Original Research Article

PRELIMINARY INVESTIGATION OF PERTINENCE OF CITATIONS IN INTRODUCTION SECTION OF PUBLISHED EMPIRICAL ARTICLES

Adedayo, A. V.[1,2*]

[1]Department of Materials Science and Engineering; Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Metallurgical Engineering; Kwara State Polytechnic, PMB 1375, Ilorin, Nigeria

Abstract: The paper presents a study on analysis of citations made in the introduction section of articles that report empirical research. The attempt is to provide preliminary study towards validation of an earlier proposition that significant amount of citations made in the introduction sections cannot positively count in the analysis to evaluate performance of scientific publications. In this present paper, citations made in the introduction sections in six different scientific publications were analyzed. A scientific journal was selected from each continent, and their first four articles published in 2014 were analyzed. Only articles that report empirical researches were analyzed. Overall, the study showed that over 80% of citations made in the introduction sections may not be applicable in the computation of effective impact of publications.

Introduction: Impact metrics have gained widespread attention as tools used in evaluation of performance in a number of academic endeavours. While there are different classifications of impact indicators, however, citation based impact metrics have gained the most widespread applications. The core principle of this methodology is the assumption that citation expressly indicates that the cited source is approved and a quality one[1-3].

Generally, this opinion is not correct. While considerable opinion among scholars is that citation analysis is suitable as used in evaluation of academic performances[4-8], however, at the same time, the critical view to this standpoint is equally significant [9-16]. Also, the success of the methodology relies on the integrity of the citing authors. The citation impact metrics would work better, only if every citing author meticulously cited only the earlier works pertinent to his theme.

Often times, citations are made to identify sources of errors in the literature. Ordinarily, in an article where a review of literature is presented, knowledge and ideas relevant to the subject of interest is conveyed. Identification of the gaps, opposing views, strength and

weaknesses in the literature is made. Insight and awareness to differing ideas, arguments, theories and approaches are provided[17]. Essentially, the literature review sections are disparate and contain citations to articles of conflicting standpoints[2,17]. Because of the motley nature of literature review sections, the present usage of citation impact metrics implicitly awards prize to counter productive efforts.

In an attempt to refine the present methodology used to compute citation impacts, Adedayo[3,17-22] understudied the true nature of citations in scientific publications, and proposed a classification of all citations within an article reporting an empirical research into two (2), viz: (i) Real Citations and (ii) Imaginary Citations. Citations made in the Methodology/Results/Discussion of Results/Conclusions are classified as Real Citations, because these truly show that the cited source support the new research being reported, and thus is pertinent to the reported study. Citations made in the Introduction/Literature Review sections are classified as Imaginary Citations. This because, any citation made in the Introduction/Literature Review that cannot be cited in the Methodology/Results/Discussion of Results/Conclusions can only be stated to have imagined pertinence to the study. The pertinence is only a figment in the Imagination of the citing author.

This preliminary study provides efforts towards validation of an earlier proposition made by Adedayo[19-22]. One significant benefit of this initial study is that it provides quick, transparent and easily grasped overview which can also be easily verified. The article forms the first attempt to use empirical methods to determine pertinence of citations made in Introduction/Literature Review sections of articles reporting empirical studies. Herein, the rationale for the study is identified.

Methodology: Citation pattern in published articles was studied. For transparency, articles considered in this study were limited to open access scientific journals. A scientific journal from a reputable journal publisher was selected from each continent. The list of selected journal publishers is presented in table 1.

The first issues published in 2014 by these publishers were selected for analysis. Only the first four articles that report empirical studies from these issues were considered. A systematic cull of citation in articles was made [2,3,13,14,17-22]. Citations in the articles were classified as citations with Real and Imaginary Pertinence[19-22]. Citations made in Introduction/Literature Review sections were considered as Citations with Imaginary Pertinence while those made in the Methodology/Results/Discussion of Result/Conclusions are considered to have Real Pertinence.

