A Bibliometric Analysis of Scholarly Publication in Malaysia Research Universities from 2006 – 2015

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ABSTRACT

This paper focuses on measuring the academic research performance of Research universities in Malaysia by using Scopus database and Scival bibliometric analysis from 2006 to 2015, total of 101,126 publications. Universiti Malaya leads in terms of publication output (24,293 titles), followed by Universiti Putra Malaysia (20,634), Universiti Kebangsaan Malaysia (19,650), Universiti Sians Malaysia (19,487) and Universiti Teknologi Malaysia (18,156). We have provided meaningful indicators to measure the research performance of Research universities as compared to non Research Universities in Malaysia (60,831). Using these indicators, we first measure the quantity and quality of the research outcomes of the universities and then examine the internationalization of research by using international collaborations, international citations and international impact metrics. Using all of this data, we finally present an overall score called research performance point to measure the comprehensive research strength of the universities for the selected subject categories such as Engineering category total of 27,053 publications (15%), Computer Science, Materials Science, Physics and Astronomy and Medicine contributing 8% to the pool respectively, Chemistry, Agricultural and Biological Science as well as Biochemistry, Genetics and Molecular Biology (5%). The comparison identifies the gap between Malaysia Research universities and non-RU universities from selected regions across various subject areas. We find that Malaysia Research universities are doing well in terms of publication volume (62%) but receive less citations from their published work. We also find that the Malaysia Research universities have relative low percentage of publications at high impact venues, which may be the reason that they are not receiving more citations. Therefore, a careful selection of publication venues may help the Malaysia Research universities to compete with world class universities and increase their research internationalization.

Keywords: bibliometric, research university, research library, scholarly publication

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INTRODUCTION

There are more than 2410 research articles that are related to research publication and bibliometric analysis from 1974 to-2016, from various types of journals that were indexed in Scopus databases. Scientometrics journals have the highest publication of 348 articles that are also indexed and listed in Scopus. Several studies have been carried out across the world to analyse scholarly publication between institutions and organization that were extracted from top tiers publisher and databases such as Web of Science (WOS), Scopus, Elsevier, Science Direct, EBSCO, JSTOR, ProQuest, and many more (van Leeuwen, van Wijk & Wouters, 2016; Boukacem-Zeghmouri, Bador, Lafouge & Prost, 2016; Singh, Banshal, Singhal & Uddin, 2015; Surjandari, Dhini, Wibisana & Lumbantobing, 2015; Zhu, Saeed-Ul, Mirza & Xie, 2014). Samples were taken from five to more than ten years period from all scholarly publications that were indexed and affiliated to the institutions or organizations. This assessment is comprehensive and specific and yet in this research issue only to see patterns and trends between all subject categories especially Scopus indexed publication between research universities (MRU) in Malaysia and others academic institutions that do not have research universities status (NRU).

In the recent years several previous studies have employed bibliometric tools and applications for analysing institutions publication performance in area such as biomass energy (Mao, Zou, Chen, Du & Zuo, 2015), library and information Science (Ellegaard & Wallin 2015; Dees 2015; Abrizah, et al., 2014), biological sciences (Mee-Jean Kim, 2013); business (Jason C. Dewland, 2011). Research analysis using scientometric (Singh, Banshal, Singhal & Uddin, 2015), big data analysis (Meo & Usmani, 2014) and data mining (Karno et al., 2012) were also conducted between universities and their scholarly publication that were published by their academician to understand more on the relation between authors, publication trend, citations, subject area expertise, research profile, researcher collaboration and demographic area.

Bibliometric analysis is currently used for evaluating the qualitative and quantitative interest in a specific field through the analysis of publications. This method is currently used in the sciences of information to describe patterns of publications within a given field. These methods have been used to investigate research trends of specific fields recently (Vergidis et. al., 2005; Falagas et. al., 2006; Kumari, 2006).

