Computing Research Performance Evaluation: an Exploratory Study into the Impact of NACCQ Research

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Abstract

This paper reports the findings of a preliminary investigation into the impact of research within the New Zealand National Advisory Committee on Computing Qualifications (NACCQ) sector. Using a strategy based predominantly upon keyword search of academic reference databases, the study found that NACCQ projects and publications are beginning to be cited in diverse outlets, and are now making a contribution to the international literature in the computing disciplines. The paper introduces some issues facing those with an interest in evaluating the performance of research in computing related disciplines. The study and its findings are briefly reviewed and the outlets in which NACCQ research has been cited are tabulated. This paper establishes the first profile of international citations for NACCQ research and provides a replicable baseline for subsequent studies into the impact of research originating in the sector. A further contribution of the paper is in highlighting the promising new research area that databases, search engines and digital libraries offer for expanded bibliometric research studies into the impact of computing research.

Keywords: NACCQ, computing research, computing education research,research publications, research impact.

1 Introduction

This paper reports the results of a preliminary investigation into the impact of the New Zealand National Advisory Committee on Computing Qualifications (NACCQ) sector originated research. For this sector of tertiary computing educators, which originated from a joint concern with computing curricula, research has developed significantly from its initial beginnings, accompanying the introduction of degree programmes into the sector in the mid-late 1990's.

The structure of this paper borrows in part from the study into computer science research conducted by Ramesh, Glass & Vessey, (2004).

2 The current study

2.1 Determining a suitable Classification scheme

A large variety of approaches are available for measuring research impact (Katterattanakul, Han & Hong, 2003, Moed, 2005), for journal rankings (Mylonopoulos & Theoharakis, 2001, Geary, Marriott & Rowlinson, 2004, Harzing, 2006), and research classification schemes (Ramesh et al., 2004, Glass, Vessey & Ramesh, 2002, Glass, Ramesh & Vessey, 2004).

While noting these more sophisticated techniques, the research reported in this paper has adopted a relatively simple approach, for reasons of: economy of effort and time; replicability of the study; recency of the data; and the relative youth and emerging nature of the NACCQ research community (NACCQ, 2006).

It must be recognised that the first edition of the NACCQ sponsored New Zealand Journal of Applied Computing and Information Technology was published in 1997, (with only the 2004 and 2005 editions recently made available online through the EBSCO Australian and New Zealand reference database). The first fully formalised edition (i.e. registered with an ISBN no.) of the NACCQ annual conference proceedings was published in 1998.

Thus the relative recency of its publishing history and comparative youth of the NACCQ research community militate against using well established citation databases (e.g. those such as the science citation index (SCI) or social science citation index (SSCI) included in the ISI Web Of Science, (Thomson, 2006), as these indices are heavily weighted towards journal citations only.

It is a characteristic of NACCQ research (as with a large body of computing research), that much of the research originates in conference proceedings, and is often subsequently cited in further conference proceedings. This different emphasis between disciplines for particular types of research output has been noted by Paul Callaghan PBRF moderation chair "peer reviewed publications might be the best indicator of research quality in physics, but for computer science conference papers might be better because knowledge was advancing so quickly in that field" (Gerritsen, 2004).

In contrast to this computing discipline perspective, when searched by the authors, the ISI conference proceedings indices appeared rather dated, with for instance the latest ACM SIGCSE Bulletin held in the database appearing to be dated 2001, and the ACM SIGCSE Technical Symposium Proceedings dated 2000. For these reasons this well known reference database was not used in gathering data for this paper.

The merit of this decision was reinforced subsequent to the presentation of an earlier version of this paper at the 2006 NACCQ conference (Clear & Young, 2006). A recent book on citation analysis in research evaluation

(Moed, 2005), highlights serious limitations in the Thomson ISI Web of Science database (ISI), when evaluating research by citation analysis in the Computing, Information Systems and Education fields. The ISI coverage of publications in different fields varies significantly by discipline. The table below indicates the coverage level for those disciplines considered (by the authors) most relevant to NACCQ researchers.

Table 1: ISI coverage – for relevant major journal categories and disciplines

Journal category	Imp Jnl	Cov Jnl	Ovl Cov
Engineering			
Comp Sci. (AI)	53	77	41
Comp Sci. Theory	45	70	31
Robotics	49	67	33
Economics			
Management	59	76	45
Other Social Sciences			
Educational Sciences	42	65	27
Info & library Sci.	47	71	33

Notes:

1) Figures derived from Moed (2005, pp. 129-130)
2) *Imp Jnl* – importance of journals as communication media within the field %
3) *Cov Jnl* – ISI coverage of the journal literature %
4) *Ovl Cov* – overall ISI coverage of the field %

As a more general finding, the bibliometric analysis conducted by Moed (2005, p.133) indicated that in several disciplines "the importance of journals in the scholarly communication systems was found to be less than in other disciplines". The disciplines relevant to computing appear particularly affected by this trend. The distinction between 'pure' and 'applied' research is suggested as an explanatory factor for non journal citation.

As Moed (ibid.) observes, "In engineering and applied sciences, conference proceedings and technical reference works play an important part in the exchange of information". The Engineering field (within which computer science resides in ISI) was noted to have the highest percentage of references to non journal items. In a recent study of scholarly communication in China, corroborating figures indicate not only that "computer science relies more on conference papers than other subjects" (Yan & Liu, 2005), but also reports a high ratio of citation of conference papers, namely 25.1% in Chinese Journals and 37.3% in English journals.

