Measuring journal diffusion using periodic citation counts

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ABSTRACT

This paper presents the relative percentile of diffusion (RPDiF) and compares it with the results of the following indicators: synchronous diffusion factor (DiF), synchronous relative diffusion factor (RDiF), and the five years impact factor (5IF) scores – to assess the influence of journals. The approach involves collection, analyses and comparison of bibliometric data for42 Malaysian journals that have garnered citations in the Web of Science (WoS) during 2006 to 2010.Findings show that it is important to read the RDiF with the RPDiF because RPDiF shows that journals with high RDiF and low RPDiF do not possess strong quality profile like those with both high RDiF and RPDiF. The paper concludes that a journal can be said to demonstrate high quality impact and influence if it achieves a high DiF, RPDiF and 5IF. This study contributes in providing an additional quality indicator to evaluate journals not indexed by mainstream citation databases.

Keywords: Periodic citation counts; Journal diffusion factor; Journal Impact Factor; Citation analysis; Bibliometrics; Journal quality indicators.

INTRODUCTION

Generally, the primary source of new scientific knowledge is seen in the form of academic publications, more so in scholarly journals. Evaluation of the impact or influence of individual scientific journals through various citation-based measures has been embraced by the scholarly community as a significant pursuit and is viewed as a practical alternative to subjective judgment (Glänzel and Moed 2002). The success of bibliometric studies stem from the fact that various measures applied to literature offers dynamic insights into the process, structure, pattern and development of scientific research as they evolve and revolve through certain period of time. Several measures have been applied to assess the influence and visibility of scientific literature and the most widely adopted measure is Garfield's (1964) Journal Impact Factor (JIF) (Della Sala and Grafman 2009; Egghe 2005; Franceschet 2010a, 2010b; Glänzel and Moed 2002; Rowlands 2002; Sharma 2012). Subsequent indicators were built around the JIF. Examples include: journal immediacy index and cited half-life (reported in *Journal Citation Report 2011*), h-index (Hirsch 2005), journal diffusion factors (Frandsen 2004; Rowlands 2002), Citer analysis (Ajiferuke and Wolfram 2010), journal citation identity and the journal citation image (Nebelong-

Bonnevie and Frandsen 2006), popularity factor (Sun and Giles 2007), journal downloads index (Wan et al 2010), uncitedness factor (Egghe 2005), and ch-index (Ajiferuke and Wolfram 2010) to name a few. Additionally, some social science diffusion models such as the Roger's model of innovation diffusion (Kortelainen 1997) and Bass diffusion model (Hans Franses 2003), have been used to explain diffusion of knowledge presented in various scientific publications.

In suggesting an alternative to the classical JIF, the perceived shortcomings of the JIF have been explored and discussed. A commonly held view being that a single indicator cannot boast to capture and reflect the broad reach of research quality, utility and influence of scientific journals (Rowlands 2002), considering for example the bias that may arise if a work is cited by the same author(s) multiple times or if the collections of an author's citations mainly comes from within his own series of works (Ajiferuke and Wolfram 2010). It was also argued that limiting coverage of JIF to a 2–year window potentially favors some journals especially older ones and penalize newer titles with less time to build up their citation base (Della Sala and Grafman 2009;Swartz 2009). Also, the failure to provide information about the trans-disciplinary reception of journals renders the JIF a partial indicator(Frandsen, Rousseau and Rowlands 2006; Rowlands 2002).

To improve journals measures, Ajiferuke and Wolfram (2010) suggested that citation measures should focus on the origin of the citations (unique individuals) and the number of citers per publication, not the number of citations. However, this is also constrained by the "co-authorship effect". Furthermore, since the number of citations to a paper can only accumulate over a number of years, some authors have indicated the plausibility of considering longer citation periods in the determination of impact factor. With regard to this, the Institute of Scientific Information's (ISI) five year Impact Factor was introduced which denotes the ratio of the number of citations received in the current Journal Citation Report (JCR) year to the number of articles published in the preceding five years to the number of articles published in those five years. In addition to determine the impact factor of a journal, researchers are likewise interested in examining the influence of a journal across bodies of literature; hence journal diffusion factors (JDF) was proposed.

The JDF is mathematically formulated and modeled similar to the JIF and is defined as the average number of citing journals per 100 source citations within a given time window. This indicator according to Rowlands (2002) is an indication of the extent of the ripples that flow from the publication of a particular journal as it is subsequently cited. However this measure of diffusion is found to be highly negatively correlated with the number of citations received by the journal, leading highly cited journals to get a low JDF, whereas less cited journals gets a high JDF (Frandsen 2004).

