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Original Research Article

Faculty-Student Collaboration in Enhancing Research Productivity: A Study

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ABSTRACT

Faculty-Student collaboration in scientific publications and scientific presentations merits special attention in the context of higher education institutions. The study examines the sociology of collaboration, differences in the pattern, if any, between forms of research productivity and between institutional set-ups in the discipline of speech, language and hearing sciences. The study revealed that the students' collaboration with faculty could be found in 56.68 percent of scientific publications and in 59.26 percent of the scientific presentations. Students preferred to collaborate with junior faculty ≤35 years, who were either pursuing doctoral programme or already possessed a doctorate degree. Government institutions had the highest faculty-student collaborations than the private institutions. No difference could be seen either in the extent or in the sociological pattern of faculty-student collaboration between scientific publications and scientific presentations.

Key words: faculty-student collaboration, research productivity, sociology, speech, language and hearing sciences, institutional-setups.

INTRODUCTION

Sociology of science is concerned with how and in what ways social factors influence the process of generating knowledge and the product. Scientific research is a social activity and collaboration is an important part of maturation of science. In recent years, social system perspective of science has gained importance and a new mode of interactive institutional science has emerged (Kamesh, 2010). [1]

Kamesh (2010) [1] has further observed that "in the realm of sociology of scientific knowledge (SSK), collaboration is an aspect of the local construction of knowledge. Such a process is considered endogenous to knowledge production and driven by knowledge interests. The objects of sociological study are the roles of different groups within scientific collaboration (and the consequences of their interaction for knowledge production). These two approaches provide important insights into the nature of collaboration and the relationship between collaboration and social patterns in collaborative settings."

Universities have expanded their role in society from the preparation of the next generation (teaching) to the production of novel knowledge (research). Students' role in universities has also changed, making these students not only the recipients of existing knowledge, but also active participants in knowledge generation. In recent years, students' participation is an essential factor for carrying out academic research in universities and for diffusion of

tacit knowledge in innovation system (Patra and Krishna, 2015). [2]

Collaboration in research has many advantages. First, collaboration is a key mechanism for mentoring graduate students and post doctoral researchers (Bozeman and Corley, 2004). [3] Second, participation in scientific publications and scientific presentations provides a golden opportunity to "socialize" students into the profession (McKinney, Jarvis, Creasey et al, 2010). [4] Third, it enhances students' research skills (Kardash, 2000). [5] Fourth, it establishes positive mentoring relationships (Cox, Mcintosh, Terenzini et al, 2010). [6] Fifth, it provides "extra-classroom" communication / interaction with professors (Ryser, Halseth, Thien, 2007). [7] Finally, it helps students understand the disciplinary nuances of research.

Graduate students have been argued to play the most important role in university research output and having more students in master programs or Ph.D. programs positively correlated with professors' productivity (Berelson, 1960; [8] Hagstrom, 1965; [9] Ryu and Pae, 1997; [10] Salter, D'Este, Pavitt et al 2000; [11] Merlin, 2000 [12]). An interview among 51 scientists carried out by Fonseca, Velloso, Wofchuk, et al (1997) [13] to identify factors that influence their productivity revealed that the majority of respondents felt that students did influence their productivity.

Gemme and Gingras (2008) [14] conducted a survey, albeit on a smaller scale (104 respondents), on the socialization into research of graduate students (at the master's and Ph.D. level) in Quebec. Though their dataset is not large enough to compile meaningful statistics on publication practices of students by field or level of study, their data nonetheless show that slightly more than 80 percent of students had contributed to at least one publication since the beginning of their graduate program. Indeed, 55 percent of students had contributed to at least one conference paper, 43 percent to at least one research report, 41 percent to at least one article and 39 percent to at least one poster. All of these tend to indicate that students do contribute to scientific publications and conference papers and that, in some fields, their contribution is substantial.

