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TO WHOM IT MAY CONCERN

The full papers were refereed by a double-blind reviewing process according to South Africa's Department of Higher Education and Training (DHET) refereeing standards. Before accepting a paper, authors were to include the corrections as stated by the peer-reviewers. Of the 59 full papers received, 41 were accepted for the Proceedings (acceptance rate: 69.5%).

Papers were reviewed according to the following criteria:

- Relevancy of the paper to Web-based applications
- Explanation of the research problem & investigative questions
- Quality of the literature analysis
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Content versus quality: a Web of Science, Scopus and Google Scholar comparison

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Abstract

Citation tracking and citation analysis is facilitated by making use of online information resources via the Web which specialize in citations and tools for conducting citation analysis. The prolific growth of the online citation resources like Scopus and Google Scholar created new opportunities for academics in citation tracking and citation analysis. This paper presents the results of a comparative study of Web of Science (WOS), Scopus, and Google Scholar (GS) for the South African environmental sciences scholarly journals.
The objectives of this study included comparing WOS, Scopus and GS on a macro-level, micro-level, in order to determine whether GS could be considered a substitute for the fee-based citation resources WOS and Scopus. The South African scholarly environmental sciences journals were chosen as the target population. This paper focus on the results of the content verification process which measured amongst others the citation counts, multiple copies and inconsistencies encountered across the three citation resources WOS, Scopus and GS. The results regarding the total citation count of the three citation resources indicated that WOS retrieved the most citation counts. In addition GS retrieved the most multiple copies which included duplicates and triplicates. The study also show that all three citation resources retrieved unique citation hits of which WOS retrieved the most. The study was able to establish that GS is not yet a substitute for WOS and/or Scopus for the South African scholarly environmental sciences journals internationally accredited during the period 2004-2008. It was concluded that GS can be used as a supplementary citation resource to the fee-based citation resources WOS and Scopus.

Keywords: Google Scholar, Web of Science, Scopus, citation resources, comparing citation resources

1. Introduction

Citation resources have become an important tool for citation analysis at academic institutions. These resources are used to retrieve citation references in order to conduct citation analysis in an attempt to measure the impact and contribution of a study to the body of knowledge. Generally, citation resources are used to keep track

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of who is doing what research, and the impact of the research within the discipline. The prolific growth of the online citation resources like Scopus and Google Scholar created new opportunities for academics in citation tracking and citation analysis. This paper presents the results of a comparative study of Web of Science (WOS), Scopus, and Google Scholar (GS) for the South African environmental sciences scholarly journals.

2. Citations and citation resources

In order to define a citation resource effectively, it is necessary to clarify what is meant by a citation and to highlight the importance of citations and citation analysis in scholarly information. Citing is the process by which scholars give recognition to research used by another academic researcher. A citation can be described as a written reference to a specific work or portion of a work (book, article, dissertation, report, musical composition, etc.) by a particular author, editor, composer, etc., that clearly identifies the document in which the work is to be found. The frequency with which a work is cited is sometimes considered a measure of its importance in the literature of the field (Reitz, 2004:142).

Citation analysis is therefore an attempt to measure the impact and contribution of a study to the body of knowledge and research (Pringle, 2008:90; Wohlin, 2007:2; Grant, 1991:557). Citation resources are tools used by academics for keeping track of who was doing what research, and the impact of the research within the discipline.

Using the understanding of citation, the concept ‘citation resource’ can be clarified. This concept is also referred to as ‘citation index’, ‘citation tool’, ‘source index’ and ‘subject index’ (Bar-Ilan, Levene & Lin, 2007:26). Reitz (2004:143) describes a citation index as a tool in which works cited during a specific year are listed alphabetically by name of author cited, followed by the names of the citing authors (sources). Full bibliographic information for the citing author is given in a source index. Also provided is a subject index, usually listing articles by significant words in the title.