Noting the shortcomings of Rowland's JDF, Frandsen (2004) thereafter suggested another approach for journal diffusion measure, which is defined as the number of different citing journals per article. Although Frandsen's (2004) JDF is statistically independent of the number of citations, there is a strong correlation between the JDF and JIF (Frandsen 2004; Frandsen et al. 2006). Nonetheless Frandsen's (2004) JDF can serve to differentiate journals with similar JIF. Frandsen et al. (2006) presented formal descriptions of two forms of diffusion metric based on previous studies on journal diffusion factors: "*relative diffusion factors" and "journal diffusion* factors" in both their synchronous and diachronous forms. Results indicated that, diffusion factors captured different aspects of the citation reception process than the existing bibliometric measures and that they can be applied at the whole journal level or for a set of articles. These diffusion factors also

minimize the problem of self-citation at both the article and journal level since a work or journal title cannot contribute to the diffusion calculations more than once. These indicators were found to be suitable to complement the more traditional indicators such as the JIF.

The aim of this paper is to contribute to the discussion on journal diffusion factors by proposing another approach to calculate the journal diffusion factor. We shall discuss the definition of the JDF and suggest a modified approach for calculating the JDF with worked examples comparing results for 42 Malaysian scholarly journals. The reasons for choosing these journals are explained under materials and method.

Explanation of the Journal Diffusion Factors

Several concepts in citation analysis can be explained by the publication-citation (p-c) relation, which can be represented in a matrix table (Ingwersen et al. 2001). The entire diffusion factor series are derived from the p-c matrix which highlights the number of articles published per year and the number of citations received. The p-c matrix can be extended to include the number of "unique new" journals involved in citations per year. This is referred to as the augmented publication-citation matrix table (in both synchronous and diachronous versions). The p-c matrix can be used to derive the impact factor, while the augmented p-c matrix can be used to derive the diffusion factors for a particular journal or set of articles. As an example we present the p-c matrix table (Table 1) for a hypothetical journal *J* during a particular time window.

Table 1:Publication-Citation (p-c) Matrix for Journal *J*

Publication year	2006	2007	2008	2009	2010
A	PUB	PUB	PUB	PUB	PUB
B (2006)	CIT				
C (2007)	CIT	CIT			
D (2008)	CIT	CIT	CIT		
E (2009)	CIT	CIT	CIT	CIT	
F (2010)	CIT	CIT	CIT	CIT	CIT

*PUB: Number of publications; CIT: Number of citations received

Also we present the augmented p-c matrix table for journal *J* (synchronous version) (Table 2) and the augmented p-c matrix table for journal *J* (diachronous version) (Table 3).

Table 2**:** Augmented Publication-Citation (p-c) Matrix (synchronous version)

Publication year	2006	2007	2008	2009	2010
A	PUB	PUB	PUB	PUB	PUB
B (2006)	CIT-U				
C (2007)	CIT-U	CIT-U			
D (2008)	CIT-U	CIT-U	CIT-U		
E (2009)	CIT-U	CIT-U	CIT-U	CIT-U	
F (2010)	CIT-U	CIT-U	CIT-U	CIT-U	CIT-U

*PUB: Number of publications; CIT: Number of citations received – U: Number of unique journals involved (unique new, with respect to each citation year, row by row from B - F)

Table 3: Augmented Publication-Citation (p-c) Matrix (diachronous version) for Journal *J*

Publication year	2006	2007	2008	2009	2010
A	PUB	PUB	PUB	PUB	PUB
B (2006)	CIT-U				
C (2007)	CIT-U	CIT-U			
D (2008)	CIT-U	CIT-U	CIT-U		
E (2009)	CIT-U	CIT-U	CIT-U	CIT-U	
F (2010)	CIT-U	CIT-U	CIT-U	CIT-U	CIT-U

*PUB: Number of publications; CIT: Number of citations received – U: Number of unique journals involved (unique new, for the publication year on top of the column, and with respect to previous rows).

The following explains the various journal indicators used in this study.

(a) Journal Impact Factor (JIF)
For a particular journal *J*, the impact factor is given as *Equation 1*

$$JIF = \frac{CIT}{PUB} \dots\dots\dots\dots\dots\dots (1)$$

Where CIT denotes citations in year *Y* to articles published in previous two years and PUB, number of *citable* articles published in those previous two years

(b) Synchronous Diffusion Factor (DiF)
The *n*-year "synchronous journal diffusion factor" for a journal *J* in the year *Y* is *Equation 2* (Frandsen 2004).

$$DiFn(Y) = \sum_{j=0}^{j=n-1} U(Y, Y-j) / \sum_{j=0}^{j=n-1} PUB(Y-J) \qquad \dots\dots\dots\dots\dots\dots . (2)$$

U(*Y,Y–j*) denotes the number of unique new journals for citations in the year *Y*, to articles published in journal *J* in the year *Y–j*. The phrase "unique new" refers to the fact that this journal has not cited an article published in the journal *J* in the years *Y*, … , *Y*–j+1, but that it did cite (in the year *Y*) an article published in the year *Y–j*.