However, despite the fact that there is a higher degree of engagement and involvement of students in research productivity in academic settings, this aspect of the contribution of the students to research productivity is underexplored in large part and has not been adequately acknowledged in the existing literature on research productivity (Kwon, Kim, Park, 2015). [15] In India, very little efforts have been made to understand the sociology of research, especially, the contribution of students. It is essential for students to get involved in research, especially, in a multilingual country like India as they form the next generation work force. It is against this background, the present study is attempted. It is first of the kind in the discipline of speech, language and hearing sciences with a focus on socialization into research of students. It is an empirical analysis of the influence of students on research productivity. The research questions posed for the study are as follows:

a) To what extent the students' collaboration with faculty impact the research productivity in scientific publications and scientific presentations at the institutional and individual faculty levels?
b) How the students are distributed *vis a vis* the age, rank and educational qualification of the faculty with whom they collaborated?
c) Is there any difference in the sociological pattern of faculty-student collaboration between scientific publications and scientific presentations?
d) Is there any difference in the faculty-student collaboration between the Government institutions and Private institutions?

METHOD

Sample: The organizational set-up of the institutions offering academic programmes in speech, language and hearing sciences, in India at master's level and above can be classified as: (a) National Institutions funded by the Government, (b) institutions forming part of an University set-up, functioning as a separate department of studies under allied health sciences and (c) private institutions which are colleges affiliated to an University. Two national institutions under the Government set-up and two private institutions under an University set-up, a Private University and a Deemed-University were selected for this study, taking into account, the completeness of data and having regard to a minimum threshold of the number of publications and presentations.

Procedure: The information on scientific publications, scientific presentations and the demographic data were gathered from (i) the institutional website, (ii) the annual reports of the institutions, (iii) mailed questionnaire. While collecting the data, the scientific publications of teaching faculty in the core departments of speech, language and hearing sciences alone were reckoned. The publications by the researchers in the allied departments were excluded, unless in combination or collaboration with a speech and hearing professional. Publications in symposium/conference proceedings were included. Doctoral, postgraduate and undergraduate students who participated in the scientific publications/presentations were reckoned for studying the impact of students on the research productivity at the institution level as well as at the individual faculty level. The data collected covered a period of 5 years (2009-10 to 2013-14). The data set contained 637 scientific publications and 680 scientific presentations.

Age cohort groups: Based on their chronological age, the researchers were classified under seven age intervals as follows: $\leq$30, >30$\leq$35, >35$\leq$40,>40 $\leq$45, >45$\leq$50, >50 $\leq$55 and > 55. The age group of $\leq$ 30 included teaching staff from 23-30 years and the age group of > 55 included teaching staff from 56-63 years.

Rank: Rank represents the designation or academic position of the faculty in terms of job title. The classification was made under the three categories: viz., Assistant Professors, Associate Professors, Professors (including Deans and Directors).

***Educational Qualificatio*n:** The educational qualification of the faculty was considered under three categories: Category 1: Faculty with a doctorate degree; Category 2: Faculty with a master's degree, pursuing a doctoral degree. Category 3: Faculty with only a master's degree.

Institutional set-up: The institutional set-ups taken up for study included: (a) Institutions fully funded by the Government of India and National Institutes involved in human resource development, research, clinical services and public education (herein referred to as Government Institutions and denoted as G1 and G2). (b) Institutions under a University set-up: one of them, a Private University (denoted as U1) and the other, a Deemed University (denoted as U2).

RESULTS

Extent of faculty-student collaboration in scientific publications and presentations: The results indicated that faculty collaborated with students in 361 out of a total of 637 scientific publications (56.68 percent) and in 403 out of a total of 680 in scientific presentations (59.26 percent).The faculty-student collaboration ranged from 31.58 percent in U2 to 72.43 percent in the case of G1 in scientific publications. In the case of scientific presentations, the extent of faculty-student collaboration ranged from 37.28 percent in U2 to 70.21 percent in G1. Table 1 shows the cumulative number of scientific publications and scientific presentations institution-wise and the number of faculty-student collaborations in these activities covering a period of five years (2009 to 2014).

