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Impact of International Co-Authorships to a Young Malaysian University Specialising in Science, Technology, Engineering and Mathematics

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ABSTRACT

Internationalisation for a higher education institution is defined as a process of integrating an international, intercultural, or global dimension into the teaching and learning, as well research activities. International co-authorship in research article is one of the means of collaboration towards internationalisation. Henceforth, this paper investigates the impact of international co-authorship of the research articles in the field of science, technology, engineering and mathematics (STEM) for a specialised young university (<50 years old) in Malaysia. The study focused on approximately 9450 article and the citations ranging from 2012-2017. The impact due to annual article publication, annual citation count, most cited article, annual citation per article and the correlation between the publication and citation were analysed. The finding shows that faculty members of the university have been collaborated with authors from 86 countries since 1997, which dominated by Asian institutions. From the results, annual citation per article (C_{pp}) showed that collaborations with European countries brought highest impact for the mean C_{pp}. Meanwhile, the analysis on the cumulative citation trend illustrated that the citation count is proportional to the number of articles, which proves that international co-authorship does impacts STEM specialised young university.

Keywords: International co-authorship; Impact of publication; Impact of citation; Young university; STEM; Internationalisation.

1. INTRODUCTION

Internationalisation is well-defined as a process of change to adopt the understanding in an international context, which also reflects the way a country responds to the impact of globalisation with respects to the individuality of the nation[1]. Nonetheless, this helps to promote cross-cultural understandings and deepening international cooperation. Yet, this has to avoid messing it up with Westernisation or Americanisation[2], as political, economic, academic and societal are the pushing forces for an institution for internationalisation[1].

As a result of the knowledge-based economy of the 21st century, higher education systems were echoed by the internationalisation effect. Through which the importance of internationalisation of higher education institutions (HEIs) was defined differently for different context. One sees internationalisation as an important element in the HEIs to improve the quality of education[3]. There is also an increasing importance of relation, trade, alliances among nations, or internationals and integrating the international or intercultural context into the research, teaching and service function of an institute[4]. Given these points, internationalisation activities such as international partnership, academic programs and research activities were executed in HEIs[4–6].

Research collaboration is one of the great areas to explore for internationalisation of HEIs. Researchers[3,7–9] highlighted that internationalisation of HEIs may focus on knowledge transfer, mobilisation of talent, enhancement of international curriculum. Identically, the improvements measured by both international and domestic co-publishing articles. Should the internationalisation be focused on research collaboration, concern on the measurement of effectiveness between relationship of the research collaboration and internationalisation arises. International collaboration was reported as the easiest and form of collaboration in writing of research findings[10]. Forthwith, Abramo[11-12], *et al.* investigated the international collaborations of Italian university researchers, analysing the linkage between degree of internationalisation and research performance. This finding was supported by Santin[13], *et al.* who investigated the contribution of internationalisation of science in Brazil through research output from the international collaboration. Henceforth, it is hypothesised here that research performance in the mean of research output is one of the best options to be considered to measure the effectiveness of research collaboration. A tangible measurement of the quality international collaboration, by means of research co-publication or co-authorship will be considered in this study.

The international collaboration that represented by the corresponding co-authorship of the research finding writing was recommended to be analysed by bibliometric methods[14–16]. Bibliometric or scientometrics has been adopted for almost a decade to assess the research performance by the publication and citation counting techniques[17]. Nevertheless, citation analysis was adopted widely to examine the trends and patterns