Table 1: List of Journals analyzed in the study

S/N	Journal Name	Journal Issue	Continent of Publication	Country of Publication	Publisher
1.	South African Journal of Chemistry (SAJC)	Vol. 67	Africa	South Africa	South African Chemical Institute (SACI)
2.	Journal of Brazilian Chemical Society (JBCS)	Vol. 25, No. 1	South America	Brazil	Brazilian Chemical Society (BCS)
3.	Analytical Chemistry Research (ACR)	Vol. 1	Europe	Netherland	Elsevier
4.	Applied Petrochemical Research (APR)	Vol. 4, No. 1	North America	USA	Springer
5.	The South Pacific Journal of Natural and Applied Science (SPJNAS)	Vol. 32	Australia	Fiji	CSIRO
6.	Asian Journal of Biochemistry (AJB)	Vol. 9	Asia	Singapore	Scialert

The total number of authors cited in the Introduction sections were counted and recorded as N_c. Also, a counting of common citations made both in the Imaginary and the Real sections was made, and recorded as n_c. Pertinence (p) of the Imaginary section (Introduction section) of each article was determined by finding the ratio n_c: N_c expressed as a percentage i.e.

$$p = 100 \left(\frac{n_c}{N_c} \right) \qquad (1)$$

The average Pertinence for each journal and the entire publishers were determined.

Results and Discussion: Tables 2 to 7 and Figures 1 to 8 present the results for the study.

Table 2 and Figure 1 provide information on pertinence of Introduction section in articles published in South African Journal of Chemistry (SAJC). From the Table and Figure, the first article (pages 1-5) in the journal has a pertinence of 8.8%. This shows only 8.8% of citations made in the introduction section of this article truly support the reported study. Article published in pages 6-11 has a pertinence of 4.3%. The next two (2) articles published in this issue have 0.0% pertinence. This shows that none of the citations made in the introduction sections of these article have truly supported the reported study. The average pertinence for this journal issue is 3.3%.

Table 2: Analysis of citations in South African Journal of Chemistry (SAJC)

| S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common Citation	n_c	p
1.	Sabinet; ISI	Vol. 67	Inhibiting or Accelerating Effect of Different Surfactants…	1-5	34	Refs.: 6; 23; 24	3	8.8
2.	"	"	Synthesis of MoS2 Inorganic Fullerene…	6-11	23	Refs.: 4	1	4.3
3.	"	"	Rating of Sweetness by Molar …	12-20	17	-	0	0.0
4.	"	"	Nano-TiCl4.SiO2: a Versatile Catalyst	21-26	24	-	0	0.0
	Average Pertinence for the Journal Issue							**3.3**
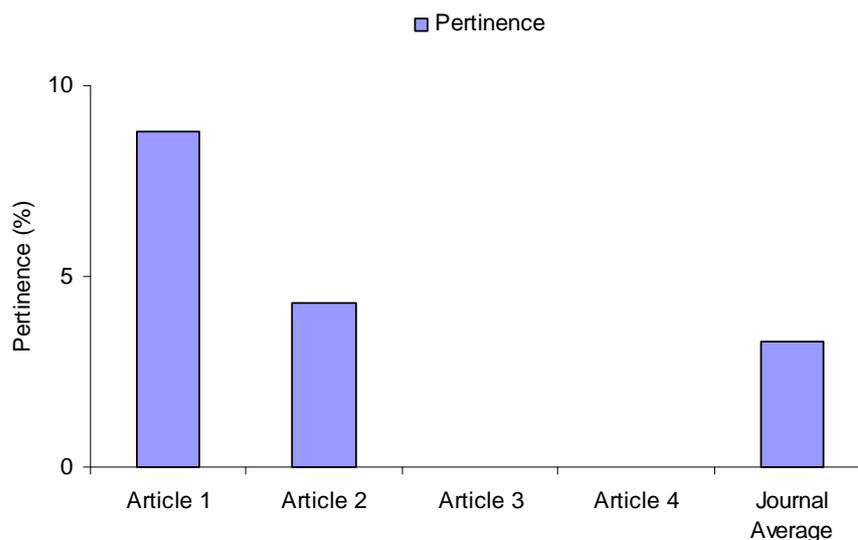
Figure 1: Pertinence of Introduction Section in SAJC

Analysis of citations in Journal of Brazilian Chemical Society (JBCS) is presented in Table 3 and Figure 2. For this journal issue, articles published in pages 5-8; and 9-19 are Not Empirical Research Article (NERA). These articles were not included in the analysis for this journal issue. Only articles published in pages 20-26; 27-35; 36-49; and 50-64 were used for this journal issue. In this issue, aricle published

in pages 36-49 has the highest pertinence of 30.0%. This implies that about 30.0% of citations made in the introduction section of this article truly support the reported study. Article published in pages 20-26 has a pertinence of 5.6% while articles of pages 27-35; and 50-64 have 0.0% pertinence. The average pertinence for this journal issue is 8.9%.