In terms of this study a citation resource includes any print, electronic or Web-based resource which includes citation references, cited references and citation analyses tools for the purpose of accessing citation trends. This study focused on the three citation resources, Web of Science, Scopus and Google Scholar.

3. Web of Science, Scopus and Google Scholar

WOS originates from the 1960s as a print citation index and was launched online in 1997, and currently comprises seven databases (Thomson Reuters, 2009:1). WOS has built up a reputation as the oldest resource, containing the most prestigious academic journals, used for the purpose of citation analysis (Norris & Oppenheim, 2007:141). Dess (2006:8) identifies WOS as the trail blazer for citation resources. For more than 40 years, WOS had no competitors (Meho & Yang, 2006:3).

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In November 2004, Elsevier launched Scopus as a multidisciplinary citation resource (Norris & Oppenheim, 2007:163). Dess (2006:8) refers to Scopus as an interdisciplinary citation resource which is marketed for Science, Technology and Medicine market. Scopus is an abstract and citation resource of research literature and Web sources. LaGuardia (2005:42) describes Scopus as a powerhouse for the sciences. According to Manafy (2005:12) the challenge for Scopus was to position itself as a citation resource in a market where WOS held the monopoly and where newcomers like GS began to gain momentum. Manafy stipulates that Scopus aimed to creating a new niche market by combining the best of both worlds: providing specific Web-based tools and features with peer-reviewed citation resources.

Google Scholar (GS) was introduction in 2004 in beta testing format as a citation resource which is available via the Web, and provides a simple way to broadly search scholarly information (Google, 2009:1). Newer versions with enhancements have been implemented. It was this very ability of GS to adapt and evolve while maintaining its simplicity that has caught the imagination of the information industry. The study by Harzing and Van der Wal (2008:12) describes GS as being responsible for the democratization of citation analysis. The appeal of GS lies in the fact that it is a free Web-based citation resource which allows easy access to scholarly information on any discipline (Jacso, 2005b:208).

4. Research methodology

This paper reports on the finding of the research done for a Masters study at the University of Johannesburg. The empirical component of the research used a comparative research design (Mouton, 2001:154). The journal population of the study included South African scholarly environmental sciences journals selected from the DoHET list of South African accredited journals. These adhered to an inclusive environmental sciences definition and were represented on the three citation resources. Purposive non-probability sampling was used to define the sample population which included only South African environmental sciences journals which were internationally accredited during the year range of 2004-2008. The sample consisted of the following nine journals: *African Entomology*, *African Journal of Marine Science*, *African Zoology*, *Bothalia*, *Ostrich*, *South African Journal of Botany*, *South African Journal of Geology*, *South African Journal of Wildlife Research* and *Water SA.*

One of the research aims was to compare the three citation resources with a view to establishing a possible substitute for WOS, and to determine whether GS could rather be a complementary and supplementary citation resource to WOS and Scopus. In addition the study identified the citation information resource with the most representative South African scholarly environmental sciences citation coverage. In order to do this the three citation resources were compared via:

- Macro-level evaluation
- Micro-level evaluation
- Content verification.

This paper reports on the results of the content verification process.

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4.1 Content verification

The content verification process established whether the citation resources retrieved is a true reflection of the complete content of the journal (e.g. comprehensive and complete set of citation hits). The verification of content therefore reflects not only the completeness of the journal contents but also the quality of the information represented by the retrieved data. A control list was drawn up from consulting the publisher archives and the SABINET database.

The contents of the journal articles of the nine journals were listed by year using the following data fields for verification purposes: authors, journal article title, volume, issue, beginning page and end page numbers. The verification list was compared to the data retrieved from the three citation resources to establish the content completeness and content quality of the journal article references. The content verification process involved the following:

- The number of citation hits, ultimately to attempt to establish the citation coverage of the journals across the three citation resources.
- Multiple copies, citation overlaps and unique items.
- The types of documents contained in and retrieved from the three citation resources.
- Inconsistencies retrieved during the data collection from the three citation resources.

