



DOCTORAL PROGRAMS IN COMPUTING AND ALLIED SUBJECTS IN INDIA WITH REFERENCE TO PRIVATE UNIVERSITIES: A GROWING TREND

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Abstract

The education and training programs are changing rapidly internationally. In recent past, most of the reputed and emerging universities in the world moving not only to offer the degrees with knowledge but also 'skills'. Hence today universities are moving to bundle knowledge and training. Previously bachelors degrees and masters degrees were treated as a capsule of in depth knowledge and training programs as a separate one for skilled manpower. But the trend for the inclusion of skill in the traditional bachelors and masters programs become important day by day. India is moving towards a developing nation powered by emerging economies, technological societies, and digital economy. Thus universities and HEIs are increasing rapidly and importantly higher degrees especially doctoral degrees leading to PhDs also been offered higher and started in different types of universities. Private universities are offering a good number of PhDs in the nation and the quality of some of the universities no doubt comparable to the funded universities and even few have increased their standards more than that. The field of Information Sciences i.e. Computing related domains have different nature than others as it is available in different nomenclatures. The present study is analytical one with agenda of exploring Doctoral programs in the entire field of IT and Computing in private universities. The study shows the growing trend, state wise distribution, and future potentialities.

Keywords: Doctoral Degrees, PhDs, Research & Development, R&D, India, HEIs, Private Universities, IT, PhD in IT, Information Sciences.

Introduction

Information and Computing world is changing rapidly due to the development of science and technology as well as the promotion of interdisciplinary knowledge [4], [6], [8]. The field of Computing and Information initially started with the subject and nomenclature 'Computer Science' and gradually many other subjects have been added into the field viz. Computer Engineering, Computer Science and the applied demand of information professionals and information management led the development of few other nomenclatures such as Information Technology, Information and Communication Technology, Informatics, Information Management, Information Science. Country to country the availability of these subjects and nomenclature basically varies. As far as India is concerned, the common programs and degrees vary from the international market [1], [5], [7]. In

India, the common nomenclatures in Computing segment are Computer Science, Computer Engineering available as a merged domain as Computer Science and Engineering, Computer Application whereas in Information segment among the wide variety of subjects only Information Technology are widely available [2], [3],[8]. And in India, the Computing and Information Sciences branches mention above available as Bachelors, Masters, and Doctoral Degrees. The branches moreover available in two track Science (in which degrees are offered as BSc/MSc instead of internationally known BS/MS) and Technology and Engineering track (i.e. offered as BE/BTech/ME/MTech). Though the branch of Computer Application not available in Technology track and rarely available within Science track i.e., BSc/MSc-CA. Hence in terms of Doctoral Degrees, the branch is available in two track first one is PhD (Science) and another on PhD (Technology/ Engineering). Naturally, PhD in Computer Science or Information Technology may have Science track or Engineering track. Private Universities have different opinion and norms in this regard.

Objective and Agenda

The present work is conceptual in nature and deals with various aim and agenda which includes but not limited to the following—

- To learn about the Information Sciences and Computing field at large including their basic nature and characteristics.
- To know about the changing nature of Information Sciences and Computing field including degrees available internationally and in India.
- To dig out the Doctoral degrees and it's basic in the Indian context with a slant to the international market.
- To learn about the Higher Educational Institutes (HEIs) in India with reference to the private universities.
- To learn about the PhD degrees in Information Sciences and Computing field available in India.
- To dig out and mapped the PhD degrees offered in Information Sciences and Computing field in Indian private universities.