Table 3: Analysis of citations in Journal of Brazilian Chemical Society (JBCS)

S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common citation	n_c	p
1.	Science Citation Index; ISI Alerting Service; SciELo	Vol. 25, No. 1	Chemometrics in Argentina…	5-8	-	-	-	Not Empirical Research Article (NERA)
2.	"	"	New Trends in Sample Preparation…	9-19	-	-	-	NERA
3.	"	"	Composition and Antifungal Activities…	20-26	18	Refs.: 18	1	5.6
4.	"	"	New Volumetry Based Technique…	27-35	9	-	0	0.0
5.	"	"	Enrichment of Tropical Peat with Micronutrient…	36-49	20	Refs.: 1; 4; 6; 8; 9; 14	6	30.0
6.	"	"	Evaluating Sedimentation Rates in…	50-64	11	-	0	0.0
	Average Pertinence for the Journal Issue							**8.9**

A breakdown of citations in Analytical Chemistry Research, the journal published in Europe by Elsevier is presented in Table 4 and Figure 3. For this journal issue, the first article published in the issue is an editorial – NERA. This specific article was not included in the analysis for this journal issue. For this issue, article published in pages 16-21 has the highest

pertinence of 18.2%. About 18.2% of citations made in the introduction section of this article truly support the reported study. Article published in pages 23-31 has pertinence of 9.1% while article in pages 8-15 has pertinence of 5.7%. The first article in pages 1-7 has 0.0% pertinence. The average pertinence for this journal issue is 8.3%.
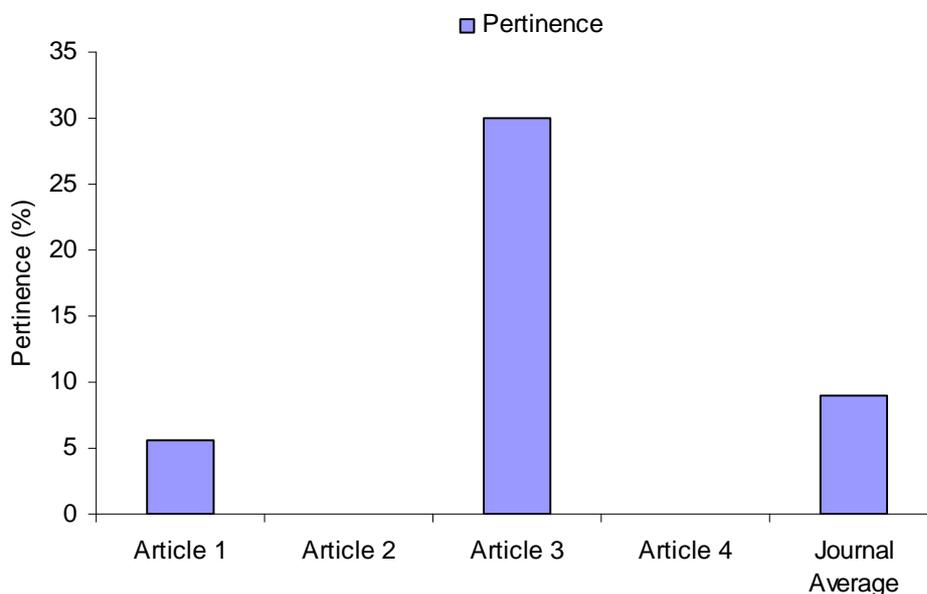
Figure 2 : Pertinence of Introduction Section in JBCS

Table 5 and Figure 4 show the analysis of citations in the introduction section of Applied Petrochemical Research (APR), the journal published by Springer in North America. Articles published in pages 1-2; 3-10; 11-31; 63-77 were not included in the analysis for this journal issue because they are NERA. Analysis of citations in this issue shows that article published in pages 79-84 has the highest pertinence of 12.5%. Articles in Pages 41-53 and 55-62 have pertinences of 6.3 and 5.9% respectively. Article published in pages 33-39 has 0.0% pertinence. The average pertinence for this issue is 6.2%.