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in the growth of research[18–22]. Despite citation analysis also correlated to the number of references, whereby papers contained with greater number of references were claimed relatively increased in the citation[23]. In general, studies focused on the impact of international co-authorship were reported since last decade[8,24–27]. Additionally, the impact on citation due to international co-authorship has also been performed. In the context of Malaysia, the research publications of the research universities are expected to be high. A study aimed to identify the degree and type of research collaboration focused on the established research universities was performed by Cheng[28], *et al.* to analyse the research publication. The findings showed that science-based research activities in Malaysia are more aggressive, however lacking in international collaborations. This finding is supported by Tan[29], *et al.* where they found that domestic partnerships are dominating the country's research trend. Noorhidawati[30], *et al.* also echoed that multiple and international co-authorships are benefiting the citations. It has then brought to the concern of the authors on how the impact of citation owing to international co-authorship for a science, technology, engineering and mathematics (STEM) specialised young university would sound. Henceforth, this paper answering the question: Does articles with international co-authorship reach more citations than the one without that published in STEM? and How? It is hypothesised that international co-authorships do impact on the citations owing that articles with international co-authorship has better probability of exposure to the international scholars. Besides, it is also hypothesised that data and results may be varying according to the subject area. Henceforth, a focused study on STEM is proposed hereby for a specialised young university.

2. DATA AND METHODS

2.1 Data Extraction and Processing

The finding of the present study is based on the publication data set retrieved in the period from 2002 to 2017 from SCOPUS database. Owing to low citation rate prior to year 2012, hence citation only accounted from year 2012 to 2017. The database has been considering all types of articles published in the STEM for a young university. Prior to the analysis, the data was first being processed by identifying if the article published with international co-authors. Article is counted with international co-authors as if there is more than one affiliation from another country. The international co-authorship was then being classified based on country and region e.g. Asia, Europe, America etc respectively. Following with that the citation analysis was performed, where citation counted from 2012 to 2017. To quantify the impact of international co-authorship, indicators such as annual article publication, annual citation count, most cited article, annual citation per publication were selected and presented by countries.

The definitions of the indicators are as follows:

- Annual article publication (P) is defined as the number of articles published for the particular year.
- Annual citation count (C) is defined as the cumulative citation for the particular year.
- Most cited article (C_{max}) is defined as the number of citations for the highest cited article.
- Annual citation per publication (C_{pp}) is defined as the average number of citations per publication for the particular year.

On top of this, the growth rate of the publication (GR_p) and citation (GR_c) by country have also been quantified, by the following equation:

$$GR_p = (P_{x+1} - P_x) / P_x \quad (1)$$

$$GR_c = (C_{x+1} - C_x) / C_x \quad (2)$$

where $x+1$ is the year of consideration, x is a year before the year of consideration.

3. RESULTS

3.1 The Publication Trend of Young University

To understand more about the research activities about the university, a background study was performed. The publication activity of the university began in year 2002. However, the activities were limited as the university was still in the development phase of physical and infrastructure. In 2009, the university embarked on the transformation journey towards a research university, only then the research and publication activities active. Within the years, the publications and citations have grown tremendously as illustrated in Fig. 1. GR_p showed a significant improvement especially in year 2016 by 75 per cent. Similarly, GR_c, improved about 45 per cent in year 2016.

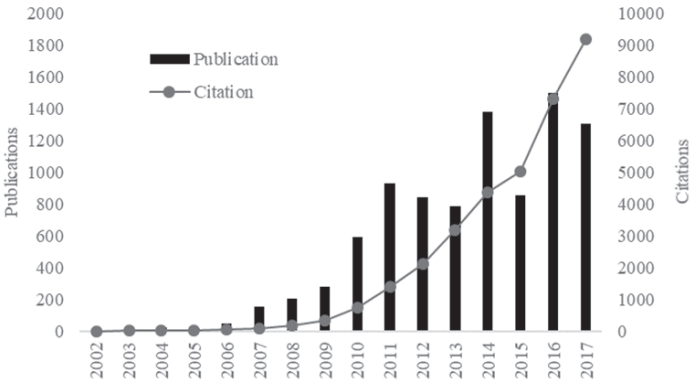

Figure 1. Publication and citation trends of the young university (2002-2017).