So, to calculate the "synchronous JDF" for journal *J,* the p-c matrix is extended by including the number of unique new journals that yield the citations (Table 2). In this context, the word "new" will refer to the fixed citation year that we are considering, and it means that we would consider the matrix row by row and add new journals from the right (the citation year) to the left. This approach leads to Table 2.

(c) Diachronous Diffusion Factor
The n-year "diachronous journal diffusion factor" for a journal *J* in the year Y is *Equation 3* (Frandsen 2004).

$$Din(Y) = \frac{\sum_{j=0}^{j=n-1} U(Y+j, Y)}{PUB(Y)} \dots\dots\dots\dots . (3)$$

U (*Y+j,Y*) denoted the number of unique new journals involved in citations in the year *Y+j* to articles published in this journal in the fixed year *Y* . The phrase "unique new" refers to the fact that this journal has not cited an article published in the journal *J* in the year *Y* during the years *Y*, *Y*+1, … , *Y*+*j*−1, but that it did cite (in the year *Y*+*j*) an article published in the year *Y*.

Therefore, to calculate the "diachronous JDF" for journal *J,* we have extended the p-c matrix by including the number of unique new journals that yield the citations (Table 3).In this context, "new" refers to the fixed publication year that we are considering and it means that we will consider the matrix column by column and add new journals from the top (the publication year) to the bottom, which results in Table 3.

(d) Synchronous Relative Diffusion Factor (RDiF)

The *n*-year "synchronous relative diffusion factor (RDiF)" of a journal *J* in the year *Y* is *Equation 4* (Frandsen et al. 2006).

$$RDiFn(Y) = \sum_{j=0}^{j=n-1} U(Y, Y-j) / \sum_{j=0}^{j=n-1} CIT(Y, Y-J) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

It should be noted that the definition of the relative diffusion factor is different from the journal diffusion factor because rather than dividing the number of unique new journals by the number of publications, alternatively we are dividing by the number of citations.

(e) Diachronous Relative Diffusion Factor

The *n*-year "diachronous relative diffusion factor" of a journal *J* in the year *Y* is defined as *Equation 5* (Frandsen et al. 2006).

$$RDin(Y) = \sum_{j=0}^{j=n-1} U(Y+j, Y) / \sum_{j=0}^{j=n-1} CIT(Y+J, Y) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

In equation *(2) – (5),* any journal can only contribute to the numerator once.

Proposing the Relative Percentile of Diffusion (RPDiF)

We propose a diffusion index that is the sum of the products of the ratios of the unique new citations to total citations and ratios of unique new citations to the number of articles published for all the years being taken into account. The unique new citations however, are reinitialized every given cycle, meaning that if a particular journal cited the diffused journal in a previous cycle, the citations for first year in which the citing journal cites the diffused journal again in the next cycle is counted as part of the unique new citations. We are taking this measure to account for the fact that some journals tend to be cited and recited multiple times over many years by the same citing journals, but these very same citing journals themselves may attain new readership circles in the interceding years and therefore should not be discounted. The advantage of taking into account both ratios is that any perceived weakness or bias caused by a particular journal setting the total number of publications low to increase citation to publication ratio is moderated while a very high citation count is taken as only half the equation also moderating any bias towards very high citation counts.

$$RPDiFn = \sum_{j=0}^{j=n-1} \left[\left\{\frac{U(Y,Y-j)}{PUB(Y,Y-j)}\right\}.\left\{\frac{U(Y,Y-j)}{CIT(Y,Y-j)}\right\}\right] \ldots\ldots\ldots \quad (6)$$

Therefore, rather than using a fixed citation year (synchronous) or a fixed publication year (diachronous), we propose using a fixed time period. We refer to it as a five–year diffusion bound; for instance, (2001 – 2005; 2006 – 2010 and so on). The model uses a five year cycle for each diffusion count and we consider a citation to be "unique new" with respect to the five – year diffusion bounds and we consider the cross-table column by column and add new journals from right to left (on a year by year basis) (Table 4).

Table 4: Publication-Citation Table for *RPDiFn*

Publication year	2006	2007	2008	2009	2010
A	PUB	PUB	PUB	PUB	PUB
B	CIT	CIT	CIT	CIT	CIT
C	JUR	JUR	JUR	JUR	JUR
D	U	U	U	U	U

*PUB: Number of publications; CIT: Number of citations received; JUR: Number of journals involved in the citation; U: Number of unique journals involved in citations per year.