LITERATURE REVIEW

Publication as a measure of performance

The western academic model derived from Europe has been successful in providing advanced education, fostering research and scientific development, has also been imported by most nations in the world including the US, Japan, China, India and post colonial countries as well, such as Malaysia (Altbach, 2004). One of the noble ideas is that universities should participate in the creation as well as the transmission of knowledge (Altbach 1998). Western universities have been the centre of knowledge networks and the means of knowledge dissemination such as journals and scientific publication. on the operation side, journals and scientific publications are not only the

centre of the latest knowledge dissemination but also act as essential links for the seasoned academicians to keep abreast with the development in their area and implicitly facilitate academicians with contemporary knowledge to be imparted to their students. Such special importance of creation and transmission of knowledge has put scholarly publication as one of the most common performance indicator for most universities globally. Scientific publication has been used to measure research productivity in both public and private universities in the US (Adam and Griliches, 1996) Australia (Avkiran, 1999) (Butler, 2003) and Europe (Van Looy, 2013).

Moving on from being a platform meant for knowledge discussion, publication has now become one of the most important performance indicators for Malaysian academician. "Publication count is an indicator of research productivity and is used to rank faculties and academic institutions... ascertain author's productivity ...or the publication productivity of research groups" (Norhazwani and Zainab, 2007). Malaysia Ministry of Higher Education (MOHE) necessitated that Scopus and ISI journals are included as the target for publication and such publications are accounted for in the public universities performance indicator (Abu Bakar, 2010). The recognition on such publication is evident through orders communicated to the academicians in various occasions by the Higher Education Department (JPT, 2010) and the Malaysian Ministry of Higher Education (MOHE, 2010). Many universities in Malaysia expect the academicians to publish in Scopus, ISI and impact factor journal and this aspiration is clear when some universities such as Malaysia National University (UKM, 2010) and Universiti Malaysia Perlis (UniMAP, 2010) offer rewards to the writers in forms of 'seed money' or research grants for published research articles.

Publication and University Rankings

Rankings in terms of publications and citations have become widely accepted as indicators of scientific worth of universities and whole countries (e.g. Groot and Garcia-Valderrama, 2006; Guan and Ma, 2007; Moed et al., 1985; Nederhof and van Raan,1993; Tijssen and van Wijk, 1999). Evaluating scientific quality is a notoriously difficult problem. "One such difficulty is that the production of research typically involves multiple inputs and multiple outputs, which makes it problematic to use standard parametric/regression techniques. Another, more serious problem is that minimal 'engineering' knowledge is usually available about the precise interrelationship between the research inputs that are used and the research outputs that are produced" (Cherchye and Abeele, 2005: 496).

Publication count is an indicator of research productivity and is used to rank faculties and academic institutions (Narin and Hamilton, 1996; Toutkoushian, et al., 2003; Liu and Cheng, 2005; Meho and Spurgin, 2005). It can also be used to ascertain author's productivity (Hart, 2000a; 2000b) or the publication productivity of research groups (Uzun, 2002; Kademani, et al., 2005). It has been used to assess the productivity of persons in a particular discipline (Gu and Zainab, 2001 for computer science; Tsay, 2004 in subject indexing literature). Most studies have used the *ISI Thomson* databases to obtain publication productivity counts (Muffo, Mead and Bayer, 1987; Waworuntu and Holsinger, 1989; Liu and Cheng, 2005).

The results of the rankings are not only affected by the indicators used, but also by the amount of information retrieved, from both national and international databases (Liang, Wu and Li, 2001). Realizing the importance of research publication within the Research Universities ranking, bibliometric tools analysis has been used to determine all of the scholarly publication indexed in Scopus and ISI published by higher education institutions. It includes verification by the Times Higher Education (THE), Quacquarelli Symonds (QS) World University Rankings (2010), QS Asian University Rankings (2010) and the Academic Ranking of World Universities from Shanghai Jiao Tong University (ARWU).

