find out the scholarly physics output of central universities of Uttar Pradesh and Delhi during the year 2006-2010 as reflected by Web of Science. The study deals about the 1936 publication output of Indian Central Universities like University of Delhi, Banaras Hindu University, University of Allahabad, Aligarh Muslim University and Jawaharlal Nehru University especially in the field of Physics. Singh [8] has measured contribution of scholarly research output in Physics Banaras Hindu University. The study deals about the 2300 contributions made by the scientists of Banaras Hindu University (BHU) especially in the field of physics. It examines the contribution of this university under the various heading including decade wise growth of Physics publication, contributions over different areas (subfields) of Physics, contributions by the authors of the Department of Physics, most prolific authors of the Department of Physics and most preferred journals in which top physicists prefer to publish their work. The research output of BHU especially in the field of Physics is found to an upward trend. Sudhier [9] analyzed the research productivity of physicists at the Indian Institute of Science and the University of Kerala during 2004-2008. Gooden [10] performed citation analysis of chemistry dissertations. For this study 30 dissertations studied and generated total 3,704 citations. It is found that journal articles were cited more frequently than monographs. 85.8% of the citations were journal articles and 8.4% of the citations were monographs. Nagarkar [11] studied on bibliometric analysis of publications of the chemistry department, University of Pune, India, 1999-2012. Ambily and Shivaraman [12] have studied life science research profile of Kerala State. Biswas [13] has done the study on 'The bottom line' journal from 2011 to 2015.

This literature review reveals that citation analysis and research output has been used by many researchers for evaluating contribution of research in universities. The present paper focuses to find out answers to some of basic questions which is framed as the objectives of the research.

3. OBJECTIVES OF THE STUDY

To analyse the research contributions of the Ph.D. research workers of Department of Physics, Savitribai Phule Pune University from 1953 to 2013

4. METHODS

The Ph.D. theses which are the products of research activity have been examined for this study. There are about 517 Ph.D. theses which were submitted at the Department of Physics of Savitribai Phule Pune University, Pune, India during 1953-2013 which are physically available in the Jayakar Library. The necessary data have been collected from 517 doctoral theses. The title page and the bibliographical references cited at the end of the doctoral theses are taken as the source of data for the study. Dewey decimal classification ed.23 is used for classification of these theses to sub-subject. Total number of citations appended to these theses is 96,236. The same data is tabulated in Microsoft Excel, and the data extracted to meet the objectives of the study.

According to DDC 23rd ed. the universe of knowledge is divided into the 10 main classes (first summary)) i.e. 000,100,200,...500,600,...900 then again divided in the 100 divisions (second summary) i.e. 000,010,020,...500,510 520,530,540,550,...990 after that it is again divided in to the 1000 sections (third summary)

i.e. 000,001,002,...530,531,532,533,534,535,...999 according to its predominant content. [14]

Physics is further sub-divided into 10 main sections. Accordingly theses are classified to these sub-subjects as follows:

- 1.(530) Physics
- 2.(531) Classical Mechanics
- 3.(532) Fluid Mechanics
- 4.(533) Pneumatics (Gas Mechanics)
- 5.(534) Sound and related Vibrations
- 6.(535) Light and related Radiation
- 7.(536) Heat
- 8.(537) Electricity and Electronics
- 9.(538) Magnetism
- 10.(539) Modern Physics

It is also observed that some Ph.D. research is done on border disciplines of physics and mission oriented fields, such as Astrophysics, atmospheric and space research, chemistry, meteorology, geophysics, biophysics, applied physics etc. [15] Ph.D. theses on such interdisciplinary Research are also submitted at the Department of Physics and those are classified in the following subjects by DDC 23rd edn.

- 11.(520) Astronomy and allied sciences
- 12.(540) Chemistry and allied Sciences
- 13.(550) Earth Sciences
- 14.(570) Biophysics

15.(600) Engineering and allied Operations

5. ANALYSIS

The sequence of the sub-subjects is maintained according to DDC numbers for physics and for interdisciplinary subjects. There are about 517 Ph.D. theses which were submitted at the Department of Physics of Savitribai Phule Pune University, Pune, India during 1953-2013 which are physically available in the Jayakar Library. All these theses are thoroughly studied by the researcher.

