

Citation Analysis of Master Dissertations at the Central University of Technology, South Africa

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Abstract

Data must be given context to become information. Information must be given meaning to become knowledge. Knowledge, in turn, can only become wisdom if applied correctly. Data from postgraduate dissertations, including an analysis of the types of citations used, can give rise to information that can subsequently contribute to knowledge and wisdom. This type of analysis is warranted, as it has been reported that poor references are a common fault in dissertations. The purpose of this article is to analyse 157 Master dissertations from 19 different disciplines that were completed over a 10-year period at one university in order to identify the types and the trends of the citations used in order to highlight any major concerns with regard to credibility. An ex-post facto study is used where citation analysis is used to obtain quantitative data. Results reveal that 17063 citations were used in total, where the disciplines of Electrical Engineering and Information Technology had the highest number of internet-based sources, as compared to journal articles and books. Engineering postgraduate students also used a fewer number of citations (average of 60 per dissertation) as compared to students in Humanities (103 citations per dissertation), Environmental Sciences (138 citations per dissertation) and Management (121 citations per dissertation). The use of Wikipedia was limited to 79 citations, of which almost 50% was found in Electrical Engineering. An important implication of this research is that it may help postgraduate students to select more credible

sources for their citations, formatting them more correctly so as to easily identify their types. This in turn may have a bearing on improving the quality of their dissertations that may ease the examination process.

Keywords: Internet, Journals, Conferences, Disciplines, Bibliometrics

Introduction

“I hope that, in the future, data is used to empower people and not just for marketing purposes” (Brainy Quote, 2019). These words, by Hilary Mason, a 20th Century English actress, conveys the idea that data should be used to enrich the lives of people, or empower them, rather than just being used for statistical, or marketing, purposes. However, this data needs to be transformed into information, by adding context, and then into knowledge, by adding meaning. Finally, it must be applied in the correct way to enable the acquisition of wisdom that truly enriches or empowers a person.

Applying knowledge in the correct way may well be equated to “putting knowledge to work” or “fusing theory with practice” or “practising knowledge”. This has been advocated for many years, and especially within the field of higher education. Engineering curricula must include this fusion (Swart, 2010) as must academic writing. It has been stated that students must practise academic writing and referencing skills in advance to prevent plagiarism (Girard, 2004) and to achieve academic success. This is especially applicable to postgraduate students who need to apply knowledge about academic writing in the correct way so as to ensure that their dissertations meet an acceptable level of quality.

Why, though, gather data from completed postgraduate dissertations? Swart (2018) mentioned a number of reasons, including the fact that postgraduate students struggle to structure their

dissertation correctly (Schulze, 2012). The structure of a dissertation encompasses a number of variables, including the title page, the various chapters, the references and the annexures (Flamez et al., 2017). It has been noted that poor references are a common fault of dissertations (Atkinson and Johns, 2001) that may be construed as unscholarly practice (Mutula, 2015). Postgraduate students should be made aware of what common referencing mistakes exist in order to avoid them so that they may enhance their scholarly practice. It can also create awareness of the number and types of citations that have been used by postgraduate students in different disciplines. This type of awareness may help postgraduate students through their academic writing journey (Azkah et al., 2016), as they continue to put into practice acquired knowledge. It has been noted that efforts to address poor referencing practice should be focused on during the early years of undergraduate programmes, at which point students are still honing their academic skills (Brown et al., 2018).

One way to hone academic writing skills is to read and cite academic journal articles. In fact, academic journals are the best sources to use for academic writing (Johnson, 2016). However, in recent years, the growth of the Internet has enabled students to access information more easily (Nadzir and Puteh, 2017), giving rise to more Internet-based sources being used for citations. However, these sources are not always credible. Scholarly information on the web is no longer limited to a finite number of publishers whose role as gatekeepers of knowledge has remained virtually the same in online and traditional publications. Within this new digital landscape, everyone can be a producer as well as a consumer of information that introduces unique issues of trust for researchers (Tenopir et al., 2016).

The research question thus arises “What types of citations have been used by postgraduate students over a 10-year period where the Internet has gained prominence? This relates to credibility in two ways: first, what types of sources are being used; second, have the citations been formatted correctly. Previous studies have sought to determine the types of source that were cited during pre-web and post-web periods (Condic, 2015), reporting the number of different types of citations and citation age (Eckel, 2009; Swanepoel, 2010; Becker and Chiware, 2015;

Chande-Mallya and Sife, 2015; Ahmadiéh et al., 2016; Sinha et al., 2016; Poplašén and Romiæ, 2018; Fasae and Aladeniyi, 2019; Nishat et al., 2019). However, many of these studies were limited to specific disciplines where light was not shed on the trend of usage between a number of disciplines.

The purpose of this article is to analyse 157 Master dissertations from 19 different disciplines that were completed over a 10-year period at one university in order to identify the types and the trends of the citations used in order to highlight any major concerns with regard to credibility. These dissertations are sourced from the institution’s online repository and analysed using citation analysis. The tree of informetrics is firstly reviewed along with a brief list of credible citations, followed by the context of this study. The methodology, the results and the discussion are then presented, followed by succinct conclusions.