The trend for Research Performance Evaluation (RPE) in the world led to the development of new scientometric indices and examining of their applications. Consequently, concerns and anomalies arise about the convergent validity and reliability of these indices for the decision making purposes. The way of accountability of research performance evaluation is going to be changed. Significant changes have been observed during the last pair of five year's Malaysian plans (2001-2005; 2005-2010) that is focused on Vision 2020. Consequently, monitoring of such activities by standard methods and techniques has become a vital element for the success of R&D programs. Eventually, the application of performance evaluation metrics/indices for gauging productivity and visibility becomes a major interest for policy level decision making and strategic planning. Publication activity as a quantitative core and citation as an impact, influence or quality core are two critical indicators of research performance (Garfield, 1997; Mingers, 2007, Moed, 2005; Bornmann and Daniel, 2005).

Assessment of quantity and impact of the researchers' publications by fair metrics/indices is a serious concern for both decision makers and academics being evaluated. The sole use of Peer Based Approach (PBA), lacks objectivity, simplicity, requires more time and expert panels, budget, non-scientific and complication in processing and disciplinary perspectives (Moed, 2005, van Raan, 2005; Opthof and Leydesdorff, 2009; DEST, 2005; Donovan, 2007b; Abramo and Angelo, 2011). To look for excellence, the peer assessment is informed by many indicators for a better monitoring and evaluating purpose. There are various new evaluation indices on the scene in the academic and research scenario. The present scientometric study addresses the application and usefulness of the most noted h-index (Hirsch, 2005), and its variants along with selected activity and impact metrics in the Malaysian context. This topic has become an important subject of study for policy makers, institutions and researchers.

There have been a number of research studies conducted worldwide focusing on university ranking by evaluating research performance through publications and citations. For example, Colman, Dhillon and Coulthard (1995) assessed the research performance of 41 British university political science departments by analyzing the number of articles published between 1987 and 1992 in selected European politics journals with the highest citation impact factors. Hu and Rousseau (2009) used the output of papers and their citations in ten biomedical fields, based on Thomson's Essential Science Indicators (ESI) 1996–2006, of ten selected Western and Asian countries and found that Asian countries' performances were below the world average. Research on publications and their citation within 24 universities in Thailand were conducted by (Sombatsompop et al., 2010) found that 9 universities listed and ranked

as top world universities which can be measured and compared for their impact factor publication and citation with others. similar research as shown in table 1 below is related to research on publication in higher education.

RESEARCH METHOD

In this study, Scholarly publication of 5 Malaysia Research Universities (MRU) were selected and the research publications produced during 2006–2015, and the citations of the selected articles SCOPUS during 2006–2015, were used for assessing their research performance. At this point, the number of publication includes various documents such as articles, conference paper, review, article, short summary, conference review, editorial review and even notes. The search then was narrowed down further to articles only. The number obtained included the numbers of articles in various fields. The total publications by each university on the database were traced back to year 2006 up to 2015. After that the numbers of publications were tabulated according the affiliation, and simple analysis was carried out using average and percentage. Since, there was quite a good number of citations (Hussain and Fatima, 2011) to the review and short communications articles during the initial stage of data retrieval, so it was reasonable to include such articles in this study, although majority of the retrieved articles for this study were original research articles. The published articles and their citations from SCOPUS databases were searched and retrieved via 'Advanced Search' using university names and publication year as of 2006 to 2015. The research performance of each of the scholar was evaluated in terms of the productivity, impact, and excellence of the retrieved publications (Maharana, 2013). Productivity was measured by the number of published articles, whereas the impact of the research was evaluated through total citations and number of cited articles. . In order to obtain a precise comparison for research performances of all MRU scholarly publications reported in this work, the number of researchers for each publication were taken into account, and the research productivity was then evaluated as the number of published articles per researcher. However, it was extremely difficult to obtain information on the number of researchers in each publication. , For, the numbers of researchers for all publications are( ) changed every year due to retirements and new staff recruitments. As a result, the number of researchers were not included in the calculation of research productivity in this study. The ratio of citations (impact) to the numbers of publications (productivity) was also considered; the indicators include citations per article, cited article/published article and citations received/cited article.