Table 1: Faculty-Student collaboration and institutional productivity

	Scientific Publications (2009 to 2014)					Scientific Presentations (2009 to 2014)				
	G1	G2	U1	U2	Total	G1	G2	U1	U2	Total
No. of publications / presentations	243	162	194	38	637	319	NA	184	177	680
No. of Faculty-Student collaborations	176	91	82	12	361	224	NA	113	66	403
Faculty-Student collaborations in percent	72.43	56.17	42.27	31.58	56.68	70.21	NA	61.41	37.28	59.26

G1: National Institution 1. ; G2: National Institution 2; U1: Private University; U2: Deemed University; NA: Not Available.

To understand the impact of faculty-student collaboration on the research productivity at the individual faculty level, the data pertaining to prolific researchers (having >10 scientific publications/ scientific presentations during the five years of 2009-2014) in relation to the number of student collaborations was investigated. The results indicated that the highest percent of student collaboration occurred with a faculty having 12 publications in G1,11 publications in G2,and 37 publications in U1. The results also showed that the percent of student collaboration occurred with a faculty having 19, 11 and 14 presentations in G1, U1 and U2. Table 2 shows faculty-student collaboration and research productivity of individual faculty.

Table 2: Faculty-Student collaboration and research productivity of individual faculty

Instn. Ref.	Faculty. Ref.	Scientific Publications (2009 to 2014)			Instn. Ref.	Scientific Presentations (2009 to 2014)			
		No. of publications	With student collaboration	percent		Faculty Ref	No. of presentations	With student collaboration	percent
G1	110	12	12	100.00		114	19	18	94.74
	103	14	13	92.86		128	14	13	92.86
	102	11	10	90.91		119	12	11	91.67
	106	20	18	90.00		124	11	10	90.91
	105	13	10	76.92		102	16	14	87.50
	104	29	22	75.86	G1	115	23	19	82.61
	113	15	11	73.33		113	34	24	70.59
	124	11	08	72.73		103	11	7	63.64
	109	14	10	71.43		126	18	11	61.11
	115	18	12	66.67		104	23	14	60.87
G2	511	11	10	90.91	U1	313	11	9	81.82
	517	17	13	76.47		309	20	16	80.00
	515	24	17	70.83		301	56	43	76.79
	507	41	29	70.73		307	14	3	21.43
U1	319	37	18	48.65		308	15	3	20.00
	301	28	5	17.86	U2	205	14	10	71.43
	308	13	1	7.69		212	11	6	54.55
	307	16	1	6.25		209	23	10	43.48
U2	202	11	5	45.45		204	25	10	40.00
						201	31	9	29.03
						202	20	1	5.00
						214	11	0	0.00

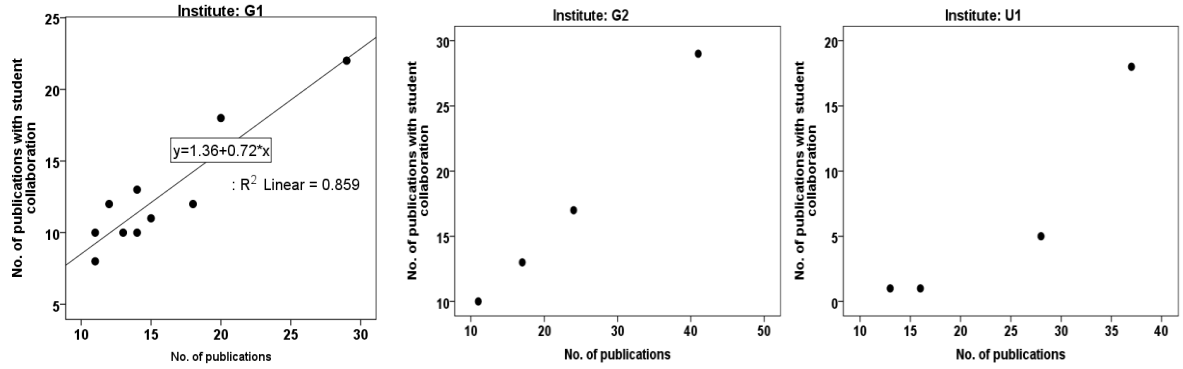

Figure 1: Scatter plots (with regression line) between number of publications and number of publications with student collaborations.