Table 4: Analysis of citations in Analytical Chemistry Research (ACR)

S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common citation	n_c	p
1.	-	Vol. 1	Editorial	-	-	-	-	NERA
2.	"	"	Screening of Children Saliva Samples for…	1-7	18	-	0	0.0
3.	"	"	Identification of Toxic Cyclopeptides based…	8-15	35	Refs.:11; 12	2	5.7
4.	"	"	Parameters Affecting the Determination of…	16-21	33	Refs.: 10; 24; 25; 26; 27; 33	6	18.2
5.	"	"	Validated HPTLC Method for the Simultaneous	23-31	22	Refs.: 7; 16	2	9.1
	Average Pertinence for the Journal Issue							**8.3**

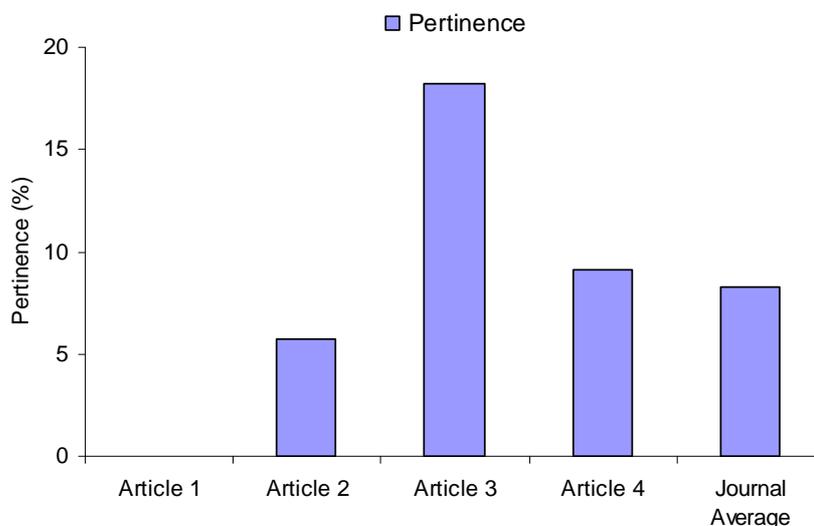Figure 3: Pertinence of Introduction Section in ACR
Table 5: Analysis of citations in Applied Petrochemical Research (APR)

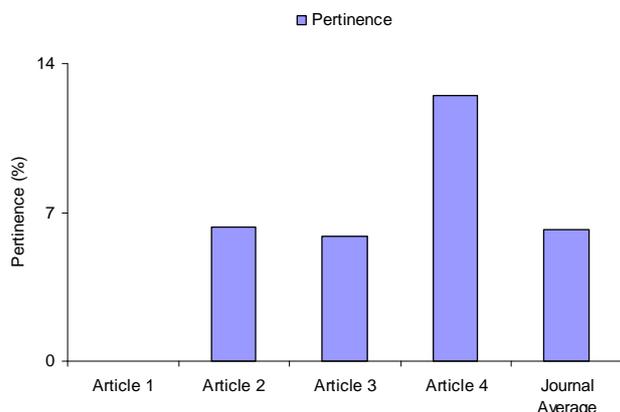| S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common citation	n_c	p
1.	Google Scholar, ChemWeb, DOAJ, CAS, EI-Compendex, OCLC, ProQuest	Vol. 4, No. 1	Preface for the Special Issue of the 3rd…	1-2	-	-	-	NERA
2.	"	"	Nitrides as Ammonia Synthesis…	3-10	-	-	-	NERA
3.	"	"	Catalysing Sustainable Fuel…	11-31	-	-	-	NERA
4.	"	"	Characterising Carbon Deposited During…	33-39	14	-	0	0.0
5.	"	"	CO2 Recycling Using Microalgae…	41-53	16	Refs.: 33	1	6.3
6.	"	"	Ethanol Photoreaction over…	55-62	17	Refs.: 12	1	5.9
7.	"	"	Carbon dioxide Capture and…	63-77	-	-	-	NERA
8.	"	"	Characterization of Polyethylene …	79-84	8	Refs.: 5	1	12.5
	Average Pertinence for the Journal Issue							**6.2**

Figure 4: Pertinence of Introduction Section in APR

Table 6 and Figure 5 present a breakdown of the citations in the South Pacific Journal of Natural and Applied Science. This journal was published in Australia by CSIRO Publishing. For this journal issue, the first article published is

NERA, as a result, this specific article was not included in the analysis for this journal issue. The highest pertinence for this issue is 28.6% which is from article published in pages 47-54. Articles published in pages 55-60; and 61-68 have pertinences of 20.0 and 16.1% respectively. Article in pages 43-46 has 0.0% pertinence. The average pertinence for this journal issue is 16.2%.