In this method, the publication year of the cited article is not so important, only the citing journal is taken into account. Our diffusion bounds will be every five years. For instance, the first period could be (2001 - 2005) and the next period or cycle is (2006 – 2010). So if a particular journal cites journal *J* at any time during 2001-2005, it will be considered "unique new" regardless of how many times the citation occurs during that diffusion bound. Note that this journal can only contribute as a unique new (numerator in the Equation 6) only once during the five-year diffusion bound. However if the same journal is also involved in citation during the next or later diffusion bound, for example (2006 – 2010; or 2011 - 2015) it will be considered as unique new because it falls into a new period. In fact we can calculate the final diffusion index (Equation 7), as the average of all the periodic diffusion indexes. Total unique new citations for year, *Y*, will be

$$\begin{aligned} &Total\ Unique\ New\ Citations, U_n(Y) \\ &\quad = \sum_{j=0}^{j=4} U(Y,Y-j) + \sum_{j=5}^{j=9} U(Y-5,Y-j) \\ &\quad + \cdots\ldots\ldots\ldots + \sum_{j=n-5}^{j=n-1} U(Y-n+5,Y-j) \qquad \ldots\ldots\ldots\ldots\ldots (7) \end{aligned}$$

For example, when calculating the number of unique new citations, *U*, for a journal from the year 2010 to the year *n*, we calculate *U* as

$$\begin{aligned} &Total\ Unique\ New\ Citations, U_n(2010) \\ &\quad = U(2010,2006) + U(2005,2001) + \cdots\ldots\ldots\ldots + U(Y-n+5, Y-n-1) \end{aligned}$$

However if $n < 5$, then

$$Total\ Unique\ New\ Citations, U_n(Y) = \sum_{j=0}^{j=n-1} U(Y, Y-j) \quad \ldots\ldots\ldots\ldots (8)$$

The best argument for the periodic calculations is that it reduces the bias towards new journals with short citation history, since newer journals are possibly going to generate more "unique new" citations than older journals. Periodic diffusion counts will reduce these biases. Another argument in support of the periodic approach is that even if we do not have citation data account for a journal since inception, by using the diffusion bounds and a five years citation cycle, we can still calculate the diffusion factor. For instance if a journal only has citation data for 4 years, then the calculation of the total unique new citations will be as shown in Equation 8. This is useful especially for journals with poor archive documentation or old citation records not previously covered in citation databases. Many journals actually fall into this category and this new method can resolve this problem and reflect the spread of knowledge of their publications. Therefore, we apply this new method to 42 Malaysian scholarly journals, which have garnered citations in the Web of Science (WoS). We also compare the Journal Impact Factor with the Diffusion factors.

MATERIALS AND METHODS

Data employed in bibliometric analysis can be obtained from any comprehensively compiled publication list or any sufficiently large data set, perhaps a database designed for the retrieval of scientific information (Frandsen et al. 2006; Glänzel 2003). The objective of this study is to propose another journal diffusion indicator and apply it to a set of national journals produced in a developing country, Malaysia, in order to assess their influence. The selection criteria for this study was based on two reports on Malaysian scholarly journals produced by Zainab et al. (2012) and Abrizah et al.(2013). The former identified among other information, the status and rank of Malaysian journals indexed in WoS and Scopus database, while the latter examined the cited Malaysian journals in WoSand the journals citing Malaysian journals in WoS. Journals indexed by WoS are considered to have a certain degree of quality and authoritativeness and since the distribution of this database is worldwide, journals cited in WoS can be said to have achieved a certain degree of visibility and influence. Therefore, the citation data set for the study was collected from WoS, while the publication data was compiled from MyJurnal (http://www.myjurnal.my) and MyAIS (http://myais.fsktm.um.edu.my), which are the most comprehensive databases of Malaysian journals. This was double-checked with publication records made available in the respective journal's website.

We selected 42 Malaysian scholarly journals for this analysis, one of which is indexed only in WoS, nine in both WoS and Scopus, 16 only in Scopus, while another 16 is indexed in both MyJurnal and MyAIS databases. The data collection process was painstakingly tedious which took more than 2 months to complete (19th of September to 12th of November 2012). In the database, we focused on the "Web of Science" page and selected "Cited reference Search". In the "Citation Database" option, we marked the box to select Science Citation Index Expanded (SCI - EXPANDED), Social Sciences Citation Index (SSCI) and Arts and Humanities Citation Index (A&HCI), leaving others unmarked. In the search box, we use multiple abbreviated journal names to broaden our search as wide as possible and also selected year 2006 – 2010 as the "date range". We filter through the list of result produced to confirm its accuracy. We chose "Analyze Results" option after the completion of the search and exported the results in a spreadsheet application for further manual counting

and analysis. To avoid potential bias due to a journal's name change or variants names, the "unique new" journals are carefully scrutinized. Therefore, using the fundamental "journal impact factor" and the new "periodic diffusion factor", the study compares and examines the five year impact factor and diffusion factors for 42 Malaysian journals during year 2006–2010. We created a table for each participating journal as illustrated in (Table 4).