The Family Tree of Informetrics and a Brief List of Credible Sources

Informetrics is used and/or applied across many disciplines, which include library management, the sociology of science, history of science, information retrieval, and biometrics, econometrics, chemometrics, sociometrics, and quantitative linguistics (Onyancha, 2014). It has also been applied to different disciplines within Engineering, Humanities, Management and Environmental Sciences when considering postgraduate dissertations (Swart, 2018). The basic tree of informetrics is shown in Figure 1, where citation analysis falls under Bibliometrics. Citation analysis has been defined as “a bibliometric technique in which works cited in publications are examined to determine patterns of scholarly communication; for example, the comparative importance of books versus journals, or of current versus retrospective sources, in one or more academic disciplines” (Reitz, 2004). Citation analysis can be used to:

- assess the performance of scientists (Garfield and Sher, 1963);
- illustrate the influence of a particular research, researcher, or field on a selected publication (Jeung et al., 2011);
- determine the most influential scientific papers

in specific fields (Wrafter et al., 2016);

- to understand the uptake and spread of a theoretical framework (Boyko et al., 2016);
- assess the aptitude of researchers towards the learning resources they usually read and cite during the conduction of their research (Ullah et al., 2018);
- examine any type of writing which includes citations and/or source lists and for research into student writing abilities (Weaver and Barnard, 2019); and
- to examine research trends, patterns and interactions (Leung et al., 2019).

In this study, citation analysis is used to determine the types and the trends of the citations used by 157 postgraduate students across 19 different disciplines who completed a Master's Degree between 2005 and 2014. This may provide insight into the aptitude of these students as to what sources they read and cite while also highlighting any possible research trends with regard to the use of internet-based sources. It may also help establish if postgraduate students are consistently formatting their citations correctly in their academic writing.

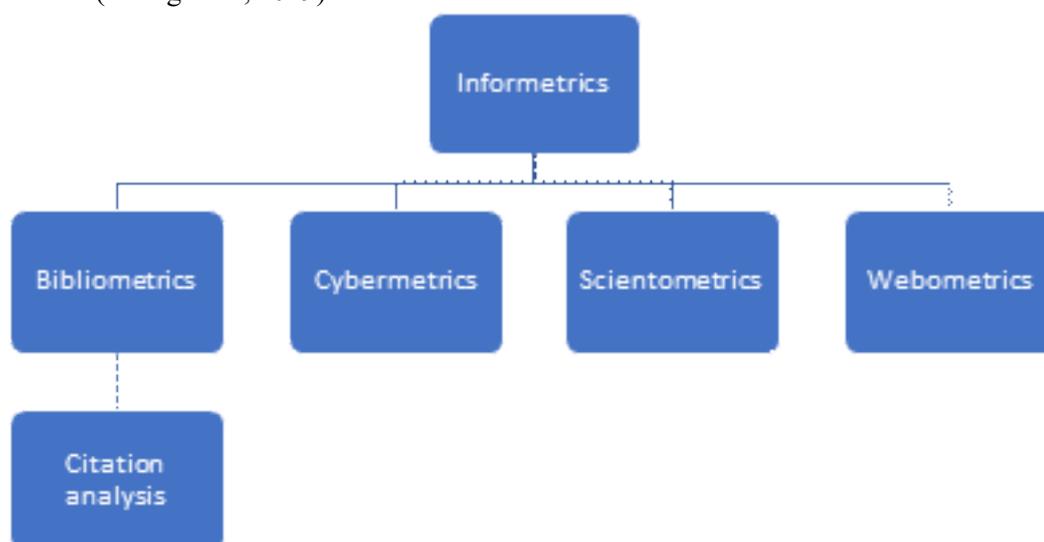


Figure 1: Informetrics family tree (Swart, 2018)

Credible sources for citations must include academic journals, peer-reviewed conference papers, peer-reviewed books, and book chapters and dissertations (see Table 1). These types of citations have been peer-reviewed by experts in their relevant fields, having been accepted as valid and reliable. Schmied (2018) states that credibility in academic writing requires evaluation by peer-review. In academia, research visibility and quality research have largely been seen from the vantage point of research publications that appear in peer

refereed journals (Ocholla, Mostert and Rotich, 2016).

Non-credible sources would include specific Internet websites. For example, Vallely (2015) states that uncritical quoting of weak sources, like Wikipedia, by students in the field of music has been found. Many academics oppose the use of Wikipedia completely, whereas others hold that it may be used as a jump page to find a credible source, as it is a tertiary source where writers with no credibility can make a contribution (Schmied, 2018).

Table 1: Brief list of credible sources according to priority

Priority	Source	Advice
1.	Journal articles	Seek peer-reviewed journals from non-predatory publishers
2.	Conference papers	Seek full conference papers that have been peer-reviewed and NOT abstracts alone
3.	Dissertations	Seek dissertations from university repositories that have also been examined
4.	Books and book chapters	Seek ones that have been reviewed or that have been published by reputable publishers
5.	Internet websites	Seek .org or university based or research foundation based URLs

Wikipedia has been called the encyclopaedia ‘anyone can edit’ (Ross, 2018). It must be emphasised that any source of information that has not been peer-reviewed cannot be accepted as being scientifically sound. In fact, peer review is fundamental to scientific advancement where the acquisition of wisdom through science can inspire confidence in the knowledge gained (Desselle et al., 2019). Table 1 is not exhaustive in its list of credible sources. There are manuals, handbooks, policies, government documents, reports, newspapers interviews, etc. In determining which sources to use, postgraduate students should try to consider the time it was published and if there is any evidence of peer review.