The present quantitative evaluative study is based on the positivist paradigm by using bibliometric approach to evaluate the impact of research performance with new developments. One common method of bibliometric research is to trace publications using the SCI of the Institute for Science Citation Index (SCI), (Fu et al., 2010). The data required for bibliometric analysis in this research consists of bibliographic information of publications by RU's researchers and the citations to these publications. It is important that these data are from authoritative and accurate sources and are available for the time period stated in the study's objective. Publications from the period 2006 to 2015 were selected as the sample for the bibliometric analysis. There are many scientific databases which cover all of these researchers but the indexed journal that were listed in Scopus only counted in doing this research. Scopus is the most widely used by

researchers conducting bibliometric studies and was selected as the main source of data for this pilot study. All research outputs published by MRU researchers from 2006 to 2015 indexed in SCOPUS were included in the primary sample. Several search strategies were tested before the following procedures were selected as the most effective to gain the best possible recall of RU research papers. Using the basic search interface:

Search method

1. **Business understanding**
   Objective - Total number of publications in citation-indexed journals, including refereed proceedings and Cumulative impact factor of publication
   Operational – i) Number of publications in Impact Factor Journal (SCOPUS/ISI/SSCI/AI) including Refereed Proceedings published by institution (have institution name as the affiliation of the publication) ii) Cumulative impact factor for all publications in citation-indexed journals (ISI) for that particular year and Tiers ranking (Quartile) iii) Non –index journals and other publication listed in RADIS will be verified and analysed

2. **Data understanding**
   a) Initial Data – only UTM's recognize affiliation, Research Alliance, Centre of Excellence or Research Group will be extracted from Scopus and Web of Science.
   b) Explore Data - Data verification and author verification
      The exclusive data only verify UTM Staff, either first, second, third author, et. al.; Check for Non UTM Staff with UTM Affiliation (Student, Research Grant etc); All kinds of publication format

3. **Data Preparation**
   a) Select Data - Select only title that affiliate with UTM and; author that is funded by UTM or; UTM   student that is base at UTM.
   b) Clean Data - Every author's name through the UTM staff List (by ID card Number or Barcode), faculty and their program also their citation Impact analysis will be updated
   c) Construct Data - Log every attribute and record in Excel, Text or Word; and the record will be generated and recorded by Monthly
   d) Format Data - The data are formatted accordingly to;
      Notification; Month; Title; Authors; UTM's Authors; Staff No.; Faculty; Author 1/2/3/4/5/6/7/8/9 etc; Staff No 1/2/3/4/5/6/7/8/9 etc; year; Source; Volume; issue; pagination; Impact factor; Quartile; citation; Document type; DOI; ISSN; Journal Status; Full text; notes

4. **Modeling Technique**
   Sum all the finding through means, mode and median by simple probabilistic statistic.
   Average and aggregates the total impact factor and clearly differ between authors and their affiliations. Association rules between authors and their subject, agency, faculty and fund will be generated

RESULT/FINDINGS

This study looks at the publication productivity of Malaysian-based authors in the various Malaysia Research Universities (MRU). The data is obtained from the Scopus database and covers the period from 2006 to 2015. A total of 101,126 publications from Malaysia Research Universities -based authors affiliated to various types of institutions were indexed in Scopus up to February 2016 publication. Table 1 are data range of publications that were indexed and listed in SCOPUS and analyzed by; article type, authors with Scopus id identifier, Subject Area and top journal for their submission from all MRU between 2006 till 2015.

Table 1 also highlights the publication performance by the various institutions of MRU. The research-designated 5 MRU (UM, USM, UPM, UKM and UTM) lead in total publication output and subject areas, whereas Universiti Malaya leads in terms of publication output (24,293 titles), followed by Universiti Putra Malaysia (20,634), Universiti Kebangsaan Malaysia (19,650), Universiti Sians Malaysia (19,487) and Universiti Teknologi Malaysia (18,156).