Analysis of citations in Asian Journal of Biochemistry (AJB) is presented in Table 7 and Figure 6. In this analysis, the first article published (i.e. article in pages 1-15) has the highest pertinence of 29.4%. Articles published in pages 16-29; and 30-40 have pertinences of 10.5% and 27.8% respectively. Article published in pages 41-48 has 0.0% pertinence. The average pertinence for this issue is 17.0%.
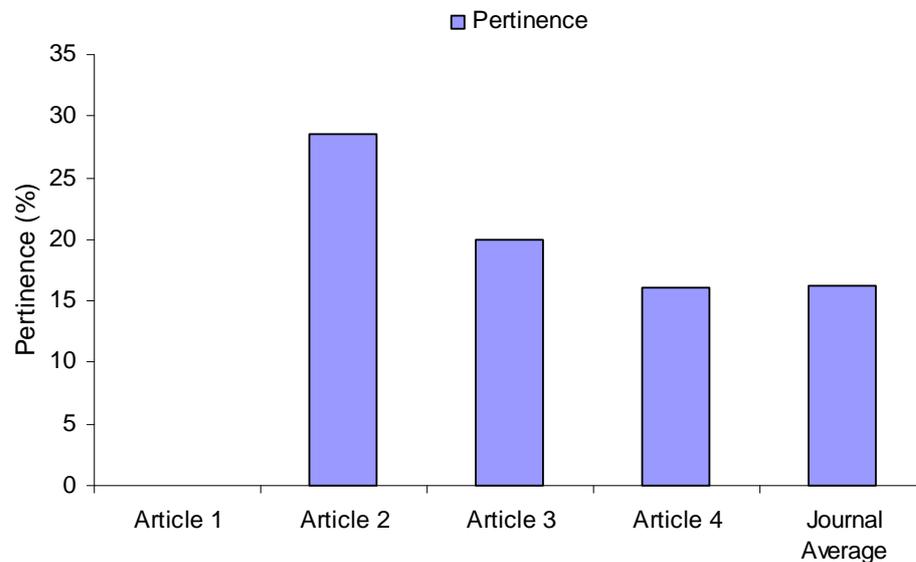
Table 6: Analysis of citations in The South Pacific Journal of Natural and Applied Science (SPJNAS)

S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common citation	n_c	p
1.	-	Vol. 32	Fuzzy Energy Distribution to a Variable…	37-42	-	-	-	NERA
2.	"	"	Isolation and Characterization of …	43-46	7	-	0	0.0
3.	"	"	Surface Ozone Profile at Selected…	47-54	21	Derwent et al., (2007); Sicard et al., (2009); Schultz et al., (1999); Oltmans et al., (2001); Gregory et al., (1999)	6	28.6
4.	"	"	In Vitro Micro Propagation…	55-60	10	Monette and James, (1990); Carvalho et al., (2008	2	20.0
5.	"	"	Evaluation of Soil Nutrient…	61-68	31	Prasad, (2006); Panapasa, (2012); Havlin et al., (2005); Jahiruddin and Satter, (2010); Mbah and Onweremadu, (2009)	5	16.1
	Average Pertinence for the Journal Issue							16.2