Table4. We inputted the publication, citation and unique citation values for each journal in algorithm created for the equation. For clarity we have provided the summation of all publications, citations and unique citation values in Table 5.

To determine if there is any strength of linear dependency between the five year impact factor (5IF) and the diffusion factors (DiF and RDiF) or the relative percentile of diffusion (RPDiF),we run a correlation analysis in IBM Statistical Products, Services and Solutions (SPSS) software version 20, using the Pearson product-moment correlation coefficient (PMCC).

RESULTS AND DISCUSSIONS

The result of our calculated diffusion factor scores and 5 years impact factor for the 42 Malaysian journals is provided in Table 5. Results show that Synchronous relative diffusion factor (*RDiF)* scores range from 0.494 to 1.00. The synchronous diffusion factor (DiF) scores range from 0.013 to 1.213.The relative percentile of diffusion (RPDiF) scores range from 0.08 to 6.91 while the five years impact factor (5IF) scores are between 0.01 to 2.049.There are 12 journals that recorded an RDiF value of 1.00, which is the highest (Table 6). There are 3 journals with DiF>= 1 (Table 6). These are *Asia Pacific Journal of Public Health*, *Malaysian Polymer Journal*, and *Tropical Biomedicine*. *Journal of Tropical Forest Science* also belongs to the top, achieving DiF = 0.94. These 4 journals also achieved the highest RPDiF and 5IF scores but achieved low RDiF scores.

This finding implies that, the RDiF is negatively correlated with the number of citations ($r = -0.579$, $p<0.01$), resulting in journals with "few citations" having high RDiF scores. By "few citations" we mean when citations is compared with publications. For example, titles such as: *Akademika Journal, International Medical Journal Malaysia, Journal of Institutions of Engineers Malaysia, Buletin Persatuan Geologi Malaysia/Bulletin of the Geological Society of Malaysia, Journal of Science and Mathematics Education in Southeast Asia*, and *Journal of Sustainability Science and Management* all have very few citations and recorded high RDiF. Apart from *Journal of Sustainability Science and Management* and *Buletin Persatuan Geologi Malaysia/Bulletin of the Geological Society of Malaysia,* which are indexed in Scopus database, the other journals do not have a presence in either Web of Science or Scopus. Besides, there are some journals with relatively high citations and recorded high RDiF such as: *Malaysian Journal of Biochemistry and Molecular Biology and Malaysian Journal of Soil Science.* The former is listed in MyAIS while the latter in Scopus. Although the RDiF reflects true influence and diffusion in these two journals, however, for a balanced comparison it will be better to take other indicators into account.

Table 5: Journal Titles Arranged Alphabetically based on the WoS Journal Title Abbreviation