Table 1: Total publications for Malaysian Research University by Broad Fields, 2006-2015

Universities	Pub. 2006-2015	Article	Authors	Highest Subject Area	Top Journal
UTM	18,156	10,308	4,498	Engineering 8,297 (45.7%)	Jurnal Teknologi (Science and Engineering)
UM	24,293	18,413	6,125	Medicine 5652 (23.3%)	Acta Crystallographica Section E
UPM	20,634	16,156	5,527	Agricultural and Biological Sciences 4968 (24.1%)	International Food Journal
USM	19,487	14,549	4,425	Engineering 4,573 (23.5%)	Acta Crystallographica Section E
UKM	19,650	13, 810	4,362	Engineering 5,117 (26.0%)	Sains Malaysiana

There are marked differences in publication and citation performances when comparison is made between the two different domains, namely Scopus and Scival.com. SciVal is a subscription based research performance assessment tool which uses data from Scopus. SciVal provides more advanced bibliometric measures than those available in Scopus. SciVal also allows you to benchmark individual researchers, groups of researchers and institutions based on a variety of different metrics. Table 2, from scival database range 2010 to 2015 ranks and list the MRU publications based on total author affiliations in the Scopus database, which altogether numbered 90,417 and the total number of citations of 316,118. UM with 21,246 publications has the most number of citations 94,082 in the list. This is followed by UKM (17,618), USM (17,390) and UPM (17,186). UTM, the newly designated research university (2010) is placed fifth with 16,977 publications. However, UTM scores high in publication growth (121.5%) and for

author growth (185.5%), after granting it the research university title. From 2010 to 2015, the number of citations received by MRU publications indexed in Scopus goes up and down. Overall UM scores the highest citation followed by USM, UPM, UKM and UTM. UM also has the highest publications with their percentage citations per publication score 4.4 followed by USM (4), UPM (3.5), UKM (2.7) and UTM (2.6).

Table 2: MRU data publication using Scival range 2010-2015

CATEGORY	UM	USM	UPM	UKM	UTM
Publications	21246	17390	17186	17618	16977
Publications (growth %)	59.2%	21.7%	59.8%	78.4%	121.5%
Outputs in Top Percentiles (top 10%)	15.2%	9.9%	9.1%	7.1%	9.8%
Publications in Top Journal Percentiles (top 10% by SNIP)	16.1%	11.0%	8.8%	7.7%	13.4%
Citations	94082	69662	59812	48281	44281
Citations per Publication	4.4	4	3.5	2.7	2.6
Views	477451	518211	481642	402871	531182
Views per Publication	22.5	29.8	28	22.9	31.3
Authors	11552	10683	11964	10887	10601
Authors (growth %)	126.5%	32.7%	52.3%	69.2%	185.5%
International Collaboration (%)	44.2%	33.6%	34.0%	23.6%	33.9%
Academic-Corporate Collaboration (%)	0.5%	0.6%	0.2%	0.2%	0.3%

The total number of publications by MRU publications indexed in Scopus from 2006 to 2015 are 101,126. Figure 1 shows the breakdown for the year 2006 to 2015 between MRU and Non Research University/Institutions (NRU) affiliated Malaysia. Figure 2, compares NRU only contributes 38% from all Malaysia publication between 2006-2015. MRU publication scores more than 60% over all Malaysia University publication in Scopus wthin a decade and the gap is getting bigger as shown in figure 1 below.
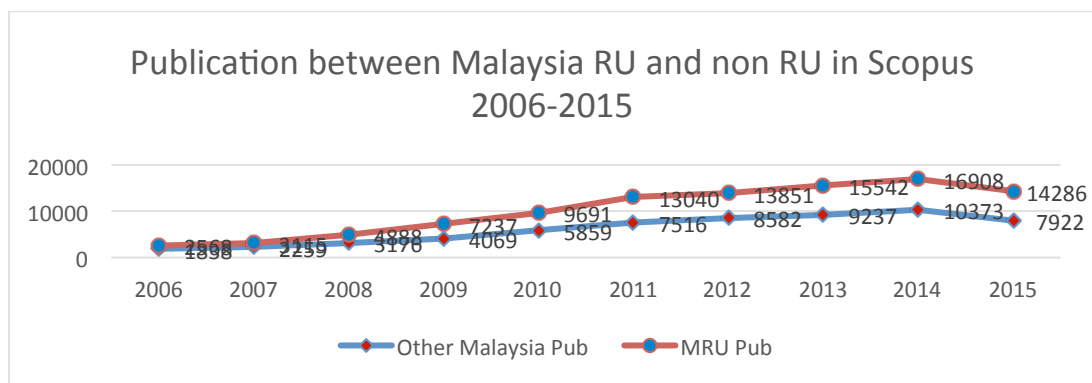