Results of linear regression analysis on publications with student collaboration showed a positive linear trend for G1, which had a good R^2 value (R^2=0.859) and also goodness of fit. Figure 1 shows scatter plots with regression line.

Results of linear regression analysis for presentations with students collaboration indicated a positive linear trend with good R square value (Linear R^2=0.800). Positive trend could be seen in U1 also, but U2 showed comparatively more scattered data, where linear, quadratic or cubic were not good fits. Figure 2 shows scatter plots with regression line for presentations with student collaborations.

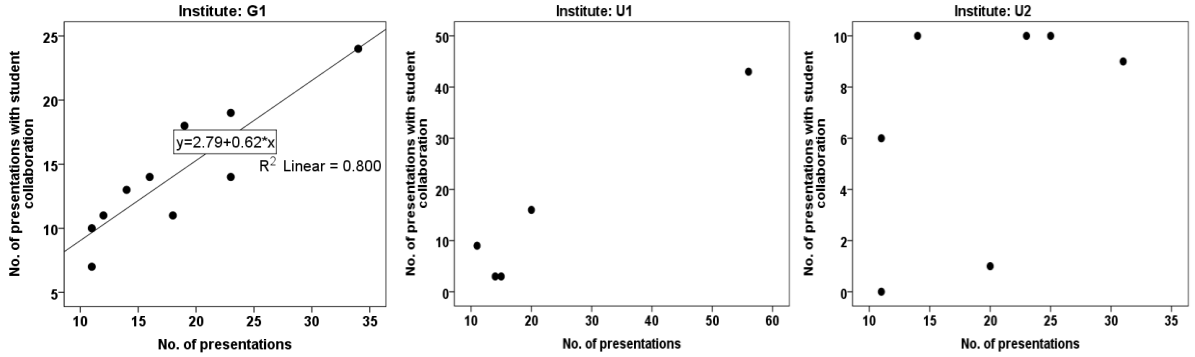

Figure 2: Scatter plots (with regression line) between number of presentations and number of presentations with student collaborations.

Age-wise, Rank-wise, and Educational Qualification-wise Collaboration:

Age: The results indicated that the students, irrespective of the institutional set-up showed a distinct preference towards faculty in the age-group of ≤35 years in both scientific publications and scientific presentations. Among the Government Institutions, in G1, the students had also collaborated higher with faculty in the age range of 50≤ 55 years in both scientific presentations and scientific publications. Table 3 shows the age-wise collaboration.

Table 3: Distribution of faculty with whom the students had collaborated in terms of age

		Publications					Presentations			
		G1	G2	U1	U2	Total	G1	U1	U2	Total
No. of faculty who collaborated with students		59	25	43	10	137	78	38	27	143
Age	<30 years	15	-	23	5	43	24	15	12	51
	30≤ 35	8	8	7	4	27	16	7	10	33
	35≤ 40	10	4	5	-	19	7	8	1	17
	40≤ 45	4	3	1	-	8	6	3	-	9
	45≤ 50	7	6	2	-	15	9	-	-	9
	50≤ 55	14	1	3	1	19	16	1	4	21
	>55	1	3	1	-	5	-	4	-	4

Results of linear regression analysis showed a negative linear trend with low to moderate R square value (0.253 to 0.579) in G1, G2 and U1 for publications with student collaborations. Figure 3 shows scatter plots with regression lines.

Results of linear regression also indicated a negative linear trend for student collaborations on presentations. Linear regression for G1, G2 and U2 showed a decreasing and increasing trend which were fitted through cubic equation. Good R square values were obtained (0.983 to 0-896). Figure 4 shows scatter plots with regression lines.