Study Context

The Central University of Technology (CUT) is

located in the Central Region of South Africa (Central University of Technology, 2017), being one of six universities of technology in the country (Swart, 2015). It was originally designated as the Free State Technikon in 1981. Technikon’s specialised in offering diploma and certificate courses that were geared to the needs of industry (Schoole and Ojo, 2015). In 2004, it was re-designated as a university of technology, being called CUT. This type of university has a strong vocation-driven teaching mandate with some strong applicable research focus (Pitso, 2013). CUT registered a number of Master degrees (called the MTech degree (Magister Technologiae)) with the Council on Higher Education as a NQF (National Qualifications Framework) level 9 qualification. These postgraduate degrees would be offered by all four faculties at CUT (see Table 2 for a concise overview).

Table 2: Faculties, number of departments and staff members at CUT during 2015 (Swart, 2018)

Faculty Name	Number of Departments	Number of Academic Staff Student	Number of Undergraduate Students	Staff to Students Ratio	Number of Postgraduate Students
Engineering and Information Technology (FEIT)	6	86	4465	51.9	216
Humanities (FH)	5	74	3645	49.2	588
Health and Environmental Sciences (FHES)	4	55	1642	29.8	38
Management Sciences (FMS)	6	80	4419	55.2	83

The overview of the four faculties at CUT indicates that the Faculty of Health and Environmental Sciences (FHES) has the least number of academic staff (55), while the Faculty of Engineering and Information Technology (FEIT) has the largest number (86). The largest number of postgraduate students (588) resides in the Faculty of Humanities (FH), while the Faculty of Management Science (FMS) has the largest staff to student ratio (1:55.2). These statistics help to better contextualize the results of this study that were obtained using the following research methodology.

Research Methodology

An ex-post facto study is employed where citation analysis is used to obtain quantitative data. An ex-post facto study has certain limitations, including an inherent lack of control of the independent variable or variables; no randomisation of the sample; and difficulties in establishing the direction of causality (one cannot ascertain cause and effect, only correlation) (Sabo and Thornburg, 2015). However, in this research, no control is exerted and no randomisation is required, as all the dissertations on the institution's repository were analysed (this equals the corpus of this study which totals 157 Master

dissertations from 19 different disciplines). No causality is required, as only the number and types of citations used over this period is required in order to highlight any major concerns with regard to credibility.

The quantitative data was extracted using a software program that was specifically developed for this purpose by a contracted software developer. The software program automatically downloads the dissertations (which are in PDF format) from the institutions online repository (termed the DSpace Repository (Central University of Technology, 2019)). The program then extracts all the citations from each PDF and inserts them into an online database for further analysis. Using specific field codes, it extracts different types of citations (see Figure 3 for a list of these types of citations). For example, consider books. The software program scans all the citations for the following words: edition, Press, publisher, publishing, st ed, number+nd ed, rd ed, number+th ed. Similar specific field codes are used for the other types of references.

The reliability of the data was determined using an inter-rater reliability test. This was achieved by using purposive sampling. Purposive sampling involves drawing a sample composed of cases that fulfil prior criteria chosen by the researcher (Maestripieri et al., 2019). In this case, an entire

discipline must be covered, as the software program can be set to extract data per student, per discipline and per faculty. One discipline per faculty was chosen that had around 5 dissertations. These included Civil Engineering (3), Language Practice (5), Radiography (5) and Business Administration (5) – the number in brackets indicates the number of dissertations that were physically analysed per discipline. This provided a purposive sample of 18 Master dissertations which were physically reviewed (PDF format used) by the researchers where the number and types of citations used were categorised and recorded in an MS EXCEL sheet.

Reference types with counts higher than 8% of the total references per discipline were considered. This eliminates scenarios where

reference types with low counts may negatively influence the reliability score. For example, a reference type may be counted as 1 by the software program and as 3 by the rater, giving rise to reliability score of only 33%. The manual examination of citations using hard copies (or prints) in order to conduct a citation analysis can also be very tedious and sometimes inaccurate (Onyanha, 2009). The results of this analysis are shown in Table 3, which gives rise to the three highest number of reference types per discipline. An average reliability score of 95,6%, 86,5% and 93,2% was observed for the three highest number of reference types. Scores higher than 80% are considered to indicate very high reliability (Wagenaar et al., 2005). The extracted data was then analysed in MS EXCEL, with the results presented next.