	Journal titles	PUB	CIT	U	RDiF	DiF	RPDiF	5JIF	Database
1	Akademika	88	3	3	1.00	0.03	0.27	0.03	MyAIS
2	Ann. Of Dentistry	42	11	11	1.00	0.26	1.06	0.26	MyAIS
3	Arch. Of Orofacial Sci.	59	55	51	0.93	0.86	3.81	0.93	MyAIS
4	Asean Food J. /Int. Food Res. J.	241	271	167	0.62	0.69	3.30	1.12	Scopus
5	Asia Pac. J. of Mol. Biol. andBiotechnol.	115	63	56	0.89	0.49	4.01	0.55	Scopus
6	Asia Pac. J. of Public Health	244	500	296	0.59	1.21	5.71	2.05	WoS/Scopus
7	Biomed. Imaging and Intervention J.	217	182	150	0.82	0.69	2.41	0.84	Scopus
8	Bull. of the Geol. Soc. of Malaysia	57	4	4	1.00	0.07	0.11	0.07	Scopus
9	Bull. of the Malaysian Math. Sci. Soc.	144	171	88	0.52	0.61	1.91	1.19	WoS/Scopus
10	Folia Malaysiana	64	23	16	0.70	0.25	2.15	0.36	MyAIS
11	IIUM Eng. J.	55	8	8	1.00	0.15	0.75	0.15	MyAIS
12	Int. J. of Bus. and Society	65	45	37	0.82	0.57	2.49	0.69	Scopus
13	Int. Med. J. Malaysia	155	2	2	1.00	0.01	0.08	0.01	MyAIS
14	J. of Eng. Sci. and Technol.	153	118	111	0.94	0.73	4.05	0.77	Scopus
15	J. of Institutions of Eng. Malaysia	174	3	3	1.00	0.02	0.09	0.02	MyAIS
16	J. of Oil Palm Res.	128	127	100	0.79	0.78	3.25	0.99	WoS/Scopus
17	J. of Rubber Res./J. of the Rubber Res.	100	67	39	0.58	0.39	1.38	0.67	WoS/Scopus
18	J. of Sci. and Math. Educ. in S East Asia	50	5	5	1.00	0.10	0.48	0.10	MyAIS
19	J. of Sustainability Sci. and Manage.	68	4	4	1.00	0.06	0.15	0.06	Scopus
20	J. of the Rubber Res. Inst. of Malaya	79	69	40	0.58	0.51	0.83	0.87	MyAIS
21	J. of Trop. Forest Sci.	216	306	203	0.66	0.94	4.08	1.42	WoS/Scopus
22	JurnalFizik Malaysia	74	10	10	1.00	0.14	0.71	0.14	MyAIS
23	Malaysian Applied Biol.	97	48	43	0.90	0.44	2.05	0.49	MyAIS
24	Malaysian Fam. Physician	102	35	34	0.97	0.33	1.81	0.34	Scopus
25	Malaysian J. of Anal. Sci.	228	176	138	0.78	0.61	1.99	0.77	Scopus
26	Malaysian J. of Biochem. and Mol. Biol.	40	23	23	1.00	0.58	2.85	0.58	MyAIS
27	Malaysian J. of Comput. Sci.	67	29	22	0.76	0.33	1.43	0.43	WoS/Scopus
28	Malaysian J. of Libr. and Inform. Sci.	86	89	44	0.49	0.51	1.94	1.03	WoS/Scopus
29	Malaysian J. of Med. Sci.	163	75	65	0.87	0.40	1.94	0.46	Scopus
30	Malaysian J. of Microbiol.	104	91	66	0.73	0.64	2.60	0.88	Scopus
31	Malaysian J. of Nutr.	116	59	46	0.78	0.40	1.96	0.51	Scopus
32	Malaysian J. of Pathol.	103	86	80	0.93	0.78	3.86	0.83	Scopus
33	Malaysian J. of Pharm. Sci.	48	28	27	0.96	0.56	2.56	0.58	MyAIS
34	Malaysian J. of Psychiat.	107	25	23	0.92	0.22	1.15	0.23	MyAIS
35	Malaysian J. Of Sci.	197	72	64	0.89	0.33	1.57	0.37	Scopus
36	Malaysian J. of Soil Sci.	34	12	12	1.00	0.35	3.17	0.35	Scopus
37	Malaysian Online J. of Instructional Technol.	14	9	9	1.00	0.64	0.64	0.64	MyAIS
38	Malaysian Polymer J.	59	98	68	0.69	1.15	6.91	1.66	MyAIS
39	Med. J. of Malaysia	726	523	438	0.84	0.60	2.32	0.72	Scopus
40	Neurology Asia	288	177	122	0.69	0.42	2.78	0.61	WoS/Scopus
41	SainsMalaysiana	409	273	184	0.67	0.45	1.86	0.67	WoS/Scopus
42	Trop. Biomed.	233	431	233	0.54	1.00	4.67	1.85	WoS/Scopus

*PUB – Number of publications received; CIT – Number of citations received; U – Number of unique new citations received during the five years publication and citation counts; RDiF - Synchronous Relative Diffusion Factor; DiF - Synchronous Diffusion Factor ; RPDiF - Relative Percentile of Diffusion ; 5JIF - Five years Impact Factor; Database – The database that currently index the journal title.