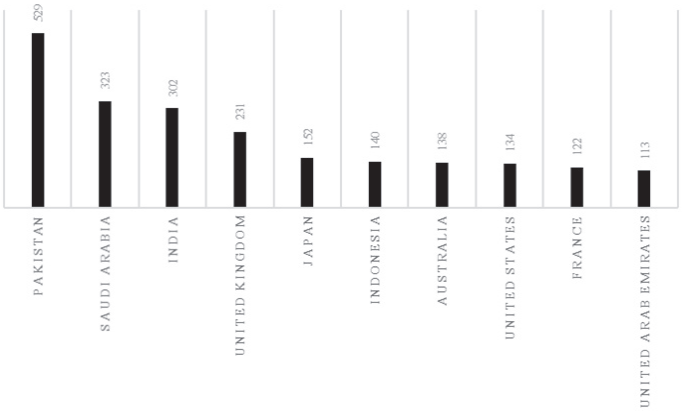

Figure 2. Ranking of top 30 countries with highest number of articles co-authored.

Table 1. Publication growth rate of the Top 10 countries with the most article co-authored

Country	Publication Growth Rate (GRp)					Average GR
	2012/13	2013/14	2014/15	2015/16	2016/17	
Malaysia	-0.10	0.77	-0.46	-0.91	-0.23	0.12
United Arab Emirates	-0.33	3.50	0.44	0.62	0.14	0.87
China	0.00	0.00	2.50	0.71	0.58	0.76
Japan	2.25	0.77	-0.17	0.42	0.07	0.67
Oman	0.00	0.00	0.00	1.00	1.50	0.50
Pakistan	0.00	1.73	-0.26	0.48	0.06	0.40
India	0.00	0.83	0.03	-0.35	1.00	0.30
Indonesia	-0.22	0.43	0.20	0.33	0.75	0.30
Saudi Arabia	0.95	0.30	0.02	0.35	-0.20	0.28
United Kingdom	0.41	-0.17	-0.35	1.00	0.46	0.27
Australia	0.17	-0.21	0.64	0.28	-0.30	0.11

Table 2. Statistics of the top 10 most cited articles by country

Country	Publication year of most cited articles	C_{max} (Nos)	Nos of citation/ year
Malaysia	*2009*	*234*	*29.3*
Australia	2013	184	46.0
Iran	2009	239	29.9
China	2015	49	24.5
Viet Nam	2016	24	24.0
Japan	2011	99	16.5
Hungary	2015	32	16.0
Netherlands	2012	73	14.6
Qatar	2013	56	14.0
Spain	2009	111	13.9
Germany	2009	111	13.9

3.2 Trend of International Co-Authorship in Publication

Among the 9471 article analysed, 26 per cent of the articles were published with more than one international co-author. Meanwhile, the articles were cited in a total of 39255 times, where 32 per cent of it cited the articles with international co-authorships. This is aligned with the hypothesis that international co-authorship gives impact to the citation. In the time frame of 15 year, the university has been collaborated with 100 over institution worldwide through Memorandum of Understanding (MoU). The activities captured in the MoU including students' activities, academic and research collaborations. Nevertheless, the quality of the research output is to be showcased by the evidence through research publications. As a result, 3380 article were published under these collaborations.

Figure 2 presents the Top 10 country ranking of the highest number of co-published articles. In detail, the collaborations are mainly focused in Asia region (65 %), followed by Europe (18 %), America (8 %), Australia (5 %) and Africa (4 %).

3.3 International Co-Authorship Growth Rate

To quantify the impact of long-term collaboration, a more detail analysis is as tabulated in Table 1, where the publication growth rate (GR_p) of Top 10 countries are listed. As compared to the domestic collaboration, the international co-authorship shows much greater growth rate.

3.4 Citation Analysis of the Articles with International Co-Authorship

Table 2 presents the 10 most cited articles that were compared and benchmarked with the domestic co-authorship. The highest domestic co-authored article which cited 234 times since published in 2009 was considered as the benchmark. From the analysis it was observed that articles in collaboration with Australian and Iranian institutes gives great impact in term of citation by 46.0 and 29.9 citation per annum respectively. 47 per cent of the most cited articles were with co-authorship with authors from Asia. The ranking is followed by 33 per cent, 10 per cent, 7 per cent and 3 per cent from Europe, Africa, America, and Australia respectively.