Figure 1: MRU and non NRU Publication in SCOPUS 2006-2015

MALAYSIA PUBLICATION BETWEEN RU AND NON RU 2006-2015 IN SCOPUS

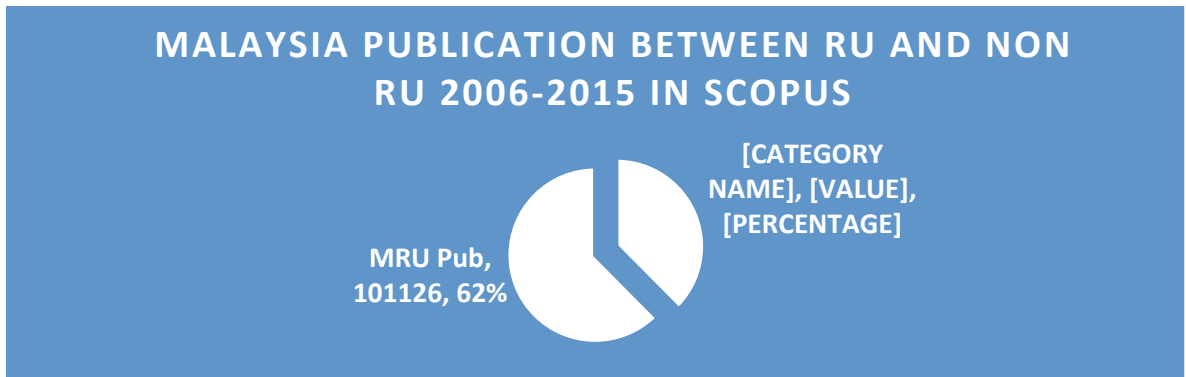[CATEGORY NAME], [VALUE], [PERCENTAGE]

MRU Pub, 101126, 62%

Figure 2: MRU and NRU publications in Scopus 2006-2015

The competition between MRU is getting high stake as they keep increasing their scholarly publication every year since 2006. Figure 3 shows a gradual increase for all MRU publication and Universiti Teknologi Malaysia scholarly publication start to overtake other RU in 2014 except UM.
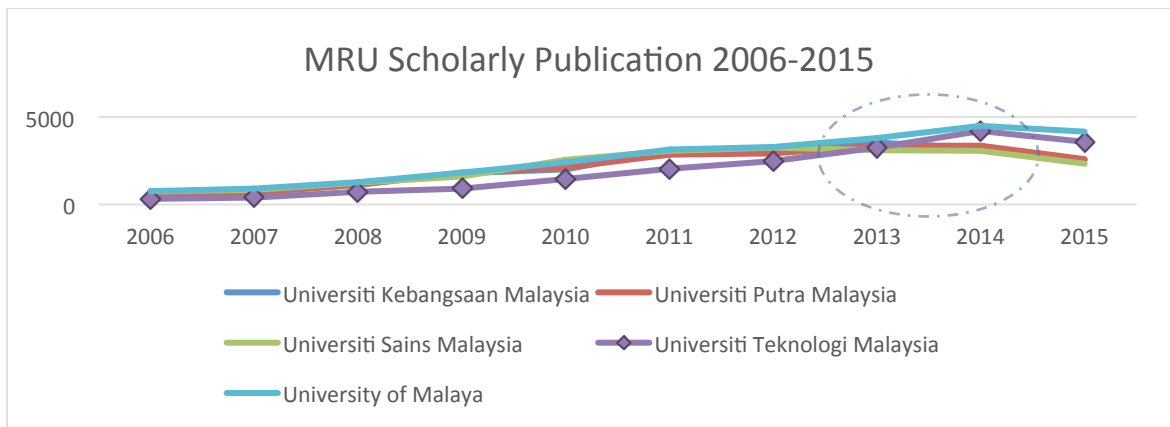