5.1. Ph.D. Research Work under Department of Physics

As discussed earlier the available theses are categorized according to DDC ed. 23, which are shown in the Table No. 1

Table 1 Subject-wise distribution of Ph. D. Theses

Sr. No.	Sub Subjects	No. of Theses
	Physics - sections (318 theses)	
1	Physics	87
2	Classical Mechanics	26
3	Fluid Mechanics	5
4	Pneumatics (Gas mechanics)	6
5	Sound and Related Vibrations	7
6	Light and Related Radiations	52
7	Heat	15
8	Electricity and Electronics	80
9	Magnetism	14
10	Modern physics	26
	Interdisciplinary – subjects (199 theses)	
11	Astronomy and Allied Sciences	28
12	Chemistry and Allied Sciences	24
13	Earth Sciences	115
14	Biophysics	16
15	Engineering and Allied Operations	16
	Total	517

From the above table the sub-subject wise distribution of 517 Ph. D. theses (core physics) is given as Physics, Classical Mechanics, Fluid Mechanics, Pneumatics (Gas Mechanics), Sound and related Vibrations, Light and related Radiation, Heat, Electricity and Electronics, Magnetism, Modern Physics is having 10 sections of the having 318 theses and Astronomy and allied sciences, Chemistry and allied Sciences, Earth Sciences, Biophysics, Engineering and allied Operations are the subjects where the interdisciplinary research is done and 199 theses were submitted.

5.2. Ranking of Research work According to Sub-Subjects

Ranking of Sub-subjects according to the number of theses shown in Table No. 2

Table 2 Ranking of Sub-Subject wise distribution of Ph. D. Theses and rank

Sr. No.	Sub Subjects	No. of Theses	Rank
1	Earth Sciences	115	1
2	Physics	87	2
3	Electricity and Electronics	80	3
4	Light and Related Radiations	52	4
5	Astronomy and Allied Sciences	28	5
6	Classical Mechanics	26	6
7	Modern physics	26	6
8	Chemistry and Allied Sciences	24	7
9	Biophysics	16	8
10	Engineering and Allied Operations	16	8
11	Heat	15	9
12	Magnetism	14	10
13	Sound and Related Vibrations	7	11
14	Pneumatics (Gas mechanics)	6	12
15	Fluid Mechanics	5	13
Total		517	----

From Table-2 It is observed that the sub subject Earth sciences has the highest number of theses (115) having 1st rank. Fluid Mechanics has the lowest number of theses (5) and it is at 13th rank. The section of physics subjects Classical Mechanics and Modern Physics has the same number of theses (26) at the position of 6th rank. Biophysics and Engineering and Allied Operations both subjects are on 8th rank having theses (16).

5.3. Sub-Subject Wise Weightage of Research work

Weightage of research work (Ph.D. theses) according to subsubjects shown in Table No. 3

Table 3 SubSubject-wise distribution of Theses and percentage

Sr. No.	Sub Subjects	No. of Theses	%
	Physics - section (61.5%)		
1	Physics	87	16.83
2	Classical Mechanics	26	5.03
3	Fluid Mechanics	5	0.97
4	Pneumatics (Gas mechanics)	6	1.16
5	Sound and related Vibrations	7	1.35
6	Light and related Radiation	52	10.06
7	Heat	15	2.9
8	Electricity and Electronics	80	15.48
9	Magnetism	14	2.71
10	Modern Physics	26	5.03
	Interdisciplinary – subjects(38.5%)		
11	Astronomy and Allied Sciences	28	5.42
12	Chemistry and Allied Sciences	24	4.64
13	Earth Sciences	115	22.24
14	Biophysics	16	3.09
15	Engineering and Allied Operations	16	3.09
Total		517	100

