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Authorship Patterns in Engineering Education

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***Abstract* - This paper examines patterns of authorship in Engineering Education literature from 2000 to 2008. The International Journal of Engineering Education was used as the database for the study. The result shows that collaboration activities dominated the literature (73%). The highest collaboration co-efficient was found to be (0.81). The aspect of International collaboration was emphasized and 64 countries were found to have participated. Proportion of male (81.1%) and female authors (18.1%) was determined, and gender composition of research groups was also outlined. Looking at the number of International collaboration participants, one could advocate that research activity serve as a connecting strand among scientists across nations and continents.**
Keywords: Authorship patterns, engineering education; literature; Bibliometrics.

I.INTRODUCTION

Authorship in scientific research entails contribution of a single person or multiple persons towards production or perfection of a work that is worthy of publishing or sharing among scientists. Smith and Williams-Jones (2011) said that, "Some contributions to research may be intellectual, such as the creation or design of the project, while others will be more technical such as the creation of a new reagent or software; both types of contribution may be legitimately important and so warrant authorship." Knowledge sharing among scientists is important and fundamental to the development, growth and acceptance of any form of scientific research. Dehaan (1997) opined that, "Scientists need each other to develop ideas, to discuss their research, to divide the burden of routine work and so on. Some scientists have a strong influence on the work of others." In this digital age scientists globally could be considered an entity whenever information, knowledge and research findings are shared among themselves. Persson et al (1997) hold the view that, "The communication of research findings is therefore fundamental to any scientific endeavor and scientists are constantly engaged in the mutual exchange of information and knowledge."

Co-operation among scientists in communicating useful information concerning research findings enhances collaboration among them and greatly assist in solving complex scientific issues. Sonnenwald (2007) expressed similar view, that, "Scientific collaboration is increasing in frequency and importance. It has the potentials to solve complex scientific problems and promote various political, economic and social agendas, such as democracy, sustainable development and cultural understanding and integration. Bibliometrics studies over the past two decades have shown a continues increase in the number of co-authored papers in every scientific discipline, as well as within and across countries and geographic areas."

Furthermore, Cho, Hu and Liu (2010) said that, " Advancements in science and technology are no longer confined to the scientific advancements of individual nations and indeed, the focus in many journals is now on collaboration and co-authorship both of which are currently on an upward trend. Collaboration or joint research gives an opportunity for the exchange of tacit knowledge among scientists and scholars." Similarly, Rey-Rocha, Mertin-Sempere and Garzon (2002) hold the view that, "It can be assured that teamwork, collaboration and interdisciplinarity are some of the principal characteristics of modern science. Team stability and cohesiveness are factors that play a key role in determining research patterns, productivity and successful performance of scientists." Cunningham and Dillon (1997) reiterated further that," Traditionally collaboration occurs through face to face meetings, telephone, postal correspondence, it is likely that, e-mail and other internet based communication modes also see significant use, given the naturally high degree of computer literacy in the field."

This paper examines patterns of authorship in engineering education literature. The International journal of Engineering Education, serves as a bridge that connects two disciplines, engineering and education. It is assumed that, all the articles found in this journal will fall within the two disciplines. Three aspects of authorship were considered for this study, they are, (a) The extent of collaborative authorship, (b) International collaboration and (c) Gender patterns of authors

Single Journal Study

The idea behind single journal study, using bibliometrics methods, is to x-ray the journal and bring out the hidden information that could be useful to scientists, information workers and general users of the particular journal. Multiple journals study may not necessarily give the details about a journal's performance. The current trends in bibliometrics research support single journal study. Anyi, et al (2009) opined that, "When a single journal is studied

bibliometrically, it creates a portrait of the journal, providing a description that offers an insight that is beyond the superficial. It can indicate the quality, maturity and productivity of the journal in any field, in a country or region. It also informs us about the research orientation that it supports to disseminate and its influence on author's choice as a channel to communicate or retrieve information for their research needs." The in-depth study, knowledge, information and understandings on a journal output could be reached quantitatively when bibliometrics methods are applied. Anyi et al (2009) conclude by outlining the in-depth knowledge that can be exhibited from single journals whenever bibliometrics methods are applied. They are as follows: - "Article productivity, author characteristics, authors' productivity, co-authorship patterns, content analysis, citation analysis and characteristics of the editorial board."