Table 6: Journal Titles Ranked according to RPDiF, DiF and RDiF Scores

	Journal Title	RPDiF Rank(Score)	DiF Rank(Score)	RDiF Rank(Score)
1	Malaysian Polymer J.	1(6.91)	2(1.15)	32(0.69)
2	Asia Pac. J. of Public Health	2(5.71)	1(1.21)	37(0.59)
3	Trop. Biomed.	3(4.67)	3(1.00)	40(0.54)
4	J. of Trop. Forest Sci.	4(4.08)	4(0.94)	35(0.66)
5	J. of Eng. Sci. and Technol.	5(4.05)	8(0.73)	15(0.94)
6	Asia Pac. J. of Mol. Biol. and Biotechnol.	6(4.01)	21(0.49)	20(0.89)
7	Malaysian J. of Pathol.	7(3.86)	6(0.78)	17(0.93)
8	Arch. Of Orofacial Sci.	8(3.81)	5(0.86)	16(0.93)
9	Asean Food J. /Int. Food Res. J.	9(3.3)	10(0.69)	36(0.62)
10	J. of Oil Palm Res.	10(3.25)	7(0.78)	26(0.79)
11	Malaysian J. of Soil Sci.	11(3.17)	28(0.35)	11(1.00)
12	Malaysian J. of Biochem. and Mol. Biol.	12(2.85)	16(0.58)	10(1.00)
13	Neurology Asia	13(2.78)	24(0.42)	33(0.69)
14	Malaysian J. of Microbiol.	14(2.6)	12(0.64)	30(0.73)
15	Malaysian J. of Pharm. Sci.	15(2.56)	18(0.56)	14(0.96)
16	Int. J. of Bus. and Society	16(2.49)	17(0.57)	25(0.82)
17	Biomed. Imaging and Intervention J.	17(2.41)	9(0.69)	24(0.82)
18	Med. J. of Malaysia	18(2.32)	15(0.6)	23(0.84)
19	Folia Malaysiana	19(2.15)	33(0.25)	31(0.7)
20	Malaysian Applied Biol.	20(2.05)	23(0.44)	19(0.9)
21	Malaysian J. of Anal. Sci.	21(1.99)	13(0.61)	27(0.78)
22	Malaysian J. of Nutr.	22(1.96)	26(0.4)	28(0.78)
23	Malaysian J. of Libr. & Inform. Sci.	23(1.94)	20(0.51)	42(0.49)
24	Malaysian J. of Med. Sci.	24(1.94)	25(0.4)	22(0.87)
25	Bull. Of the Malaysian Math. Sci. Soc.	25(1.91)	38(0.07)	41(0.52)
26	Sains Malaysiana	26(1.86)	22(0.45)	34(0.67)
27	Malaysian Fam. Physician	27(1.81)	29(0.33)	13(0.97)
28	Malaysian J. Of Sci.	28(1.57)	30(0.33)	21(0.89)
29	Malaysian J. of Comput. Sci.	29(1.43)	31(0.33)	29(0.76)
30	J. of Rubber Res./J. of the Rubber Res.	30(1.38)	27(0.39)	38(0.58)
31	Malaysian J. of Psychiat.	31(1.15)	34(0.22)	18(0.92)
32	Ann. Of Dentistry	32(1.06)	32(0.26)	2(1.00)
33	J. of the Rubber Res. Inst. Of Malaya	33(0.83)	19(0.51)	39(0.58)
34	IIUM Eng. J.	34(0.75)	35(0.15)	4(1.00)
35	Jurnal Fizik Malaysia	35(0.71)	36(0.14)	9(1.00)
36	Malaysian Online J. of Instructional Technol.	36(0.64)	11(0.64)	12(1.00)
37	J. of Sci. and Math. Educ. In S East Asia	37(0.48)	37(0.10)	7(1.00)
38	Akademika	38(0.27)	40(0.03)	1(1.00)
39	J. of Sustainability Sci. and Manage.	39(0.15)	39(0.06)	8(1.00)
40	Bull. Of the Geol. Soc. Of Malaysia	40(0.11)	14(0.07)	3(1.00)
41	J. of Institutions of Eng. Malaysia	41(0.09)	41(0.02)	6(1.00)
42	Int. Med. J. Malaysia	42(0.08)	42(0.01)	5(1.00)

- RPDiF– Relative Percentile of Diffusion ; DiF– Synchronous Diffusion Factor ; RDiF– Synchronous Relative Diffusion Factor

According to Rowlands (2002), the different modes of journals influence is indicated in in Table 7.

Table 7: Different Modes of Influence: Journal Diffusion and Impact

FOUR SCENARIOS	low impact (5IF)	high impact (5IF)
	A	**B**
Low diffusion (DiF or RPDiF)	less intense citation activity, highly concentrated in relatively few journals	intense citation activity, highly concentrated in relatively few journals
High diffusion (DiF or RPDiF)	**C**	**D**
	less intense citation activity, more evenly spread across citing journals	Intense citation activity, more evenly spread across citing journals

*DiF - Synchronous Diffusion Factor ;RPDiF - Relative Percentile of Diffusion ; 5JIF - Five years Impact Factor
Adapted from Rowlands (2002)

If a journal has low impact factor score and low diffusion score, the journal demonstrates less intense citation activity of which is highly concentrated in relatively few journals. When the result of each diffusion index is sorted and correlated, we found that journals with the highest RDiF exhibit low DiF, RPDiF and 5IF. We also found significant positive correlations between the DiF and RPDiF (r = 0.885, p<0.01) (Table 8).