Table 3: Reliability scores for the inter-rater reliability test

Reference Type	Analysis Type	Radiography	Business Admin.	Language Practice	Civil Eng.	Average Reliability Score
Books	Software analysis	24%	24%	35%	9%	95,6%
	Rater analysis	24%	24%	34%	10%	
Internet	Software analysis	11%	26%	26%	9%	86,5%
	Rater analysis	10%	23%	23%	7%	
Journals	Software analysis	47%	37%	19%	61%	93,2%
	Rater analysis	43%	38%	17%	65%	

Results and Discussions

Figure 2 highlights the number of dissertations (17063 in total) produced over the 10-year period that were available to the public on the online repository of CUT. No dissertations exist prior to 2005, due to the fact that the institution was a Technikon, with no real research focus. Since becoming a university of technology in 2004, a window of the institutions research needed to be provided to the outside world, which dissertations can provide according to Baro and Oriode (2014). A peak number of postgraduate

students completed their Master's degree in 2013 (being 34), with the lowest number in 2005 (being 2). The low numbers are indicative of the transformation from a Technikon to a university of technology, as well as of the small number of qualified supervisors that would have to hold a minimum of a Master's degree. The dominant qualification of academic staff at a Technikon would have been a Bachelor's degree or a Higher Diploma. Figure 3 shows the different types of reference sources used over the 10-year period, with their individual number of counts or occurrences.