Many studies on single journals can be found focusing on different disciplines and subject areas. Goldenberg (2006) based his study on the journal of music theory, Kaur (2006) studied the Malaysian law journal, Rao and Bhusan (2008) compared journal of the American society for information science and technology (JASIST) with Scientometrics. Hussain and Fatima (2010) analyzed Chinese librarianship: an international electronic journal bibliometrically and found that, "The majority of articles were contributed by single authors. And most authors were librarians, faculty members or researchers affiliated with academic or research institutions." Similarly Thanuskodi (2011) studied Library Herald Journal and draw conclusion that, "Researchers preferred journal articles more frequently for their research, than any other type of communication channels." Warraich and Ahmad (2011) analyzed Pakistan journal of Library and Information Science and found that, "Authors from the University of Punjab contributed maximum papers followed by the university of Karachi,"

In another study conducted by Thanuskodi (2010) on journal of social sciences, concludes that, "The highest number of articles has appeared in the area of economics. Most of the contributions are from foreign 78.39% while Indian contribution is less." In addition to this Crawley-Low (2006) conducted a study on American journal of Veterinary research and found that, "The majority of items cited were journals 88.8%. A core collection of veterinary medicine journals from zone 1 and zone 2." Rethlefsen and Wallis (2007) used American journal of Public health in their bibliometrics studies and drew conclusion that, "Knowing which titles are the most critical, can help decision making in smaller libraries or help librarians develop collections for public health professionals and the zone 1 title in the current study may serve as one useful aid for informing and substantiating such decision processes." Tsay (2011) examined journal of Information science and found that, "Journal articles are the most cited documents, followed by books and book chapters, electronic resources and conference proceedings respectively."

II.METHOD

A bibliography was compiled manually from the printed version of *The International Journal of Engineering Education.* The journal is considered one of the popular journals in engineering education globally. It is consistent in publishing activity and publishes from all the nooks and corners of the world. These qualities contributed towards the choice of the journal for this study. The range of the years covered for the study was from 2000-2008. Papers published in this range of years were examined using Bibliometrics techniques to explore, the number of authors per paper, year of publishing, international collaboration and gender of authors. Manual counting of authors to examine their collaborative nature was employed. Years of publishing of papers were also counted and recorded. The extent of International collaboration among the contributing authors was also examined and recorded. On the gender of authors, a brief biography on each of the authors is given at the end of each article. This information assisted greatly in generating a comprehensive list of authors along their gender line.

III.FINDINGS AND DISCUSSION

A total of 1016 papers (Table 1) were published during the 9 years period of the study (2000-2008). The pattern of authorship in the literature started experiencing significant growth from the year 2003. The highest collaboration coefficient of 0.81 ([100/123]) was recorded in the year 2008. The essence of year wise study is to investigate into the details of growth of the literature. This assist in giving information that could be accurate and reliable. The year wise information allows for comparison in order to exhibit the year that records the highest growth of the literature. Patterns of authorship within the period of the study could be established through proper evaluation of the year wise information on the spread and growth of the literature. Collaborative works are beginning to take the center stage in the dissemination of the literature of engineering education. One can easily discern from the result of the study that, the year 2008 turned out to be leading in collaborative activities.

Key;
SAP-Single author papers
MAP-Multiple author papers
T-Total
CC- Collaboration co-efficient

There were 64 entries on collaboration activities among countries from different continents of the globe. This clearly shows that, collaborative researches in engineering education transcend various continents of the world. United States of America collaborated with other countries and produced 482 (Table 2) researches. Spain emerged second with 53 papers, United Kingdom became third with 45 papers, Canada took the fourth position with 44 papers and

Australia won the fifth position with 39 papers. The least collaborative research among the participating countries was between one country with another, 24 countries were found to have collaborated each with one other country. This finding further confirmed the assertion that geographical location enhances collaboration among the scientists. Choi (2012) explained that, "Most previous studies agreed that geographical, economic, and linguistic factors are significant in explaining international scientific collaboration, irrespective of different co-authorship indices, study periods, and countries analyzed."