The verification process enabled the researcher to identify certain content trends and inconsistencies in the content completeness and content quality of the total journal sample. In the following section is a discussion regarding the number of citation hits (counts); issues regarding multiple copies, citation overlaps and unique items; and types of documents and inconsistencies.

4.2 Total citation count (citation hits)

The results of the total citation hits, per journal per year of the total journal sample, are listed in table 1. The table includes the verification list (total citation count) as a measure to verify the comprehensiveness of the content retrieved from the three citation resources. The sample population (represent the original journal article master copies) derived from the verification control list totals 3 199 citations. The following totals were retrieved by the citation resources: WOS retrieved 2 740 citation references, Scopus 2 192 citation references and GS 2 715 citation resources. This indicates that WOS has the total average citation coverage of 85.7%, with Scopus at 68.5% and GS at 84.9%. Based on the results above WOS performed the best with total coverage of the journal sample population.

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Table 1: Journal article coverage of journal sample population across WOS, Scopus and GS

Journal Title	Total Citation Counts		WOS	Scopus	GS
African Entomology	Total	220	211	205	197
	Coverage		95.9%	93.2%	89.5%
African Journal of Marine Science	Total	279	248	261	277
	Coverage		88.6%	93.2%	98.9%
African Zoology	Total	200	168	168	195
	Coverage		84%	84%	97.5%
Bothalia	Total	176	157	152	136
	Coverage		89.2%	86.4%	77.3%
Ostrich	Total	439	338	275	350
	Coverage		77%	62.6%	79.7%
SA Journal of Botany	Total	1 045	980	438	802
	Coverage		93.8%	41.9%	76.7%
SA Journal of Geology	Total	232	125	185	200
	Coverage		53.9%	79.7%	86.2%
SA Journal of Wildlife Research	Total	123	105	105	110
	Coverage		85.4%	85.4 %	89.4%
Water SA	Total	484	408	403	447
	Coverage		84.3%	83.3%	92.4%
GRAND TOTAL		3 199	2 740	2 192	2 715
OVERALL % COVERAGE		100%	85.7%	68.5%	84.9%

4.3 The presence of multiple copies

Multiple copies include duplicates and triplicates of records retrieved from the citation resources. The analysis of the results indicates that GS was the only citation resource retrieving multiple copies (duplicates and triplicates). There were a total of 185 duplicate and 32 triplicate records. The figure below depicts an example of a GS duplicate result from the journal Bothalia.

Figure 1: Example of a duplicate GS result from the journal Bothalia

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The occurrences of multiple copies are confirmed by other studies (McKercher, 2008:1231; Jacso, 2008a:1; Jacso 2009:1). Jacso (2009:2; 2005a:368) even claims GS has a high duplication rate. The poor capability of consolidating matching records allows GS to inflate the citation hits which does not given a true reflection of the citation count (Jacso, 2005a:368). GS does not distinguish between the master copy and the citation reference and Jacso (2009:2) suggests GS will even retrieve two master copies from two different sources without consolidating and removing the duplicate. According to Harzing and Van der Wal (2008:6) the double counting can be as a result of the automatic processing of GS. Levine-Clark and Gil (2009:38) suggest that it could be attributed to the type of material and documents indexed by GS.

4.4 The citation overlap

The citation overlap can be described as the citations that are retrieved from the three citation resources which coincide with one another. A summary of the citation overlap is given in table e below. The results of the citation overlap across the period of 2004-2008 for the journal sample population, indicated a total citation count of 3 199. WOS, Scopus and GS had an overlap of 62.5%, WOS and GS 15%, Scopus and GS 3.2%, and WOS and Scopus 1.5%. The findings in a study by Sember, Utrobicic and Petrak (2010:101) were that the greatest overlap occurred between WOS and Scopus at 54%, with GS and Scopus at 51% and WOS and GS at 44%.