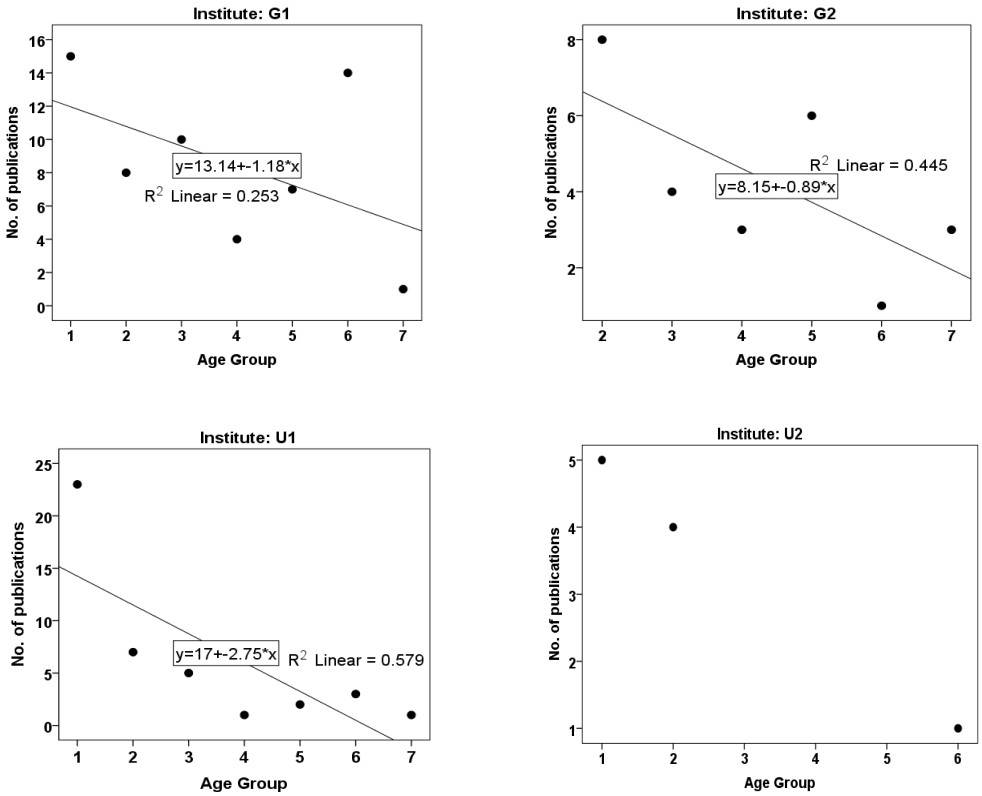

Figure 3: Scatter plots with regression lines for publications with student collaborations