Table 8: Correlations between the four Indicators
(Pearson product-moment correlation coefficient r)

	RDiF	DiF	RPDiF	IF
RDiF	1	-0.537**	-0.417**	-0.736**
DiF	-0.537**	1	0.885**	0.942**
RPDiF	-0.417**	0.885**	1	0.819**
5IF	-0.736**	0.942**	0.819**	1

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Therefore, we can assume that the editorial activity of *Asia Pacific Journal of Public Health*, *Malaysian Polymer Journal*, *Tropical Biomedicine* and *Journal of Tropical Forest Science* has resulted in intense citation activity as citation is more evenly spread across citing journals. This corroborates with Levitt and Thelwall's (2008) study, which suggested that mono-disciplinary journals are more highly cited than research in multi-disciplinary journals. Among these top four mono-disciplinary journals, only *Malaysian Polymer Journal* is not indexed in WoS or Scopus. Meanwhile, there are some journals with high citations that demonstrate high *RDiF, RPDiF and 5IF* score, such as *Archives of Orofacial Sciences* and *Journal of Engineering Science and Technology*. The former is only indexed in *MyAIS* while the latter is listed in *Scopus* database. So, if we consider all indicators altogether, these two journals would be on the top list with regards to influence and impact. There are also few journals with high *5IF* but low *DiF and RDiF,* such as *Bulletin of the Malaysian Mathematical Sciences Society, ASEAN Food Journal/International Food Research Journal and Malaysian Journal of Library and Information Science.* These journals exhibit high impact and low diffusion. The implication is that although these journals showcase intense citation activity, however, the citations are highly concentrated in relatively few journals. This result is quite surprising, because these 3 journals fall into the category of

multidisciplinary journals and it is expected that journals of such stance exhibit high impact and influence in terms of citation and diffusion as observed by Levitt and Thelwall (2009) that multi-disciplinary journals are the most widely cited.

CONCLUSIONS

In this study, we have presented and compared the results of a synchronous diffusion factor (*DiF*), synchronous relative diffusion factor (*RDiF)* relative percentile of diffusion (*RPDiF*), and the five years impact factor *(5IF)* scores for 42 Malaysian scholarly journals during 2006 to 2010. High *RDiF* values for a journal would be explained by low rate of citations received by the journal. High *DiF* and *RPDiF* will occur as a result of high number of different citing journals against the number of publications. A journal will produce a high *5IF* if the number of citations during the five-year period is higher than the number of publications produced within the same period. It will be very important to read the *RDiF* with the *RPDiF* because *RPDiF* tends to show that journals with high *RDiF and* low *RPDiF* do not possess strong quality profile like those with both high *RDiF* and *RPDiF*. We can conclude that a journal can be said to demonstrate high quality impact and influence if, it achieves a high *DiF, RPDiF* and *5IF.* Comparison of 42 Malaysian journals indicated that *Asia Pacific Journal of Public Health*, *Malaysian Polymer Journal*, *Tropical Biomedicine* and *Journal of Tropical Forest Science* have the most impact and influence across bodies of literature. Listing in WoS and Scopus is very helpful for a journal's status however it does not guarantee impact and influence for all journals. Our findings shows that non-WoS and non-Scopus indexed journals from a developing country also have impact and influence. Although the citation data utilized for the purpose of the study are obtained from the WoS databases but there are numerous non-WoS journals being cited by WoS journals. For example *Malaysian Polymer Journal* is an Open Access journal, which is only indexed in *MyAIS* database. It is a non-WoS journal but it actually has a strong impact and influence across bodies of literature. This indicates that Open Access journals and also journals indexed in local abstracting and indexing systems like *MyAIS* can boast of certain degree of influence and impact in the scholarly world.

Results reflect that it will be rewarding to read and interpret the *RDiF* together with the *DiF, RDiF* and *5IF*. Although it has been suggested that the Journal Diffusion Factors be considered as an independent measure of journal rank, but it would be superfluous to read the *RDiF* or *DiF* alone in journal evaluations without taking *RPDiF* and *5IF* into consideration, since the latter would be able to justify and compliment the result of the former as we have demonstrated in this study. The results of this work reinforce the idea that evaluation of the impact or influence of individual scientific journals through various citation-based measures is a complementary tool to subjective judgment more than a practical alternative. The study mainly highlights findings by comparing top cited journals from a particular country; as such the findings cannot be generalized. Therefore a similar effort can be carried out in other social systems or settings to enhance our knowledge and understanding on this topic. These indicators can be applied at all levels of evaluations, to single article, to a series of articles published in a specific journal issue, set of journals from a higher institution, country or region. The five-year bound can be utilized to indicate the continuous influence of a journal title in different literatures over time.

Results of journal diffusion studies can be of interest to researchers, policy makers and journal publishers (especially those from developing countries) to gauge their influence in WoS and provide an incentive to further improve their quality and ultimately gain

indexation in WoS and justify continued financial support from university governance, professional associations as well as government agencies. We recommend that the diffusion factors be calculated every five years to reduce some of the bias towards old journals and specialized journals.

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