4.5 The unique citations

The unique citations can be described as the citations that are retrieved from only one of the three citation resources. The results of the unique items retrieved across the period of 2004-2008 for the journal sample population indicate that WOS retrieved the most unique items with a total of 302. GS retrieved a total of 254 unique items while Scopus retrieved 7.

According to the study by Bakkalbasi et al. in 2006 (Kloda (2007:88) investigating the number of unique items retrieved by the three citation resources WOS, Scopus and GS, they concluded that GS retrieved the most unique items. A study by Meho and Yang (2007:2123) found that the unique items in GS are not necessarily of the same quality as in the other two citation resources.

4.6 Inconsistencies encountered

During the content verification process inconsistencies were encountered in the following: data export, author, article title, page number, references and document type (Adriaanse & Rensleigh, 2010:1). The following are examples of the inconsistencies which were encountered.

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4.6.1 Data export inconsistencies

The results of the data exported from WOS into a tab delimited form with year limitation included incorrect data, e.g. the *South African Journal of Geology,* for the year 2004 included the references for issues 1 and 2 of year 2004 and issues 3 and 4 of year 2003.

For the 45 lists exported from WOS 31 lists included inconsistencies. Export inconsistencies also occurred in GS, e.g. an article from *African Journal of Marine Science* 2005, vol. 40(1), pages 99-106. On the other hand, no export inconsistencies were encountered in Scopus.

4.6.2 Author inconsistencies

Seven types of author inconsistencies were identified: author spelling, double-barrelled surnames, diacritical marks, author sequence, separated authors, incorrect authors and nonsensical authors.

Author spelling

No author spelling inconsistencies were encountered in Scopus but various incorrect spellings of authors' names were encountered for example in:

WOS: In the *South African Journal of Botany*:

- Year 2008, vol. 74(4) pages 25-32 {Ha, Y. instead of **Jia, Y.**}.
- Vol. 74(1) pages 101-110 {Conradle, K. instead of **Conradie, K.**}.
- Vol. 74(2) pages 367-367 {God, O. instead of **Gon, O.**}.
- Vol. 74(2) pages 368-368 {Gryvenhou, M. instead of **Gryvenhout, M.**}.
- Vol. 74(2) pages 369-369 {Johnon, S.D. instead of **Johnson, S.D.**}.

GS: In the journal *Water SA*:

- Vol. 30(2) pages 267-272 {Germ, W. instead of **Germs, W.**}.

Double-barrelled surnames

Double-barrelled surnames create problems as the first half of the surname can either fall away leaving only the second half, or the first character becomes an initial of the author. Examples can be located in the *African Journal of Marine Science*:

WOS: Year 2006, vol. 28(3&4) pages 525-533 {Velho, F.V. instead of **Vas Velho, F.**}.

- Vol. 27(1) pages 617-628 {Rae, C.M.D. instead of **Duncombe Rae, C.M.**}.

GS: Vol. 28(3&4) pages 525-533 {Velho, F.V. instead of **Vas Velho, F.**}.

Diacritical marks

There are several examples of diacritical marks which are omitted in the export lists. Examples of diacritical marks are ä, ö, ø and ü. The *Journal of African Entomology* includes examples:

WOS: Year 2006, vol. 14(1) pages 1-12 {Moller, A. instead of **Möller, A.**}.

GS: The journal *Water SA* includes examples:

- Vol. 31(4) pages 511-527 {Sotemann, S. instead of **Sötemann, S.**}.
- Vol. 31(4) pages 529-544 {Sotemann, S. instead of **Sötemann, S.**}.
- Vol. 31(4) pages 545-568 {Sotemann, S. instead of **Sötemann, S.**}.