3.5 Performance Assessment of International Co-Authorship

The growth of the research collaboration and co-authorship are presented, which is followed by the assessment of citation impact. Figure 3 presents the evolution of the research output collaboration with the Top 10 countries in the period of 2008 to 2017. It could be observed that in year 2017, the university was having the most active collaboration with institutions from Pakistan, Saudi Arabia, India, United Kingdom, and Japan. A drastic growth is also observed in collaborations with Pakistan authors, mainly due to high number of researchers graduated and continued the research collaborations back in the home country.

Figure 4 illustrates the evolution of citation counts of the 10 countries mentioned above, a dramatic growth in the citation from year 2015 for articles in collaboration with Pakistanis and Saudi Arabia institutions was identified. The finding validated the hypothesis that citation count is increased proportional to the number of publications.

Following with that the average citation counts per publication (C_{pp}) per annum for the Top 10 countries are as tabulated in Table 3 to quantify the citation impact. Greater C_{pp} is observed for publication with international co-authorship, where C_{pp} for domestic co-authorship is at an average of 0.5

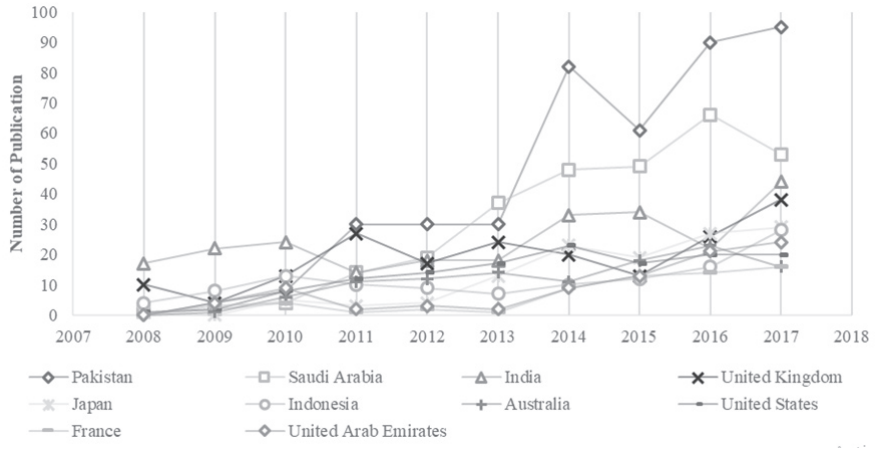

Figure 3. Evolution of article publication with international co-authorships (2008 – 2017).

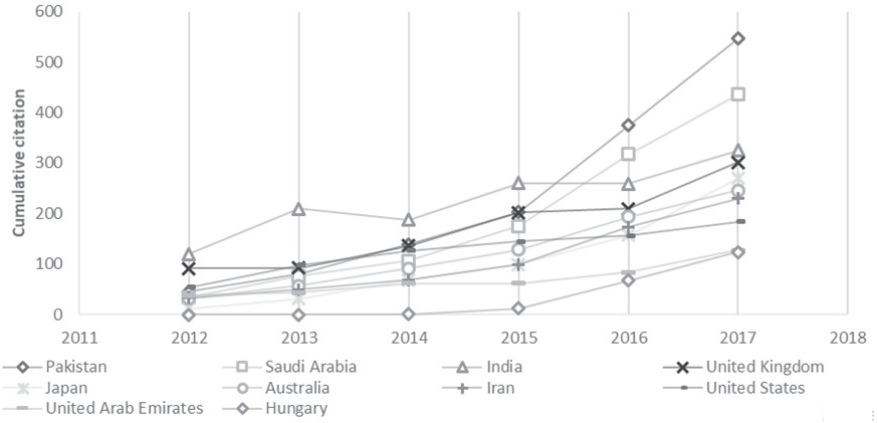

Figure 4. Evolution of citation counts for top 10 countries with International Co-Authorship (2012 – 2017).