Figure 3: MRU Scholarly publication by year

Publications in the Engineering category achieved a total of 27,053 publications (15%) which is the highest within the six subject categories. Computer Science, Materials Science, Physics and Astronomy and Medicine fall back considerably contributing 8% to the pool respectively. Chemistry, Agricultural and Biological Science as well as Biochemistry, Genetics and Molecular Biology obtained a low number of publications (Figure 4).
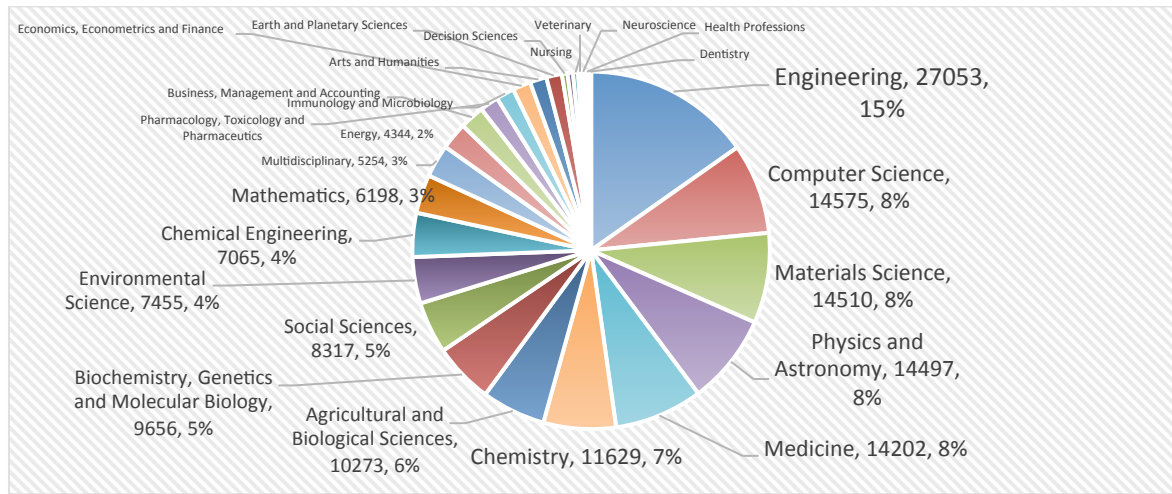
Figure 4: Malaysia Research Universities Publications in Scopus by Subject Area, 2006-2015

CONCLUSION

The data set retrieved from the Scopus database for this study comprises 101,126 publications published between 2006 and 2015 from Malaysian Research Universities based authors affiliated to various institutions. Those main research subject areas are: *1) Engineering, 2) Computer Science, 3) Material Science, 4) Physics and Astronomy, 5) Medicine, 6) Chemistry, 7) Agricultural and Biological Sciences, 8) Biochemistry, Genetics and Molecular Biology.* In terms of implications for being a Research University, it is important for the current as well as future researchers, to become true research University practitioners, for it extensively produces more scholarly publication with a total of 62% more publication than non RU. The research-designated public universities (UM, USM, UPM, UKM and UTM) lead by total publication output and times cited. Universiti Malaya leads in terms of publication output (24% of total), followed by Universiti Putra Malaysia (20%), Universiti Kebangsaaan Malaysia (19%), Universiti Sains Malaysia (19%) and Universiti Teknologi Malaysia (18%) (which outnumber other RU in terms of publication growth and author growth). This high contribution by the research universities may be attributed to the substantial allocation of grants by the government to enable and stimulate research activities. This may also be due to endorsement by the Malaysian government to the recruitment of full time equivalent researchers both from Malaysia and from abroad to help accelerate research performance and this seems to bear fruit in view of the increasing cumulative publication output from 2006 onwards.

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