Figure 5: Pertinence of Introduction Section in SPJNAS

Table 7: Analysis of citations in Asian Journal of Biochemistry (AJB)

| S/N	Journal Indexing	Journal Issue	Title of Article (First few words)	Article Page	N_c	Common citation	n_c	p
1.	Google Scholar, ISI, SCIMAGO, SCOPUS, Thomson ISI	Vol. 9	Fatty Acids composition…	1-15	17	Blank et al., (1993); Igal et al., (2001); Said, (2007); Edwards et al., (2008); Vessal et al., (2003)	5	29.4
2.	"	"	Studies of Dimensional…	16-29	19	Hill, (2006); Musta et al., (1999)	2	10.5
3.	"	"	Camel Milk Regulates…	30-40	18	Dallak, (2009); Khan and Alzohairy, (2011);Afifi, (2010); Al-Hasheun, (2009); Al-Fartosi et al., (2012)	5	27.8
4.	"	"	Correlation Studies on…	41-48	17	-	0	0.0
	Average Pertinence for the Journal Issue							**17.0**
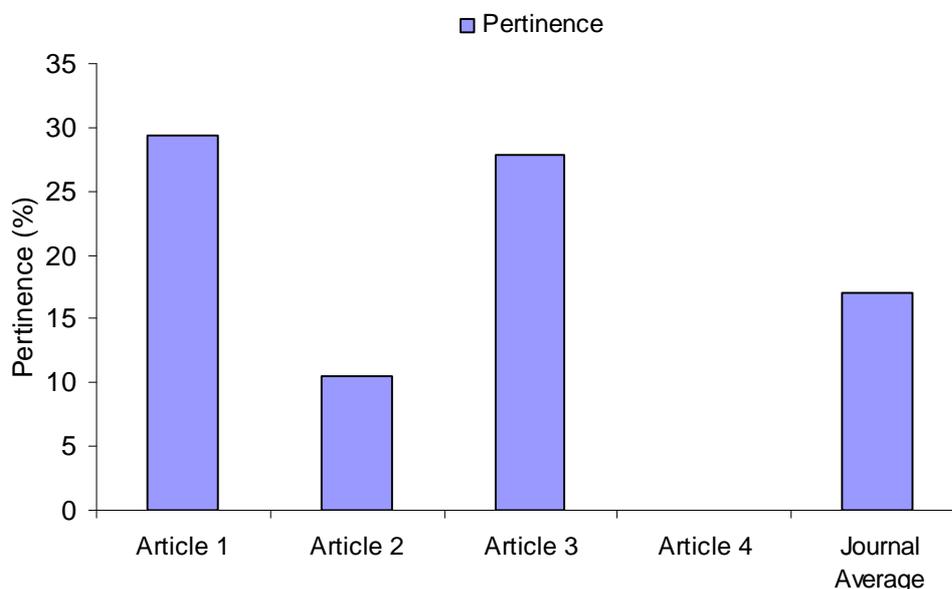
Figure 6: Pertinence of Introduction Section in AJB

Figure 7 presents the average pertinence for each of the journal analyzed. From this Figure, it is seen that the Asian Journal of Biochemistry (AJB) published in Singapore by Scialert has the highest average pertinence of 17.0%, followed by the Australian Journal – SPJNAS, which has average pertinence of 16.2%. Journal of Brazilian Chemical Society (JBCS) is next with pertinence of 8.9%. The journals; Analytical Chemistry Research (ACR) and applied Petrochemical Research (APR) have pertinences of 8.3 and 6.2% respectively. The South African Journal of Chemistry (SAJC) has the lowest average pertinence of 3.3%. The average pertinence for the entire journal analyzed is found by calculating the mean for the average pertinences for all the journals analyzed i.e.

$$p_m = \frac{p_{SAJC} + p_{JBCS} + p_{ACR} + p_{APR} + p_{SPJNAS} + p_{AJB}}{6} \qquad (2)$$

Where p_m is the mean of the average pertinences for the entire journals analyzed.

$$p_m = \frac{(3.3 + 8.9 + 8.3 + 6.2 + 16.2 + 17.0)\%}{6} \qquad (3)$$

$$p_m = 10.0\% \qquad (4)$$

This shows that, on the average, only 10.0% of citations in the introduction sections of articles reporting empirical researches are pertinent to the reported research. This result is supported by the predictions made by Adedayo[3]. In his study, Adedayo[2,3] extended the work of Saha et al.,[4] drawing similarities between citations and votes. When citations are considered as votes, Adedayo[3] predicted that about 80% of citations made in the introduction sections may not be applicable in the computation of effective impact of publications.