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Author sequence
There are several examples of the sequence of authors differing from the verification control list.
GS: From *South African Journal of Wildlife Research*:
- Vol. 37(1) pages 61-70 {Somers, M.J; Nel, J.A.J. instead of **Nel, J.A.J.; Somers, M.J.**}.
- Vol. 37(1) pages 1-8 {Radzilani, P.M.; McIntyre, T.; Tshithabane, H.N.; Ramunasi, J.A.; De Bruyn, P.J.N.; Mulaudzi, T.W.; Pistorius, P.A.; Bester, M.N.; Hofmeyr, G.J.G. instead of **Hofmeyr, G.J.G.; Bester, M.N.; Pistorius, P.A.; Mulaudzi, T.W.; De Bruyn, P.J.N.; Ramunasi, J.A.; Tshithabane, H.N.; McIntyre, T.; Radzilani, PM.**}.
- Vol. 37(1) pages 101-103 {Scheepers, GJ; Sirdar, MM; Fasina, FO. instead of **Fasina, F.O.; Sirdar, M.M.; Scheepers, G.J.**}.
- Vol. 37(1) pages 127-131 {Woodborne, S.; Wallington, B.P.; McKechnie, A.E.; Owen-Smith, N. instead of **Wallington, BP; McKechnie, AE; Owen-Smith, N; Woodborne, S.**}.

Separated authors
There are examples of where the export lists which include one article with two authors are indicated as two separate journal articles with one author each.
Scopus: The journal *Water SA* includes examples:
- Vol. 30(4) pages 547-547 {Wendel, G.; (one reference) instead of **Wendel, G. and Winde, F.** (indicated as two separate references)}.

Incorrect authors
There are examples of where incorrect authors have been included in the export lists.
WOS: In *South African Journal of Geology*:
- Vol. 108(2) pages 309-313 {Hart, R.J.; McDonald, I.; Tredoux, M.; De Wit, M.J.; Carlson, R.W.; Andreoli, M.; Moser, D.E.; Ashwal, L.D. instead of **Gibson, R.L.; Reimold, W.; Lana, C.**}.

GS: In the journal *Ostrich*:
- Vol. 75(3) pages 95-105 {TWP, F. instead of **Friedl, T.W.P.**}.

Nonsensical authors
There are examples of where nonsensical authors are encountered in the author field.
GS: In the *African Journal of Marine Science*:
- Vol. 27(1) pages 343 {Users, F. Users, T. instead of **Compagno, L.J.V.**}.

GS: In the Journal *Ostrich*:
- Vol. 77(3&4) {Options, A; Latest, TOC instead of **(Anon)**}.

4.6.3 Article title inconsistencies
Five types of title inconsistencies occurred: article title and subtitle omissions, article title variations, article title and subtitle sequence, alternative language article titles and nonsensical article titles.

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Article title and subtitle omissions

The primary title, secondary title and/or subtitle are not represented.

GS: In *African Entomology*:

- Vol. 14(1) pages 193-194 {No title included instead of "**Habrocerus capillaricornis (Gravenhorst) (Coleoptera : Staphylinidae) discovered in South Africa**"}.

WOS: In *Bothalia*:

- Vol. 34(1) page 38 {"Ericaceae - Nomenclatural changes in Erica" instead of "**Ericaceae : nomenclatural changes in Ericas : notes of African plants**"}.

Article title variations

There were variations of the title that differs from the title in the control verification list. WOS: In *Bothalia*:

- Vol. 34(1) pages 27 {"Notes on African plants…" instead of "**Scrophulariaceae: type specimens of Selago, Jamesbrittenia and Sutera at Natal University Herbarium (NU): notes on African plants**". Title sequence – main primary title and subtitles not in sequence as it differs from the title in verification control list}.
- Vol. 34(2) pages 27-27 {"Notes on African plants…" instead of "**Scrophulariaceae: type specimens of Selago, Jamesbrittenia and Sutera at Natal University Herbarium (NU): notes on African plants**"}. Title differs from title on verification control list. No full title due to item being editorial material.