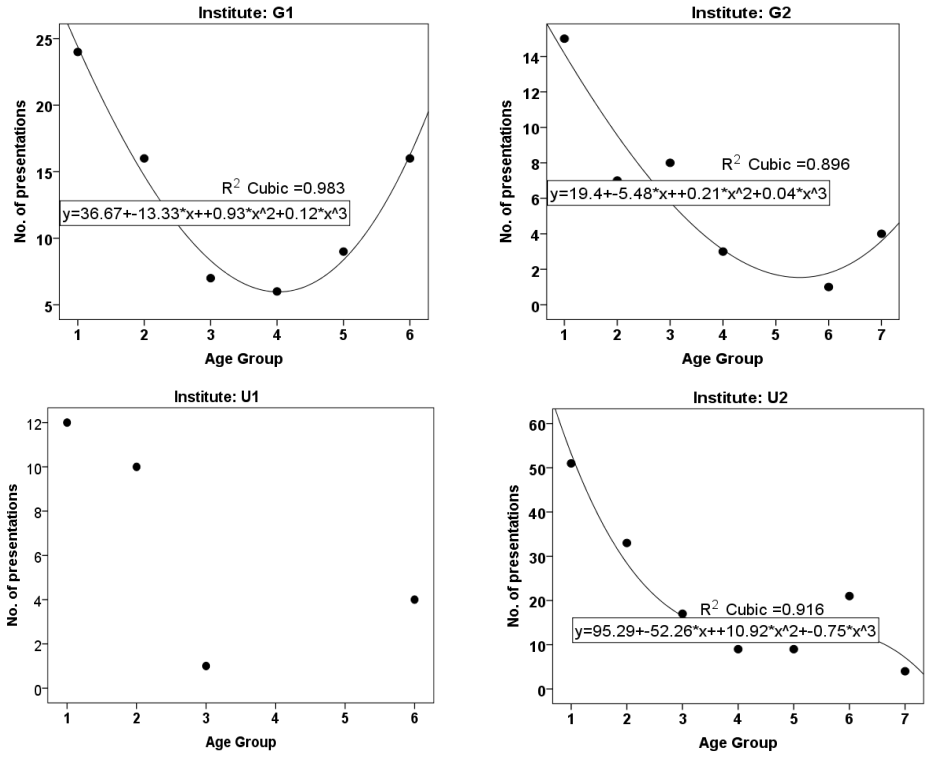

Figure 4 : Scatter plots with regression lines

Rank: Rank 1 (Assistant Professors) emerged as the first choice among students in both scientific publications and scientific presentations. The above trend was witnessed uniformly at the individual institution level as well as for the cumulative figures. Among the Government Institutions, in G1, the second highest

collaboration of students occurred with Rank 3.In U1, the second highest collaboration was with Rank 2 in scientific publications and scientific presentations. In G2, the second highest collaboration in scientific publications was with Rank 2. Table 4 shows rank-wise collaboration.

Table 4: Distribution of faculty with whom the students had collaborated in terms of rank

		Publications					Presentations			
		G1	G2	U1	U2	Total	G1	U1	U2	Total
No. of faculty who collaborated with students		59	25	43	10	137	78	38	27	143
Rank	1	30	15	22	8	75	44	16	22	82
	2	9	8	14	1	32	15	14	1	30
	3	20	2	7	1	30	19	8	4	31

Educational Qualifications: In terms of Educational qualifications, the students had collaborated highest with faculty having a doctorate degree or those pursuing doctoral degree than Master's in both scientific publications and scientific presentations. Table 5 shows the educational qualification-wise faculty-student collaboration.

Table 5: Distribution of faculty with whom the students had collaborated in terms of educational qualification.

		Publications					Presentations			
		G1	G2	U1	U2	Total	G1	U1	U2	Total
No. of faculty who collaborated with students		59	25	43	10	137	78	38	27	143
Qualification	Ph.D.	38	4	12	1	55	46	20	1	67
	Pursuing Ph.D.	20	6	21	3	50	28	10	16	54
	Master's	1	15	10	6	32	4	8	10	22

Pattern of faculty-student collaboration between publications and presentations

The faculty-student collaboration was higher for scientific presentations (59.26 percent) compared to scientific publications (56.68 percent). Table 1 shows the data on collaborative presentations and publications.

Government set-up versus University set-up

The Government Institutions (G1 and G2) had higher number of publications with higher faculty- student collaboration compared to institutions under University set-up (U1 and U2). Within the Government Institutions, G1, and within the University-set-up, U1 produced more number of publications with students compared to other institutions. In the Govt. Institutions, 176 and 91 (72 percent and 56 percent) students were co-authors in scientific publications and in institutions under Universities 82 and 12 (42 percent and 32 percent), students' co-authored scientific publications. Taking a combined data, student co-authoring scientific publications was more in number in Government institutions compared to U1 and U2. While G1 and G2 contributed to 64 percent of publications, U1 and U2 contributed to 36 percent. No data on scientific presentations were available in one of the Govt. Institution. Scientific presentations with students were higher in Govt. Institution compared to U1 and U2. U1 had more number of presentations with students compared to U2. In G1, 224 students (70 percent) presented scientific articles in seminars and conferences and in U1, U2, 113 and 66 (61 percent and 37 percent) students presented scientific articles. More number of students from G1 presented scientific articles compared to U1 and U2.