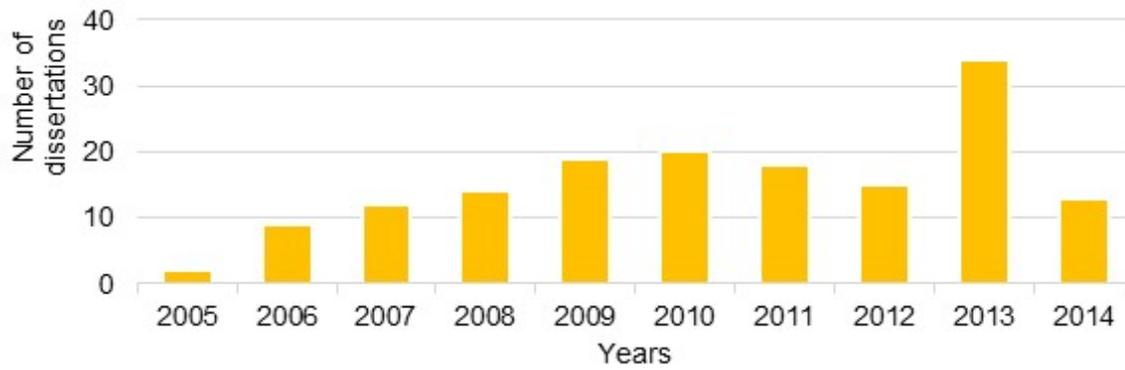


Figure 2: Number of dissertations produced per year over a 10-year period

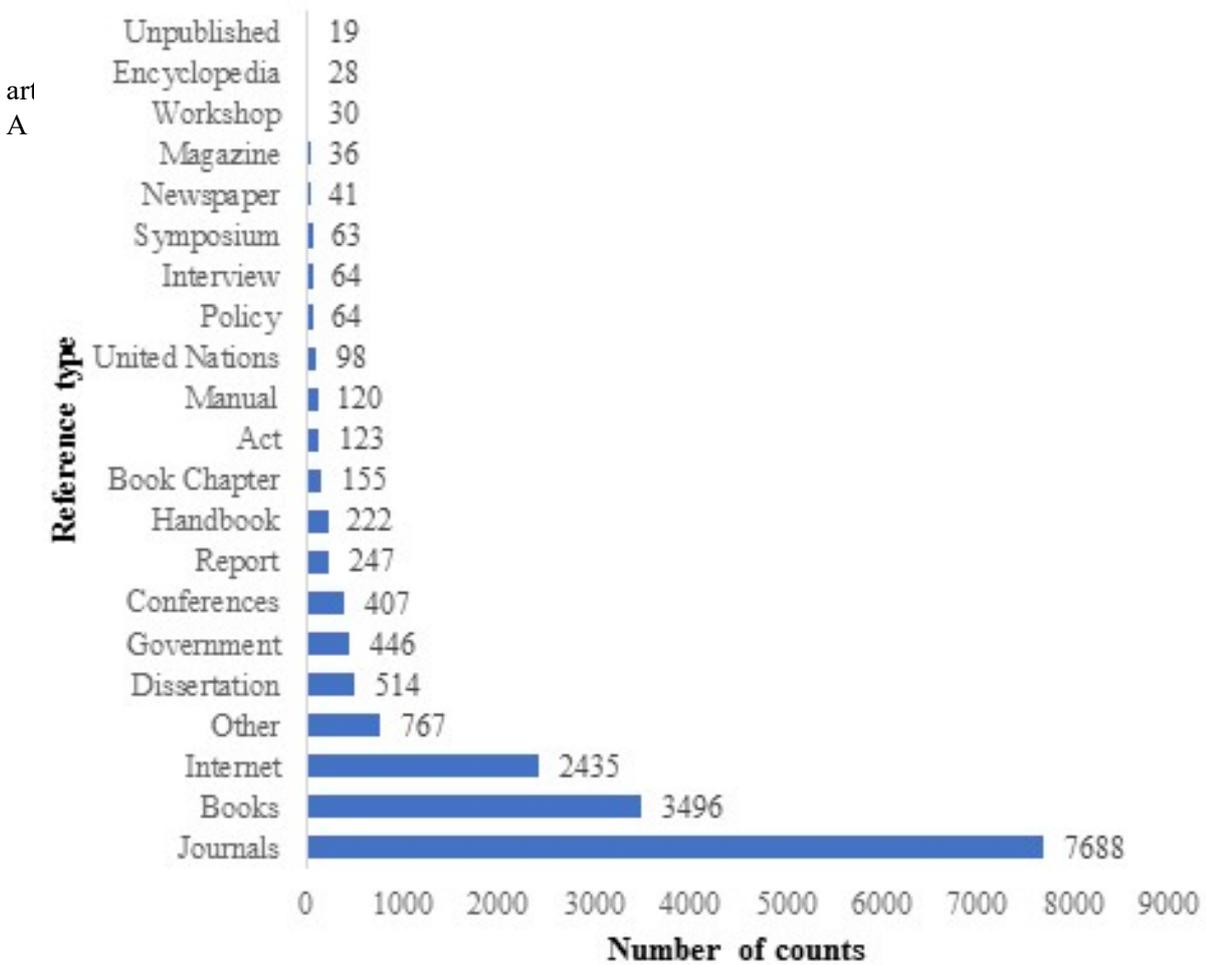


Figure 3: Types of citations used along with their number of counts out of a total of 17063

considered citation patterns in Master's dissertations submitted at the Assam University, Silchar between 2012 and 2013 (Sinha et al., 2016). However, that study did not report on the differences between disciplines. Internet-based sources accounted for 2435 citations, while the number that could not be categorised tallied 767 (Other). This suggests that many of the postgraduate students have acquired the aptitude of reading and citing credible sources, as journals and book sources represent 65,5% of all the citations (17063).

Figure 4 presents a breakdown of the top three reference types with regard to their years of publication. This analysis is given to highlight the

relevance of the citations to the time period of interest, being from 2005 through 2014. The top three reference types used by postgraduate students that were published after 1999 represent 53% of the total citations (17063). This same time period was covered by a study that analysed citation patterns of postgraduate dissertations in the Faculty of Engineering at the Cape Peninsula University of Technology (Becker and Chiware, 2015). However, it was also limited to just one field of study, being Engineering.

Figure 6 contrasts the 19 disciplines from the four main faculties with regard to the three main

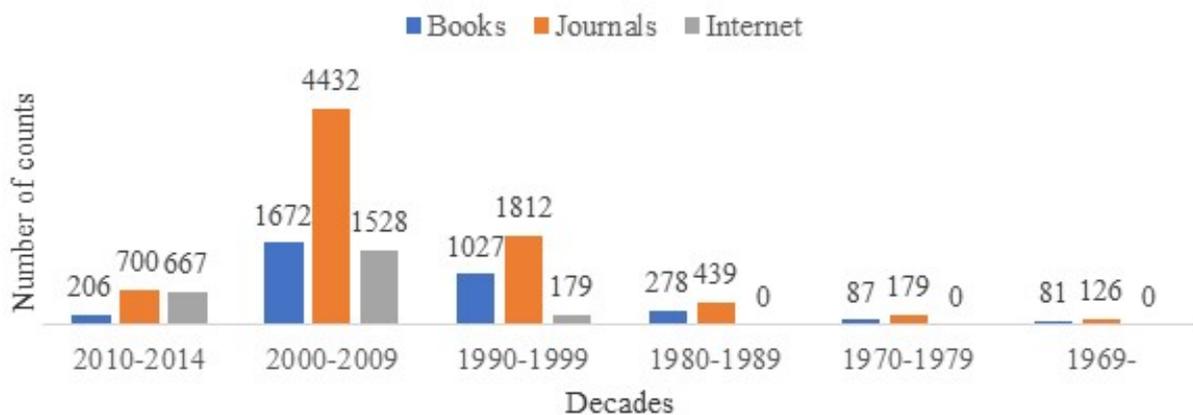


Figure 4: Top three types of citations used over the past decades

This is further confirmed when considering Figure 5 that shows the percentage of the total number of citations with regard to their years of publication. The majority of sources that were read and cited by the postgraduate students were originally published between 2000 and 2009 (representing 58%) with a further 10% occurring between 2010 and 2014. This suggests that postgraduate students acquired the aptitude of reading and citing sources that were not older than 15 years, thereby indicating

their relevance to their research topics. The results are similar to another study that sought to determine and compare the type (13 identified) and age (average of 14 years) of cited literature in master's theses of three academic disciplines at the American University of Beirut (AUB), Lebanon (Ahmadih et al., 2016). However, that study was limited to the disciplines of biology, mechanical engineering and political science.