GS: In *Bothalia*:

- Vol. 34(2) pages 27 {Includes duplication – one correct sequence as in journal - Scrophulariaceae: type specimens of Selago, Jamesbrittenia and Sureta at Natal University Herbarium (NU): Notes on African plants. The other starts with Notes on African plants: Scrophulariaceae: type specimens of Selago, Jamesbrittenia and Sureta at Natal University Herbarium (NU)}.

Scopus: In *Water SA*:

- Vol. 30(1) pages 130-130 {Erratum: Levels of… instead of "**Levels of Cd, Hg and Zn in some surface waters from the Eastern Cape Province, South Africa**"}.

Article title and subtitle sequence

There where instances where the title sequence has not been maintained and the primary title and secondary title or subtitles are not in sequence as in the verification control list. WOS: In *Bothalia*:

- Vol. 34(1) page 27 {"Notes on African plants" instead of "**Scrophulariaceae: type specimens of Selago, Jamesbrittenia and Sutera at Natal University Herbarium (NU): notes on African plants.**"}.

Alternate language article titles

There are alternative languages for the given references exported. The export lists indicate duplicate records, e.g. one in French and one in English. Although one record essentially, they were presented as two separate records on the export lists.

GS: In *Ostrich* examples of articles in French:

- Vol. 78(2) pages 401 - 403 {English title = Contribution to the monitoring of the nestling Lesser Kestrel (Falco naumanni) at the aqueduct of Zaghouan (Tunisia) and **French title =** "**Contribution au suivi de la population nicheuse du faucon crecerellette (Falco naumanni) à l'Aqueduc de Zaghouan (Tunisie)**"}.

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Nonsensical article titles

There are examples of nonsensical titles in the title field.

GS: In *South African Journal of Botany*:

- Vol. 70(2) pages 181-190 {Where am I?:: Home> Products> Journals> instead of "**The regulation of plant growth and development in liquid culture.**"}.

GS: In *Ostrich*:

- Vol. 78(2) {Support Tool instead of "**Jack Skead, 1912-2006 – Obituary.**"}.
- Vol. 78(2) {Browse journals| About| Article order info.| Register| Search instead of "**Jack Skead, 1912-2006 – Obituary.**"}.

GS: In *South African Journal of Geology*:

- Vol. 107(3) pages 413-430 {Click on image to view larger version. Figure 3.(B) 87 Rb/86 Sr versus 87 Sr/86 Sr showing primary fluorite (circles) and secondary fluorite (squares) instead of "**Rb-Sr and Nd-Sm isotopes in fluorite related to the granites of the Bushveld Complex.**"}.

4.6.4 Volume number inconsistencies

From the extracted data there were instances where the journal volume numbers were omitted.

GS: In *South African Journal of Botany*:

- Vol. ?(No volume number given) instead of **Vol. 72(2)** for the article "Seasonal variation of naphthoquinones in Euclea natalensis subspecies natalensis." by Bapela, M.J.; Lall, N.; Meyer, J.J.M.

4.6.5 Issue number inconsistencies

The inconsistencies include references with issue number omissions and incorrect issue numbers.

Issue number omitted

WOS: In *African Journal of Marine Science*:

- Vol. 26 (no issue number) instead of **Vol. 26(1)** for the article "Ecosystem approaches to fisheries in the southern Benguela – Foreword." by Christensen, V.

Scopus: In *African Journal of Marine Science*:

- Vol. 26 (no issue number) instead of **Vol. 26(1)** for the article "Ecosystem approaches to fisheries in the southern Benguela – Foreword." by Christensen, V.

GS: In *South African Journal of Geology*:

- Vol. 109 (no issue number) instead of **Vol. 109(4)** for the article "Advances in geophysics." by Hatch, D. See figure 5.28.

Incorrect issue number

These include references with incorrect issue numbers.

GS: In *Ostrich*:

- Vol. 76(3) instead of **Vol. 76(3&4)** for the article "Reproductive success and nesting periodicity of a pair of African Crowned Eagles breeding in KwaZulu-Natal." by Malan, G.