Figure 8 gives overview of the variation of pertinence of the publications analyzed for the entire study. The figure showed that the range of

pertinence for the entire study falls below 30%. This shows that the article with the highest pertinence has about seventy percent (70%)

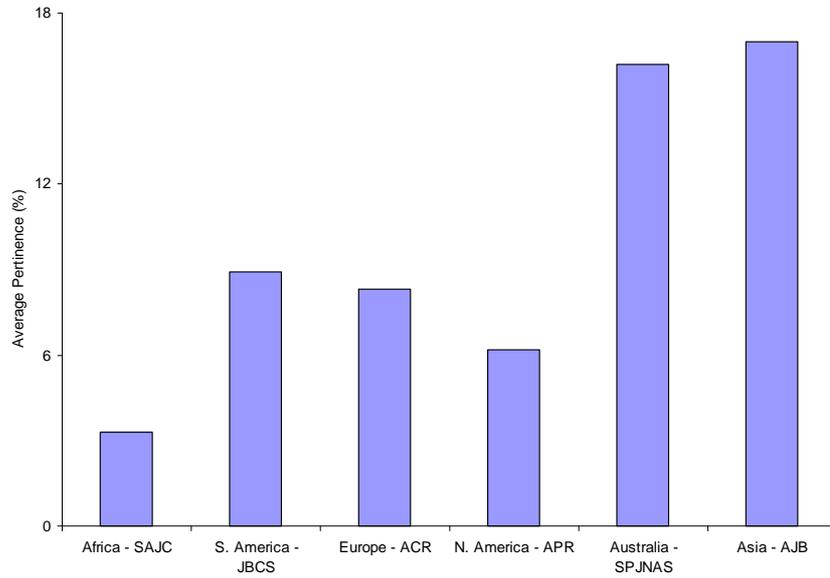citations which may not be related to the subject discussed in the articles.

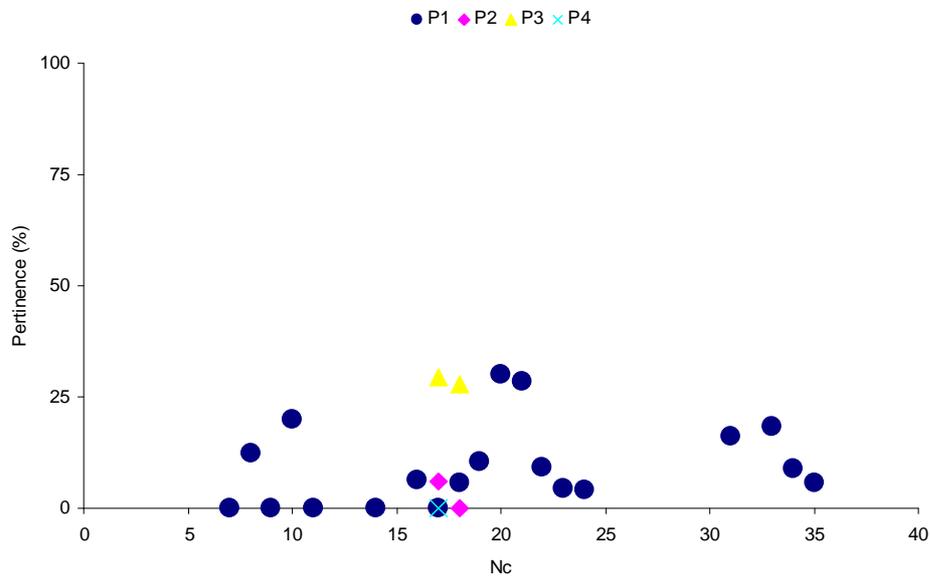Figure 7: Average Pertinence for the Entire Journals Analyzed

Figure 8: Overview of the Variation of Pertinence of the Publications Analyzed

Conclusion: The study has shown that significant proportion of citations made in the introduction sections of scientific articles represent figment of imagination of the citing author. This because, any citation made in the Introduction/Literature Review that cannot be cited in the Methodology/Results/Discussion of Results/Conclusions can only be stated to have imagined pertinence to the study. The pertinence is only a figment in the Imagination of the citing author. Overall, over 80% of citations made in the Introduction/Literature Review cannot be cited in the Methodology/Results/Discussion of Results/Conclusions. In this light, therefore, citations in scientific articles can be validly classified into two i.e. Citations in Imaginary sections and citations in the Real sections. Also, *pertinence;* a new parameter useful in the evaluation of scientific publications has been introduced.

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