Table-3 gives the sub-subject wise number of theses and their percentages. Earth Sciences ranked number one having (22.24 %) of total number of theses. The sub subject Fluid Mechanics have only (0.97%) of total number of theses which is the lowest in all the 15 sub-subjects. The sub-subject Classical Mechanics and Modern Physics are at the position of rank No. 6 having (5.03%) theses and Biophysics and Engineering and Allied Operations both subjects are on 8th rank having (3.09%). In core subject physics (61.5%) Ph.D. these were submitted while in interdisciplinary subject (38.5%) theses were submitted

5.4. Sub-Subject Wise Citations used by Ph.D. Students

Sub subjectwise citations appended in 517 theses and its percentage shown in the Table No. 4

Table 4 Sub Subject-wise Citations and percentage

Sr. No.	Sub Subjects	No. of Theses	Citations	%
	Physics - subdivision(57737citations (60%))			
1	Physics	87	17503	18.19
2	Classical Mechanics	26	4961	5.16
3	Fluid Mechanics	5	599	0.62
4	Pneumatics (Gas Mechanics)	6	1442	1.50
5	Sound and Related Vibrations	7	579	0.60
6	Light and Related Radiation	52	7949	8.26
7	Heat	15	2938	3.05
8	Electricity and Electronics	80	14420	14.98
9	Magnetism	14	2988	3.10
10	Modern Physics	26	4358	4.53
	Interdisciplinary–subjects(38499 citations (40%))			
11	Astronomy and Allied Sciences	28	4149	4.31
12	Chemistry and Allied Sciences	24	8026	8.34
13	Earth Sciences	115	17861	18.56
14	Biophysics	16	3758	3.91
15	Engineering and Allied Operations	16	4705	4.89
	Total	517	96236	100

Table -4 analyses the citations and its percentage in the 15 sub subjects. Average citation has been observed to be 186.14. Highest percentage of citations has been noted in Earth Sciences 17861 (18.56%). Lowest percentage of citation has been noted in Sound and Related Vibrations 579 (0.60%). Citations in the core subject physics i.e. physics and its sections are 57737 (60.00%) and citations in interdisciplinary subjects are 38499 (40.00%). Total 96,236 references are used to complete these 517 Ph.D. theses.

6. FINDINGS

The researchers have studied total 517 Ph.D. research work/Ph.D. theses which were submitted at the Department of Physics, Savitribai Phule Pune University, Pune during 1953-2013. It is observed that under core physics there are 318 theses and in Interdisciplinary subjects like Astronomy and Allied Sciences, Chemistry and Allied Sciences, Earth Sciences, Biophysics, Engineering and Allied Operations there are 199 theses.

It is observed that Earth Sciences ranked number one having total 115 (22.24%) theses while Fluid Mechanics have only 5 (0.97%) theses which is the lowest in all the 15 sub-

subjects. With respect to citations, it is found that there are total 96236 citations, which were appended in 517 theses with an average of 186.14 citations per thesis.

One of the remarkable findings is that Earth Sciences ranked number one having 17861(18.56%) citations and Sound and related vibrations having lowest 579 (0.60%). This clearly indicates that there is more scope to undertake research in Sound and related vibrations. Another observation is that Classical Mechanics and Modern Physics have the same number of theses (26) at the position of 6th rank. Biophysics and Engineering and Allied Operations both subjects are on 8th rank having theses (16)

With respect to citation analysis it is found that total 96,236 references are used in 517 Ph.D. theses. Citations in the core subject physics i.e. physics and its sub-sections are 57737 (60.00%) and citations in Interdisciplinary subjects are 38499 (40.00%).

The highest percentage of citations has been noted in Earth Sciences 17861 (18.56%) while lowest percentage of citation has been observed in Sound and Related Vibrations i.e. 579 citations (0.60%).

7. CONCLUSION

The present paper shows that in the Department of Physics, Savitribai Phule Pune University about 517 theses has submitted during 1953 to 2013. It is observed that there is a need for undertaking more research work in the subject like Fluid Mechanics. It is further suggested that more funds should be made available for such weak areas and for the improvement of highly specialized areas like Astronomy and allied Sciences, Modern Physics, Engineering and Allied Operations more funds are necessary. This study is very useful for researchers in selection of topic for their research and also for librarian to select reading material for current and specialized areas of the physics and develop library collection accordingly.

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