Table 3. Average citation per article per annum for the top 10 countries

Countries	Average citation per article per annum, C_{pp}						
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**Average**
Malaysia	*0.22*	*0.32*	*0.44*	*0.48*	*0.70*	*0.83*	*0.50*
Spain	0.90	2.83	2.55	2.14	1.79	1.90	2.02
Netherlands	0.80	1.35	2.50	2.10	2.45	2.80	2.00
Hungary	0.00	0.00	0.04	0.46	2.62	4.77	1.31
Iran	0.35	0.52	0.73	1.05	1.84	2.45	1.16
Portugal	0.00	0.00	0.09	0.50	2.14	3.86	1.10
Singapore	0.35	0.63	0.98	0.78	1.75	2.00	1.08
Germany	0.75	0.91	0.88	1.00	1.13	1.69	1.06
Australia	0.24	0.44	0.69	0.98	1.47	1.88	0.95
South Korea	0.47	0.70	0.67	1.09	0.89	1.54	0.89
India	0.43	0.76	0.68	0.94	0.93	1.17	0.82

In detail, Spain, Netherlands and Hungary yielded the highest citation impact.

The correlation of mean annual publications with the mean annual citations is as illustrated in Fig. 5. It could be observed that India, Saudi Arabia and United Kingdom resulting greater citation impact on a STEM based young university with high citations for lower number of publications. Even though it could be seen that articles with Pakistan co-authorship resulting the highest citations, but citation impact is low. It could summarise that citation impacts are very much about the quality of the publication, whereby it is assumed that a good quality paper will be highly cited.

4. CONCLUSIONS

An analysis has been conducted to investigate the impact of international co-authorship in the field of Science, Technology, Engineering and Mathematics (STEM) for a young university to the route of internationalisation. The study focused on publication and citation of 9471 article in the field of STEM from the year 2012-2017. The analysis considered the indicators such as annual article publication, annual citation count, most cited article, annual citation per article and the correlation between the publication and citation. About 25.6 per cent of the articles published with international co-authorship. 65 per cent of the articles are in collaborations with Asian collaborators. The university collaborated the most with Pakistanis authors, followed by authors from Saudi Arabia, India, United Kingdom, and Japan. The finding also showed that the cumulative citation counts is direct proportional number of articles published. Knowledge or expert transfer is one of the strategies that was proposed for internationalisation. Henceforth, by recruiting prominent researchers from these countries, could be a strategy to improve the growth rate in quality articles publications. To quantify the citation impact, the citation count per paper per annum was considered. 50 per cent of the Top 10 countries that gained highest C_{pp} from Europe, followed by 40 per cent and 10 per cent from Asia and Australia respectively. The correlation of the mean citation/mean publication over the year of 2012-2017 has shown that India gives the greatest citation impact. As a conclusion, international co-authorship proven to bring impact to a STEM specialised young university. From the previous performance, although the university has the most

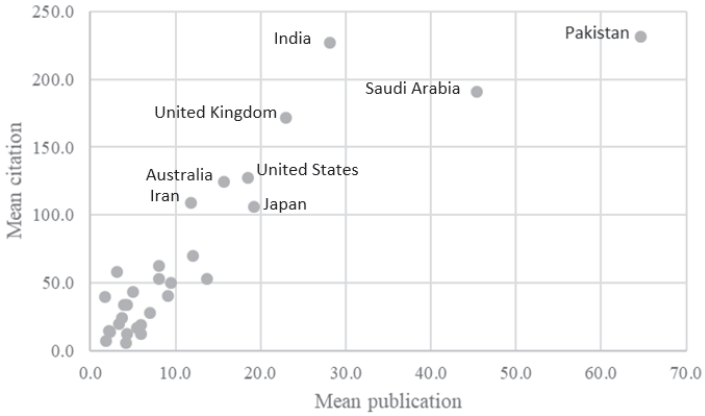

Figure 5. Correlation of mean publication/annum to the mean citation/annum.

collaboration with Pakistan collaborators, yet the collaboration with Indian Institutions shows greatest impact.

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