Methods and Limitation

The present study entitled 'Doctoral Programs in Computing and allied programs in India with Reference to Private Universities: *A Growing Trends*' is conceptual and techno-educational in nature and thus mixed mode methods have been adopted for conducting the work and to reach the hypothesis. Initially, to learn about the basics of education systems, Indian education, basics of Computing and Information Sciences domains review of literature have been undertaken. In second stage web reviews have been conducted in the context of gather newer knowledge and trends of the specified areas conducted in general review with the help of secondary sources. Moreover, the present work is designed with emphasis on private universities; and in this regard, several official educational websites were analyzed and reported in this work. Among the core URL used UGC link considered as main link to reach the private universities. It is important to note that the PhD degree offered in Computing and Information Sciences in private universities mapped and reported in this work only for those who have listed their programs in the School or Department of Computing and Information Sciences related fields. Or such universities have mentioned a PhD bar on the website and their directly Computing and Information Sciences fields are offered mentioned. Hence the present work only biased with the information provided on the website. Those universities are offered PhDs but not have mentioned the field in their website have not been participated in the study and not included and analyzed.

Doctoral Degrees: Basics

Doctoral Degrees are the highest degrees normally considered internationally with the nomenclature PhD (Doctor of Philosophy). The PhD degrees normally offered after Masters Degree while few universities in India as well as internationally accept candidates with the Bachelors Degrees (mainly four year graduate or post 10+2 education). The duration varies country to country, but normally it is a three year to six year program. The program comes in two fashion first with Research Work only and second one Coursework and Research Work combined [5], [7], [10]. In India PhD degree is comes with combined coursework and research work since 2009. Normally at-least six months coursework and then minimum two and half years research work. Hence in Information Technology and Computing field as well this model is common. Though there was a special thesis submission clause in many universities for the significant research already carried by the candidates.

Information and Computing Field

Computing and Information field is changing rapidly and during this last few years, several new fields and domains have been developed and used in respective places. The field, for example, *Computer Science* is oldest one and mainly deals with the internal and core areas of computer systems and thus highly mathematical. It is about the study, evaluate and designing of the Computer; however, the field with a due concentration of designing and development with a strong focus on Software Technologies and Development is also called *Computer Engineering*. However, the applications and integration of Computer with special reference to the Software Systems and Development is also called as *Computing/ Computer Systems*; however, in India (till now) another nomenclature has been originated i.e. *Computer Applications* with the programs with tag BCA/MCA.

In Information segment, there are many subjects and fields have been generated due to the importance of information affairs and its applications in different sectors or areas. Among these, *Information Technology* is most popular which is deals with several technologies (apart from management concern) Networking Technologies, Database Technology, Web Technology, Communication Technology in addition to the Software Technology that deals Computing and allied domains [5], [9], [11], [12]. *Information Systems* is similar to the Information Technology with due focus on application in the industries and organizations and IT Management. The field *Information and Communication Technology* also very much related with the Information Technology but it has a due focus on Communication Technology; mainly its application. Information Science is also an extension of Information Technology with additional knowledge dealings of Social Sciences, Managerial Sciences etc [4], [13], [14]. It is also closely related with the Information Studies and Information Management. Hence Information Science is the broadest domain and thus it has also gained a reputation as 'Information Sciences'.

The advancement of technologies and sciences especially interdisciplinary sciences lead several newer merged domains viz.

- Information Systems and Technology,
- Information Systems and Management,
- Information Science and Technology,
- Computer and Information Science etc.

Indian Private Universities

Indian Higher Education is combined with the different type of educational institutes such as College, Universities, Research Centers etc. Universities in India are composed with a different type of universities viz.

- State Universities,
- Central University,
- Private University and

- Deemed University.

Though apart from these, India holds another different kind of institutions called ‘Institution of National Importance’. As far as Private Universities, India holds 279 Universities (as on October, 2017) as per the study with the highest number of universities with Rajasthan (46) and second and third position of Gujarat (30) and Uttar Pradesh (29) respectively. The table: 2 depicted the distribution of private universities in this regard [5], [7], [15].

The private universities offer different kind of programs and degrees, same as other universities with due credit and preferences on Engineering Education and Professional Education. It is also important and valuable for introducing industry-integrated learning and education systems in the Nation [8], [16], [17].