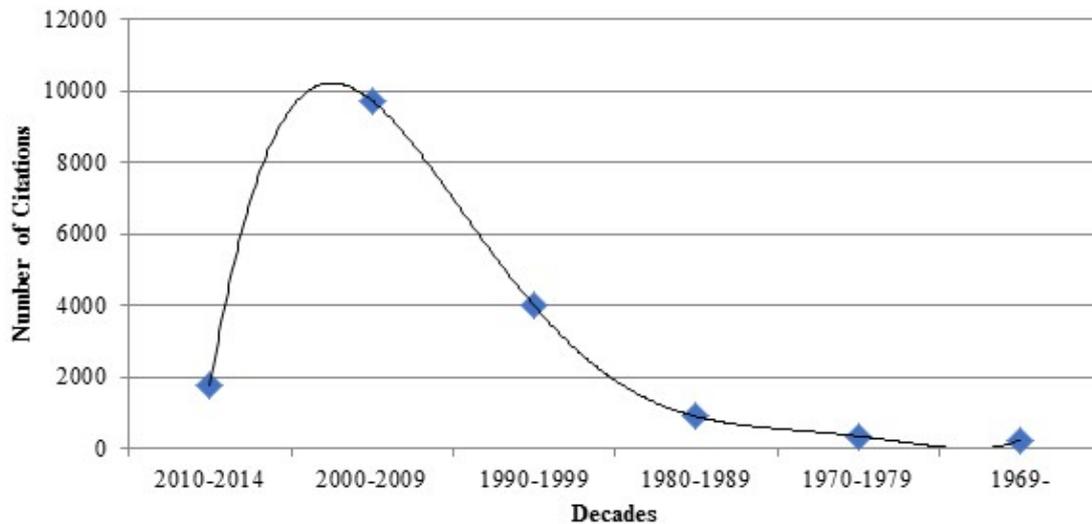


Figure 5: Citations emanating from different decades (total equals 17063)

(the citation type, Other, is also included). Students from Arts and Culture, Education, Marketing and Photography used more book sources as compared to journals and the Internet. Students from Agriculture, Biomedical Technology, Civil Engineering, Clinical Technology, Environmental Health, Graphic Design and Radiography cited more journal articles as compared to books and the internet. Internet-based sources accounted for the

highest number of citations by students in Electrical Engineering and Information Technology. This is different from a study done in Nigeria, where internet-based sources accounted for the fourth highest number of citations in Electrical Engineering (Fasae and Aladeniyi, 2019).

The finding that more Internet-based sources are used in Information Technology is similar to a study conducted at the Tshwane University of

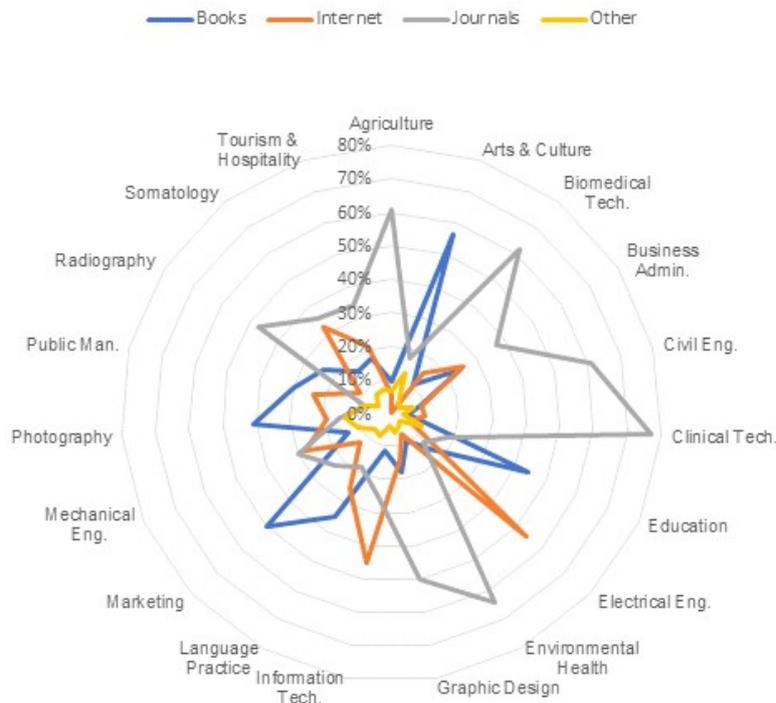


Figure 6: Field disciplines with their reference count percentages for Journals, Books and Internet-based sources

Technology in SA (Swanepoel, 2010). That study also revealed what types of information sources postgraduate students use most often and how their patterns of use differ across seven different faculties. However, it did not provide an average number of citations per discipline.

Figure 7 illustrates the average number of citations per dissertation per discipline (bar column). Tourism and Hospitality had the highest number of

citations per dissertation, being 194. The discipline of Electrical Engineering had the lowest number of citations per dissertation, being 51. This is much higher than the 31 citations per dissertation that were found at the Western Michigan University (Eckel, 2009) that only considered disciplines in engineering.

Students from the FEIT had the lowest number of average citations per dissertation (60.2) with the highest percentage of Internet-based sources (41%)