DISCUSSION

The results indicated several points of interest. First of all, the faculty-student collaboration was between 57-59 percent. in speech, language and hearing sciences is quite promising and correlates with the 63 percent of students involvement reported for health discipline in scientific publications by Lariviere, Macaluso, Archambault

(2012) [16] and 55 percent of students contribution to at least one conference paper reported by Gemme and Gingras (2008). [14] The trend affirms the argument that students play the most important role in research output of higher education institutions (Salter, D'Este, Pavitt, et al, 2000; [11] Fonseca, Velloso, Wofchuk et al, 1997 [13]).

Another reason for the encouraging trend in faculty-student collaboration in the discipline could be attributed to the course requirements of the master's and doctoral programme which insists on completion of a dissertation project at master's level and publication of scientific articles in peer reviewed journals at doctoral level. Further, the role of the faculty seems to have changed from a "sage on the stage" to that of a "guide by side" in higher education. Student-centric approach has caught up in higher education and teachers role is defined to be a facilitator with a responsibility to create an enabling environment for better learning, with a view to empower the student to develop higher order cognitive skills involving analysis, synthesis, evaluation and creation of knowledge (Ramesh, 2016). [17]

The higher percentage of faculty-student collaboration in scientific publications and in scientific presentations in G1 can be attributed to higher student intake at master's level and the offering of specialized programmes at master's and doctoral level in G1. Further, G1 also has fellowships for students enrolled for full-time doctoral programme. The results confirm that collaboration enhances the productivity of individual scientists (Merlin, 2000;[12] Berelson, 1960; [8] Hagstrom, 1965 [9]). The results also confirm the proposition put forth by Ryu and Pae, (1997), [10] that having more students in master programs or Ph.D. programs, both positively correlate with professors' productivity gets to be seen, going by the research productivity of prolific researchers. (See Table 2). The trend observed also sheds light on the research training made available to the students and the positive mentoring relationships that exists in this discipline.

Secondly, higher faculty-student collaboration was observed with faculty below the age of 35 and with faculty at the level of Assistant Professors with Ph.D. This could be attributed to the desire for contribution to science and recognition in the scientific community by young faculty with fresh ideas and increased potential for creativity. (Falagas, 2008). [18] It also supports the fact that the best work is done at a comparatively young age" (Zuckerman and Merton, 1973) [19] and this is further reinforced by the fact that the numerical and reasoning abilities of individuals are at their best in their 20s and early 30s (Skirbekk, 2003). [20] Such a phenomenon also finds support from Kyvik and Aksnes (2015), [21] wherein, partial explanations for increase in publication productivity from a generational perspective is attributed to better qualified new generations of academic staff and the tendency for higher research collaboration among the younger faculty.

Thirdly, the collaboration was higher for scientific presentation compared to scientific publications. This is perhaps due to the fact that the opportunities and acceptance rates for scientific presentations are relatively higher than that for scientific publications.

Finally, Government institutions had higher number of publications compared to private institutions. This is perhaps due to (a) greater infrastructure in terms of large size of faculty, equipments, labs, higher student intake and varied and rich clinical population (b) higher number of doctorates in G1.

CONCLUSION

A number of studies have been conducted on the determinants of research productivity. However, the impact of faculty-student collaborations on research productivity is a less explored area. The present study makes a modest attempt to understand the dimension of faculty-student collaboration in enhancing research

productivity, both at the institutional as well as at the individual faculty levels. The problem of availability of a reliable data for large samples and for conducting a cross sectional/ longitudinal study persists and is a serious limitation, especially when conducting such studies on productivity. This methodological issue in getting complete information on the scientific publications and scientific presentations has to be addressed. India needs to move towards having a reliable and updated database, discipline-wise and institution-wise so that one can attempt a large scale study in the future. The results of this study help to unearth the dynamics and sociological patterns in institutional contexts, involving two important players viz., the faculty and students in higher education institutions and can also serve as useful pointers to adopt appropriate strategies, policy initiatives for enhancing research productivity.

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