Table: 1-Distribution of Indian Private Universities (as on October, 2017)

Serial No.	States	No. of Universities
1	Arunachal Pradesh	7
2	Assam	5
3	Bihar	2
4	Chhattisgarh	9
5	Gujarat	30
6	Haryana	20
7	Himachal Pradesh	17
8	Jharkhand	7
9	Karnataka	14
10	Meghalaya	8
11	Mizoram	1
12	Madhya Pradesh	24
13	Maharashtra	9
14	Manipur	1
15	Nagaland	3
16	Odisha	4
17	Punjab	15
18	Rajasthan	46
19	Sikkim	5
20	Tripura	1
21	Uttar Pradesh	29
22	Uttarakhand	13
23	West Bengal	9
Grand Total		279

IT and Computing in Indian Private Universities: A Snapshot

Information and Computing field is one of the largest it has been already studied and reported herewith. Additionally, there are different nomenclatures within this, but as far as PhD degree is concerned it is available only Regular/Face to Face mode of study with following nomenclatures—

- PhD-Computer Science (Science)
- PhD-Computer Science/ Computer Science and Engineering (Engineering/Technology)
- PhD-Information Technology (Science)
- PhD-Information Technology (Engineering/Technology)
- PhD-Computer Applications (Science)

The study noted these are the core and available domains within Information and Computing field in Indian Private Universities (and also in other universities in India), The study (as per the methodology only for those who have listed their programs in the School or Department of Computing and Information Sciences related fields. Or such universities have mentioned a PhD bar on the website and their directly Computing and Information Sciences fields are offered mentioned). According to the study among the 279 private universities total 75 universities offered the programs. All the universities with degrees offered listed in Table: 2. However, the universities not mentioned directly the subject names but mentioned the PhD within the concerned schools/ department regarding the availability of PhD programs have listed as 'IT and Computing' field only rather a subject name.

Table: 2-Distribution of PhDs in IT and Computing field in Indian Private Universities (as per the method adopted)