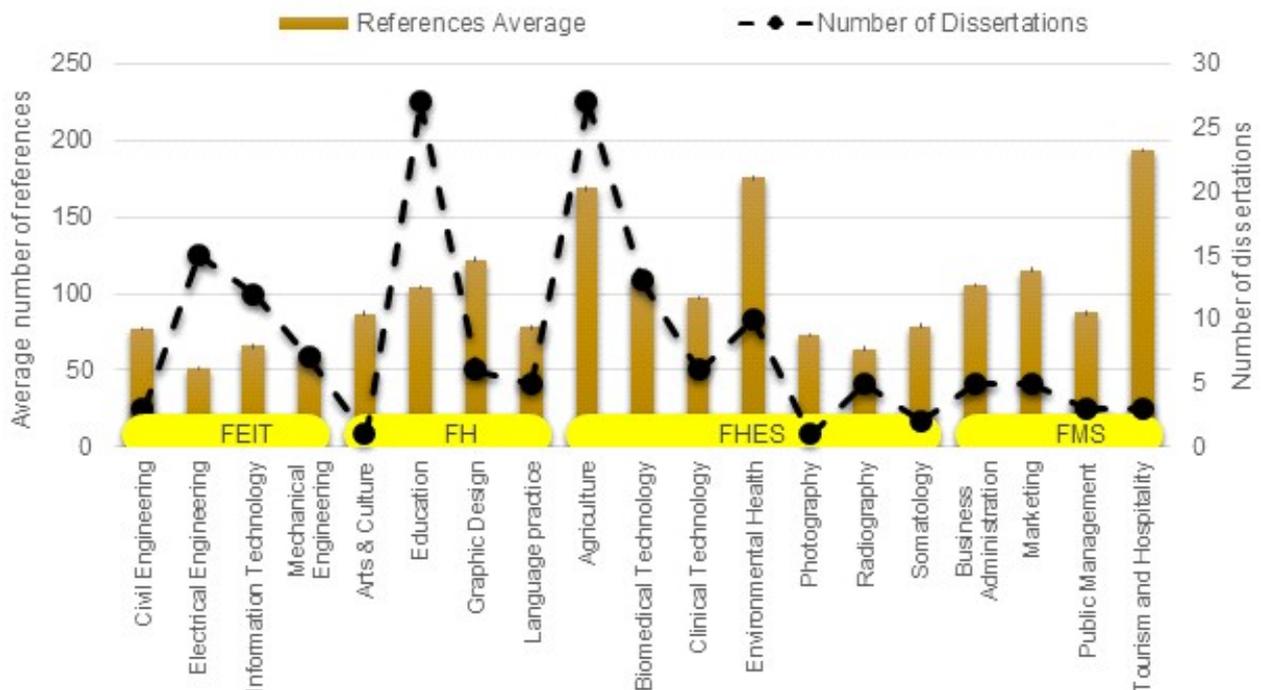


Figure 7: Average number of citations per dissertation per discipline

Figure 8 gives a breakdown of the number of dissertations per discipline (area graph) as a percentage of the 157 dissertations. It also provides the number of citations per discipline as a percentage of the 17063 citations. The disciplines of Education and Agriculture account for 34% of all the dissertations with Arts and Culture and Photography contributing less than 4%. What is evident is that

the citations as a percentage of their total are consistently lower than the dissertations as a percentage of their total for the Faculty of Engineering and Information Technology (FEIT). This is further discerned in Table 4 that shows the overall differences between the four faculties in terms of the number and type of citations used by the postgraduate students.

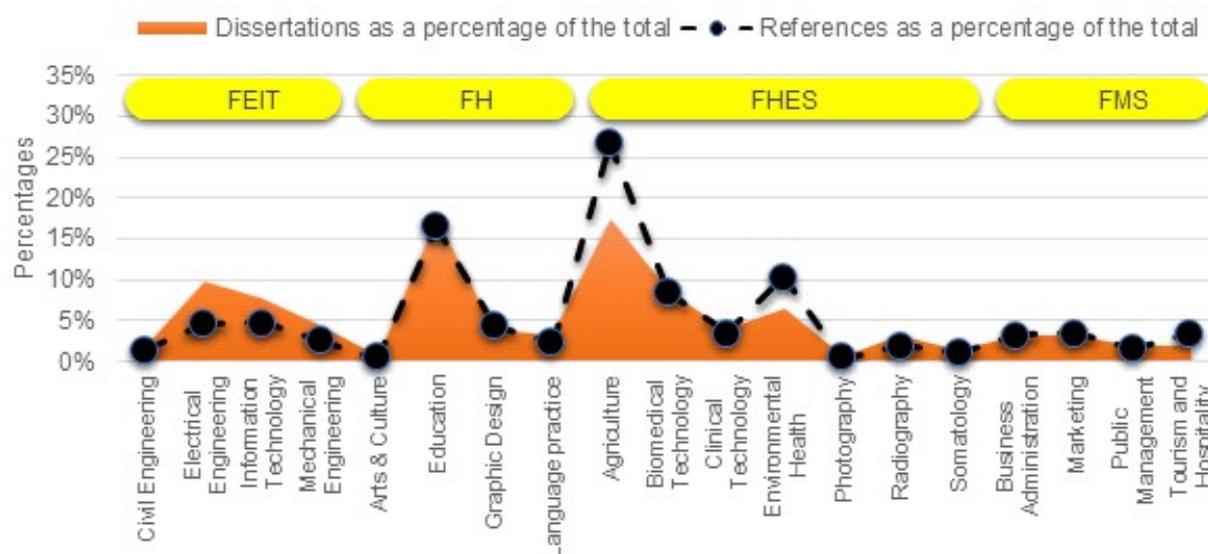


Figure 8: Dissertations and citations as percentages of the total count

of 2229). Students from the Faculty of Health and Environmental Sciences (FHES) had the highest number of average citations per dissertation (138,4), while citing the highest percentage of journals (61% of 8857). Students from the Faculty of Humanities (FH) cited the highest number of books (40% of 4028) with students from the FMS in second place (31% of 1949). Journals, books and Internet-based sources make up 80% of the citations in the FEIT

and 81% in the FHES. The study done at Tshwane University of Technology in SA revealed that citations to journals and books add up to almost 70% of all citations (Swanepoel, 2010).