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4.6.6 Page number inconsistencies

Two types of page number inconsistencies were identified: page numbers omitted and incorrect page numbers.

Page numbers omitted

Page numbers are omitted on the export lists, for example:

WOS: In *South African Journal of Botany*:

- Vol. 70(4) pages 660 to + instead of **Vol. 70(4) pages 660-663**.

Scopus: In *Ostrich*:

- Vol. 75(4) no pages instead of **Vol. 75(4) pages VI-VI.**

GS: In *Ostrich*:

- Vol. 78(2) no page instead of **Vol. 78(2) pages 291-293**.

Incorrect pages numbers

The page numbers indicated on the exported lists differ from the page numbers indicated on the verification control list.

WOS: In *Water SA*:

- Vol. 33(1) pages 51-"+" instead of **Vol. 33(1) pages 51-59**.
- Vol. 33(5) pages 665-673 instead of **Vol. 33(5) pages 665-674**.
- Vol. 34(1) pages 1-9 instead of **Vol. 34(1) pages 1-10**.
- Vol. 34(1) pages 11-17 instead of **Vol. 34(1) pages 11-18**.
- Vol. 34(1) pages 25-31 instead of **Vol. 34(1) pages 25-32**.
- Vol. 34(1) pages 61-69 instead of **Vol. 34(1) pages 61-70**.
- Vol. 34(1) pages 127-132 instead of **Vol. 34(1) pages 126-132**.
- Vol. 34(1) pages 133-140 instead of **Vol. 34(1) pages 134-140**.

WOS: In *South African Journal of Geology*:

- Vol. 109(1-2) pages 1-6 instead of **Vol. 109(1-2) pages 1-5**.
- Vol. 109(1-2) pages 7-10 instead of **Vol. 109(1-2) pages 6-10**.

GS: In *African Entomology*:

- Vol. 12(1) pages 135-139 instead of **Vol. 12(1) pages 133-137**.

4.7 Summary of results

Inconsistencies were encountered in the completeness and quality of the content of the journal articles found in the exported lists of WOS, Scopus and GS. GS displayed the most inconsistencies with a total of 448 (14%). WOS with a total of 165 (5.2%) displayed the second most and Scopus had a total of 14 (0.4%). It is evident that Scopus surpasses WOS and GS regarding inconsistencies encountered during the completeness and quality of the content verification process.

There are examples of studies in the literature which refer to the errors and inconsistencies relating to retrieved citations during a citation search. Marx, Schier and Wanitschek (2001:80) describe a correct citation as having no mistakes concerning the first author's name, publication year, the volume and starting page. These can then be seen as the important elements of a citation.

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The problem of nonsensical authors is referred to extensively in the studies by Jacso (2008:105; 2009:2). The studies refer to GS's inability to distinguish between author names and other parts of the text as a serious disadvantage. Regarding the author names with diacritical marks, the study by Harzing and Van der Wal (2007:11) indicates that WOS and GS have the problem of indexing author names with diacritical marks and do not support author names with diacritical marks.

Given the results of the study it is clear that inconsistencies occur in all three of the citation resources. GS had the most inconsistencies followed by WOS.

5. Conclusion

This paper reports on the content verification results of a study to compare the three citation resources, WOS, Scopus and GS, in the South African environmental sciences journals which were internationally accredited during the year range of 2004-2008. The content verification was the third phase after macro- and micro-level evaluation.

It became evident during the content verification process that the citation resources retrieved varied results. The total citation counts indicated that WOS retrieved the most citation results, followed by GS and then Scopus. WOS performed the best with total coverage of the journal sample population and also retrieved the most unique items.

The investigation into multiple copies indicated that WOS and Scopus retrieved no duplicates, while GS retrieved multiples copies. Scopus delivered the least inconsistencies regarding content verification and content quality compared to the other two citation resources. GS retrieved the most inconsistencies, with WOS retrieving more inconsistencies than Scopus.

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