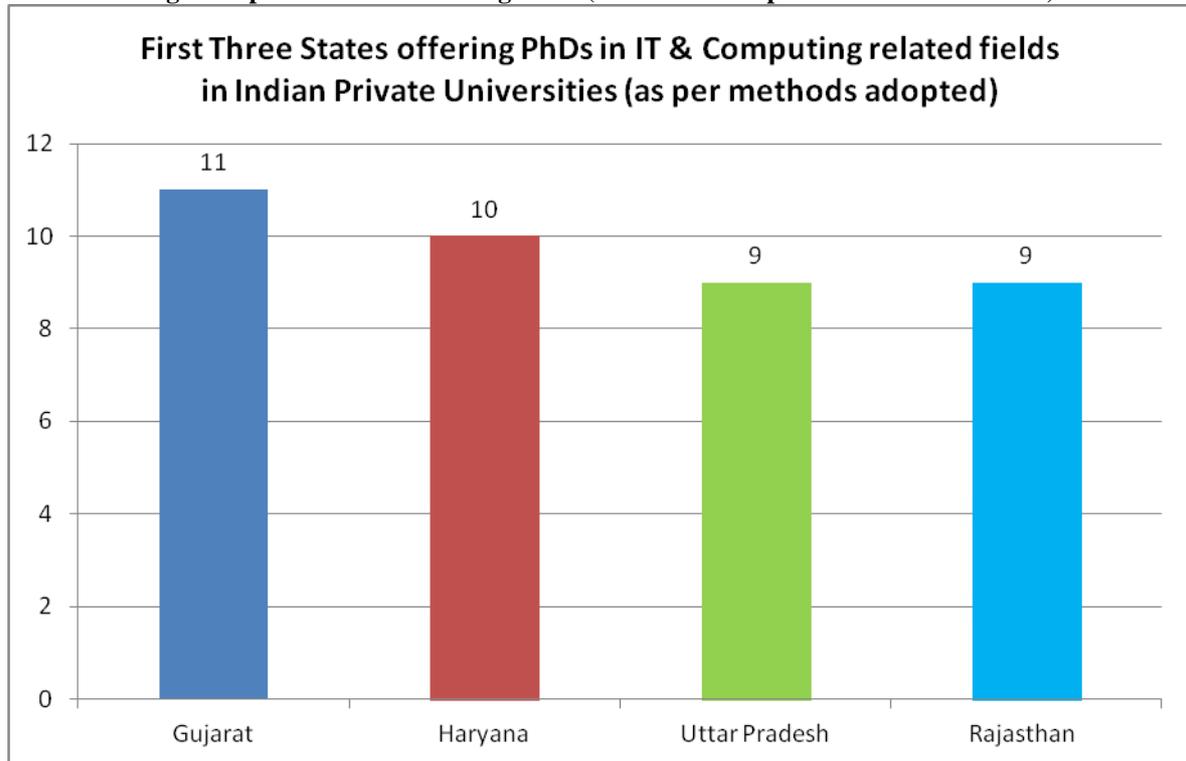
Sl. No.	Private Universities with PhD in IT & Computing related areas	
	Universities	Programs &
Arunachal Pradesh		
1	Arunachal University of Studies	PhD (IT & Computing Field)
2	Himalayan University	PhD (IT & Computing Field)
3	North East Frontier Technical University	PhD (IT & Computing Field)
Assam		
4	Assam Don Bosco University	PhD-CSE
5	The Assam Royal Global University	PhD-CSE/ IT
Bihar		
6	K.K. University	PhD (IT & Computing Field)
Chhattisgarh		
7	Amity University	PhD (IT & Computing Field)
8	Dr. C.V. Raman University	PhD (IT & Computing Field)
9	MATS University	PhD (IT & Computing Field)
Gujarat		
10	Charotar University of Science & Technology	PhD (IT & Computing Field)
11	Calorx Teacher's University	PhD-CS/ IT
12	Dhirubhai Ambani Institute of Information and Communication Technology	PhD-ICT
13	G.L.S. University	PhD-CS/IT
14	Kadi Sarva Vishwavidyalaya	PhD-CS
15	Marwadi University	PhD-CSE
16	Nirma University	PhD-CSE
17	Pandit Deendayal Petroleum University	PhD-CSE/ ICT
18	Parul University	PhD-CS
19	R.K. University	PhD-CS/ IT
20	UKA Tarsadia University	PhD-CSE/ CS
Haryana		

21	Al-Falah University	PhD-CSE/CS
22	Amity University	PhD-CSE/IT
23	Apeejay Stya University	PhD-CSE
24	Baba Mast Nath University	PhD-CSE
25	BML Munjal University	PhD-CIS
26	Jagan Nath University	PhD-CSE
27	K.R. Mangalam University	PhD-CSE
28	Manav Rachna University	PhD-CSE
29	M.V.N. University	PhD-CSE
30	NIILM University	PhD-CS
31	Shree Guru Gobind Singh Tricentenary University	PhD-CSE
Himachal Pradesh		
32	Baddi University of Emerging Sciences & Technology	PhD-CSE
33	Chitkara University	PhD-CSE
34	Jaypee University of Information Technology	PhD-CSE
35	Shoolini University of Biotechnology and Management Sciences	PhD-CSE
36	Usha Martin University	PhD-IT
Jharkhand		
Karnataka		
37	PES University	PhD-CSE/ CA/
38	KLE Technological University	PhD-Engineering Education
39	Srinivas University	PhD-Computer Science & Applications
Meghalaya		
40	University of Science & Technology	PhD-CSE
	William Carey University	PhD-IT
Mizoram		
Absent		
Maharashtra		
Absent		
Madhya Pradesh		
41	A.K.S. University	PhD-CA
42	People's University	PhD-CSE
43	Shri Vaishnav Vidyapeeth Vishwavidyalaya	PhD-CA/CS/CSE
44	ITM University	PhD-CSE