The citation analysis from this study revealed six key aspects, as summarised in Table 4. Firstly, the high number of Internet-based sources in the FEIT suggests that students from that faculty have not really acquired the aptitude of reading and citing

Table 4: Overall differences between the four Faculties in terms of the number and the main type of citations used in student dissertations

Data	FEIT	FH	FHES	FMS
Number of dissertations	37	39	64	16
Number of citations	2229	4028	8857	1949
Journals	26%	24%	61%	28%
Books	14%	40%	11%	31%
Internet	41%	9%	8%	20%
Other	5%	9%	6%	6%
Top 3 as a percentage	80%	73%	81%	79%
Citations per dissertation	60,2	103,3	138,4	121,8

credible sources. They seem to be primarily scanning the Internet for information and not really engaging with journals or books in their postgraduate studies. This is concerning as everyone can be a producer as well as a consumer of information in this digital age (Tenopir, Levine, Christian, Volentine, Boehm, Nichols, Nicholas, Jamali, and Herman, 2016) casting doubts over the credibility of the sources. Note that Internet-based sources were categorised after journals, books and conference papers have been categorised by the software program, and can therefore not include any of these reference types.

Secondly, the high number of citations from book sources occurs in the FH and in the FMS, suggesting that students from those faculties have acquired the aptitude of reading and citing more credible sources. This may also indicate why students from these faculties produce dissertations with the highest number of words, as noted by Swart (2018).

Thirdly, students in the FHES are reading and citing more than double the number of journals than students from other faculties are citing, being 61% of all the citations in that faculty. Another study revealed that journals were the most preferred source of information used by the students in the field of nursing (part of Health Sciences) accounting for 56% of all their citations (Poplašén and Romiæ, 2018). Moreover, in the field of environmental science, journal citations are the key to significant research (Dovers, Carter and Ross, 2018).

Fourthly, the average number of citations per dissertation exceeded 100 in the FH, the FHES, and the FMS, with the FEIT having an average number of 60 citations per dissertation. This is much higher than an analysis of 549 master dissertations that yielded a total of 30405 references with an average of 55.4 references per dissertation at the Muhimbili University of Health and Allied Sciences in Tanzania (Chande-Mallya and Sife, 2015). It is also higher than another study that considered a total of 6935 references in 136 dissertations that equaled 51 average citations per dissertation (Nishat et al., 2019). However, those studies did not consider the trend between a number of disciplines or faculties.

Fifthly, the number of citations that could not be categorised (termed Other) ranged from 5% to 9%. This suggests that a number of students are not always formatting their citations correctly. Inaccurate

or incomplete citation and reference data as recorded by graduate students were also noted and listed as a limitation in a study of master dissertations theses at the American University of Beirut, Lebanon (Ahmadieh et al., 2016). That same study concluded that it is evident that students need more help and guidance in creating their reference lists and properly formatting their citations.

Lastly, journals, books and Internet-based sources make up around 78% of all the citations at the university. It has been stated that a more democratised perspective on knowledge has gained greater exposure through scholarly journals, books, and the Internet (Rowell and Hong, 2017). Furthermore, around 68% of all citations originated after 1999, resulting in a citation age of less than 15 years for more than two-thirds of all the citations (last dissertation that was analysed was submitted in 2014).

Conclusion

The original research question stated “What types of citations have been used by postgraduate students over a 10-year period where the Internet has gained prominence? The results indicate that journals, books and Internet-based sources account for 78% of the total references (17063). The Faculty of Health and Environmental Sciences had the highest number of journal citations (61% of their total number), while the Faculty of Engineering and Information Technology had the largest number of Internet-based sources (41% of their total number). Books featured predominately in the Faculty of Humanities and the Faculty of Management Sciences. Over two-thirds of all the citations have a citation age of less than 15 years, while the average citations per faculty range from 60,2 (Engineering and Information Technology) to 138,4 (Health and Environmental Sciences).

Students in the disciplines of Arts and Culture, Education, Marketing and Photography used more book sources while students in Agriculture, Biomedical Technology, Civil Engineering, Clinical Technology, Environmental Health, Graphic Design and Radiography cited more journal articles. Students in the disciplines of Electrical Engineering and Information Technology read and cited more internet-based sources. Other citations (ones that could not be categorised due to formatting issues) tallied 767, representing between 5% and 9% within

the faculties.

The results of this study have established the main types of citations used by 157 master students over a 10-year period across 19 disciplines. It has also established the trend of the citations during the advent of the Internet, where only two disciplines were found to have more Internet-based sources. It is recommended that these results, and particularly Table 4, be shared with all postgraduate students, so that they may be better equipped to choose more credible sources for their references that they always need to format consistently. Indeed, consistency is often a mark of quality.

Gathered information must be processed in regard to what is already known so that it can help to create meaning or improve understanding of specific phenomena. In this way, further meaning and understanding may be fostered that can lead to the acquisition of wisdom that can truly enrich, or empower, postgraduate students to complete their dissertation with more credible references.

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