TABLE I YEAR WISE PATTERN OF AUTHORSHIP

2000	26	37	63	0.58
2001	32	46	78	0.58
2002	31	60	91	0.65
2003	36	79	115	0.68
2004	40	102	142	0.71
2005	27	99	126	0.78
2006	35	113	148	0.76
2007	27	103	130	0.79
2008	23	100	123	0.81
Total	277	739	1016	0.72

TABLE II RANKING OF PARTICIPATING COUNTRIES

Country	Frequency
United States	482
Spain	53
United Kingdom	45
Canada	44
Australia	39
China	23
Singapore	20
Turkey	19
New Zealand	17
Israel	13
Sweden	12
Germany	10
Malaysia	10
Lebanon	10
Netherland	09
Portugal	09
South Africa	08
Slovenia	07
Taiwan	06
Mexico	06
India	06
Denmark	06
Switzerland	05
Ireland	05

Kuwait	04
Greece	04
Sri Lanka	04
Italy	04
Japan	03
Cyprus	03
Iran	03
Croatia	03
Finland	03
Oman	03
Austria	03
Brazil	02
Norway	02
Chile	02
Lithuania	02
Jordan	01
Mauritius	01
Saudi Arabia	01
Czech	01
Botswana	01
France	01
Egypt	01
Philippines	01
Nigeria	01
Argentina	01
Sao Paolo	01
Palestine	01
Venezuela	01
Romania	01
Trinidad and Tobago	01
Bahrain	01
South Korea	01
Zimbabwe	01
Indonesia	01
Norway	01
Columbia	01
Pakistan	01
Burma	01

Information on gender of authors in engineering education further exhibits the major contributors towards growth and development of the field. This idea is not only peculiar to this literature, but it has been the tradition practiced in scientific disciplines. Katrina, (2002) opined that, “Sex differences in publication productivity have also been empirically established in other socio-cultural contexts and scientific communities.” Gender of authors that contributed journal articles in this literature was recorded; and this could be determined for 1016 papers, with 2529 authors. Male authors dominated the scene, (Table 3) with 81% of contributions throughout the period of the study. Furthermore, in trying to know whether both male and female have the same pattern of communication in terms of

collaboration and co-authorship in the literature, a thorough checking was conducted. The result (Table 4) indicated that, the percentage of male authors who published a single-authored paper in the literature is 11.50% ([238 male single authors] / [2069 male authors]); the percentage of female authors who published solo articles in the literature is 8.04% ([37 single author females] / [460 female authors]). The percentage of male only collaborated papers is 6.26% ([432 / 2069]), while the percentage of female authors who published in female only teams is 5.65% ([26 / 460]). Clearly one could say that, the pattern of co-authorship of both male and female authors in the literature has similar trend of development.

TABLE III GENDER OF AUTHORS

Gender	Number	Percentage
Male	2069	81.8
Female	460	18.1

TABLE IV GENDER GROUPS OF PUBLISHING TEAMS

	SMA	MMA	SFA	MFA	MAMF
No.	238	432	37	26	263
%	23.9%	43.3%	3.7%	2.6%	26.4%

Key;
SMA-Single male authors
MMA-Multiple male authors
SFA-Single female authors
MFA-Multiple female authors
MAMF-Multiple authors male and female

IV.CONCLUSION

The patterns of authorship in the literature of engineering education have shown significant development in co-authorship. The literature demonstrates the universality of co-authorship among the scientists in various fields of engineering education. A total of 64 countries participated in the collaborative researches in this subject literature. This number is substantial enough to conclude that International collaboration and co-authorship trend is highly pronounced in the literature. The gap between multiple male only authors and multiple female only authors is not very wide. Female authors in this literature could be said to have recorded a significant contribution towards the growth of the literature through team researches. Therefore, the trend of development in this aspect, between the male and female seems to be similar.

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