45	Dr. APJ Abdul Kalam University	PhD (IT & Computing Field)
Maharashtra		
46	Amity University	PhD-IT
Manipur		
Absent		
Nagaland		
47	St. Joseph University	PhD-CS/CA
Odisha		
Absent		
Punjab		
48	C.T University	PhD-CSE
49	GNA University	PhD-CS
50	Guru Kashi University	PhD-CA/CSE
51	Lovely Professional University	PhD-CA
Rajasthan		
52	Bhagwant University	PhD-CS
53	J.E.C.R.C. University	PhD-CSE
54	Jayoti Vidyapeeth Women's University	PhD-CSE
55	Maharishi Arvind University	PhD-CS/CA
56	NIIT University	PhD-CS/ Education Technologies/ GIS
57	OPJS University	PhD-IT/CSE/CA
58	Singhania University	PhD-IT
59	Sunrise University	PhD-CS
60	University of Engineering & Management	PhD-CSE
Sikkim		
61	SRM University	PhD
62	Sikkim Manipal University	PhD-CA/IT/CSE
63	Vinayaka Missions Sikkim University	PhD-CA
Tripura		
Absent		
Uttar Pradesh		
64	Amity University	PhD-CSE
65	Galgotias University	PhD-CSE/ CA
66	IIMT University	PhD-CSE/CS
67	Mangalayatan University	PhD-CSE/ CA
68	Sanskriti University	PhD-CSE
69	Shiv Nadar University	PhD-CSE
70	Shobhit University	PhD-CS
71	Shri Ramswaroop Memorial University	PhD-CSE/CA
72	Teerthanker Mahaveer University	PhD (IT & Computing Field)
Uttarkhand		
73	DIT University	PhD-CSE
West Bengal		
74	Adamas University	PhD-CSE
75	Techno India University	PhD-CSE

It is further studies and noted that among the states Gujarat hold first position with highest number of universities offering PhDs are Gujarat (11) whereas Haryana hold second position (10) universities. However Uttar Pradesh and Rajasthan jointly hold third position with nine (9) universities offering PhDs in the field (Refer Fig: 1).

Fig: 1-Top Three States offering PhDs (in Numbers as per the selected methods)



It is important and worthy to mention that the study shows that in some of the universities as like Masters program multiple PhDs are offered in different nomenclatures. And a majority of these universities are offered programs in the field of Computer nomenclatures i.e. either Computer Science or Computer Engineering (including CSE) or Computer Applications. Moreover, in few universities, three programs are also offered viz.

- NIIT University
- Shri Vaishnav Vidyapeeth Vishwavidyalaya, Madhya Pradesh
- OPJS University etc.

It is also noted as part of the study that few universities allows PhD (Engineering) in the IT and Computing not only Masters in Technology or Engineering but also from the Science background Masters (i.e. MSc in related field), including MCA Program. It is worthy to note that a maximum number of universities offers MCA program and there after PhD in Computer Science rather Computer Science. The Table: 3 depicted the list of universities with multiple PhD programs in IT and Computing areas.

Table: 3-Indian Private Universities with multiple PhDs in IT and Computing field (as per the method adopted)

Sl. No.	Private Universities in India offering multiple PhDs in IT & Computing related subjects	
	Universities	Programs
1	UKA Tarsadia University	PhD-CS PhD-CSE
2	Amity University, Haryana	PhD-CSE PhD-IT

3	Al-Falah University, Haryana	PhD-CSE PhD-CS
4	PES University, Karnataka	PhD-CSE PhD-CS
5	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Madhya Pradesh	PhD-CA/CS/CSE
6	Guru Kashi University, Punjab	PhD-CA/CSE
7	NIIT University	PhD-CS/ Education Technologies/ GIS
8	G.L.S. University	PhD-CS/IT
9	Calorx Teacher's University	PhD-CS/IT
10	Pandit Deendayal Petroleum University	PhD-CS/ICT
11	OPJS University	PhD-IT/CSE/CA
12	Sikkim Manipal University	PhD-CA/IT/CSE
13	Galgotias University	PhD-CSE/ CA
14	IIMT University	PhD-CSE/CS
15	Mangalayatan University	PhD-CSE/ CA
16	Shri Ramswaroop Memorial University	PhD-CSE/CA

The study reveals that in the field of Computing and IT, most of the universities are offering the research in the areas of core, traditional and mathematical computing viz.

- Compiler Designing
- Automata Theory including Scientific Programming
- Theory of Computation
- Machine Learning/ Deep Learning
- Artificial Intelligence/ Expert Systems
- Software Modeling etc.

Surprisingly in case of international universities, a very small amount of universities have started the emerging specializations or areas which are connected to the educational-social-business-health-governance related issues, application, enhancement, integration etc. Though a limited number of universities have started programs other than CS/CSE/IT and among these few important areas are Information and Communication Technology, Geo Information Systems, Education Technologies etc. Table: 4 in this regard offered detailed information with universities and program names.

Table: 4-Indian Private Universities with PhDs in different areas, other than IT/CSE (as per the method adopted)

Sl. No.	Private Universities in India offering PhDs (other than IT/CS/CSE)	
	Universities	Programs
1	NIIT University	PhD-CS/ Education Technologies/ GIS
2	Pandit Deendayal Petroleum University	PhD-CS/ICT
3	KLE Technological University	PhD-Engineering Education
4	Dhirubhai Ambani Institute of Information and Communication Technology	PhD-ICT

5	BML Munjal University	PhD-CIS
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Findings

- India is the largest educational hub in the world with over 40000 Higher Educational Institutes (HEIs), and among these 800+ are universities and about 300 are Private Universities.
- In IT and Computing various nomenclatures are available internationally and such are offered in two track/ focus *Computing segment* includes Computer Science, Computer Engineering (also available as a merged domain as Computer Science and Engineering), Computing, Computer Systems, Computer Application whereas in *Information segment* are include as Information Technology, Information and Communication Technology, Informatics, Information Management, Information Science.
- Indian Universities mainly offered Computer Science/CSE, Computer Application nomenclature from the Computing track whereas in Information track only Information Technology is the available subject.
- Domain focused Information Science/IT such as Health Information Science/IT, Geo Information Science/IT, Environmental Information Science/IT, Information Systems, Information Sciences etc are not yet started as a PhD program in the Indian Universities.
- It is worthy to note that a large number of universities (75 private universities as per the study and methodology adopted) have started PhD program in IT and Computing field.
- It is a good move by few universities regarding the inclusion of newer subjects and fields in the PhD viz. Education Technologies, Geo Information Systems and even Engineering Science Education.

Suggestion and Future

- Private Universities needs to include more emerging and applied fields apart from the existing in the interdisciplinary areas of Information Technology, Information, and Communication Technology, Informatics, Information Management, Information Science.
- If initially full-fledged PhD in the areas of Health Information Science/IT, Geo Information Science/IT, Environmental Information Science/IT etc are not offered then the same areas may be offered in the existing IT and Computing programs.
- Internationally universities are moving towards industry integrated learning models and in this regard apart from Bachelors and Masters degrees in some of the universities PhDs are also coming with the industry integration. Hence Indian Universities including private may also move into this direction.

Conclusion

Education System is changing rapidly internationally. Private players are doing well in this regard including new age educational models, strategies, new age programs etc. India is a developing nation and enhancing different way. Technology, Information and Education—all three are the prime mover for the societal development. And for these purposes research play a leading role. Research is available in different shape and among these based on award/ degree is important and popular. Initially and till date PhD is treated as a research degree in many countries and with coursework (if there) focused with research affairs; though the concept became changed and now many universities included coursework of Masters in the PhD as well for the skill and knowledge gathering apart from concerned research area/topic. In the area of IT and Computing thus universities may look upon the

industry integrated concepts, skill based models etc for the new age knowledge delivery. India is developing towards knowledge and digital economy and thus private universities need to implement more on technology-society integration thus PhDs etc need to enhance as per international standard as much as possible.

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