As highlighted in table 1 above, the journal categories most relevant to NACCQ researchers generally have less than 40% overall coverage in the ISI database.

Moed (2005, P. 150) further observes that the ISI citation indexes should be applied cautiously when assessing research in the social sciences and the humanities, "particularly in the subfields that have a qualitative rather than a quantitative orientation". Thus the ISI citation indexes can be viewed as biased not only against certain fields, but also against certain types of research.

2.2 Keyword & search approach

The approach adopted for this study then, involved a search of two research databases, the Elsevier database "SCOPUS" (http://www.scopus.com/scopus/home.url) and the Google database "GoogleScholar" (http://scholar.google.com/).

The following three keyword search strings were input into each database:

1. "NACCQ"
2. "New Zealand Journal of Applied Computing and Information Technology" and
3. "Bulletin of Applied Computing and Information Technology"

These three selections were chosen to enable searches with coverage of the key research publications from the NACCQ sector, namely the conference proceedings, the journal and the bulletin.

For the SCOPUS database searches the search was further refined by a set comprising the following options:

> [**in** "References"; **Published** "all years" **to** "present"; **Document type** = "all"; Subject Areas = "all"] (input as search parameters)

The reason for choice of these two databases were primarily: coverage (they both include conference proceedings as well as journals, in addition to web references); and their relative currency. The SCOPUS database, claims to cover 15,000 peer reviewed titles and 200 million quality web sources (SCOPUS, 2006). While not fully current, the database does nonetheless include several conference proceedings in its *sources* (e.g. ACM ITiCSE conferences 2000 & 2001) and the latest ACM SIGCSE Bulletin edition included is dated 2003. [These dates gleaned from a search on SCOPUS "Sources" also appear to understate the currency of the database, since they are more dated than actual publication data found in general searches of the database – for instance results for the later ITiCSE 2003 conference were found. This problem has been advised to SCOPUS as an apparent bug in their system and was being investigated as at 21 September 2006.]

Searches of the SCOPUS database reported below were restricted to the peer reviewed sources and excluded searches of the web content available from that database. Google Scholar on the other hand is fully up to date with current contents on the world-wide web.

Searches were conducted from 4 March 2006, with final results reported here being based upon 18 and 19 March data.

For each item returned from the search the NACCQ source publication was identified, together with the name of the publication in which it was cited. This frequently involved checking the reference list for each publication.

In the tables in section 3, each edition of a conference or journal cited in different years is counted as a separate publication, however multiple citations for the same outlet are counted only once.

Only citations outside the NACCQ community venues and outlets were counted and checked. Therefore the findings reported below represent visibility of NACCQ research outside our own publications and community.

3 Findings

3.1 Findings for NACCQ

The findings are tabulated below, with the publication category, its scope, and the number of items within each category in which the source NACCQ publications have been cited.

3.1.1 From Google Scholar

This search returned 440 items for analysis.

Table 2: NACCQ from Google Scholar

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	2 2 32
Journals	International	29
Books	Book Book Chapter	1 2
Other	Thesis Research Report Working Paper	4 2 1

Note: For the "NACCQ" search string the source publications were predominantly the NACCQ annual conference proceedings from 1997 – 2004.

3.1.2 From SCOPUS database

This search returned 16 items for analysis

Table 3: NACCQ from SCOPUS database

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	0 0 7
Journals	International	8

3.2 Findings for New Zealand Journal of Applied Computing and Information Technology

3.2.1 From Google Scholar

This search returned 68 items for analysis

Table 4: "New Zealand Journal of Applied Computing and Information Technology" from Google Scholar

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	0 1 7
Journals	International	6
Books	Book Book Chapter	0 1
Other	Thesis Research Report	1 2

3.2.2 From SCOPUS Database

This search returned 3 items for analysis

Table 5: "New Zealand Journal of Applied Computing and Information Technology" from SCOPUS database

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	0 0 1
Journals	International	2

By contrast a SCOPUS web search returned 67 items for analysis. Although not analysed in this study, the SCOPUS web search identified several additional international journal publications not identified in the Google scholar search profiled in table 3 above. The PhD thesis of Pip Ferguson into developing a research culture in New Zealand Polytechnics was a further noteworthy item returned from this extended web search (Ferguson, 1999).

3.3 Findings for Bulletin of Applied Computing and Information Technology

3.3.1 From Google Scholar

This search returned 12 items for analysis

Table 6: "Bulletin of Applied Computing and Information Technology" from Google Scholar

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	0 0 1
Journals	International	3
Other	Research Report	1

3.3.2 From SCOPUS Database

This search returned 0 items for analysis

Table 7: "Bulletin of Applied Computing and Information Technology" from SCOPUS database

Publication Category	Publication scope	No of items in category
Refereed Conference Proceedings	Local National International	0 0 0
Journals	International	0

Again by contrast a SCOPUS web search returned 72 items for analysis. Although not analysed in this study, the SCOPUS web search identified a diverse range of additional publications and websites not identified in the Google scholar search profiled in table 6 above.

3.4 NACCQ Projects

Augmenting the above data, drawn from keyword searches of the specified databases, is a more subjective depiction based upon local knowledge of the authors about the penetration of key NACCQ projects into the wider computing literature. While not so readily replicable, this data serves to complement the picture drawn from the database searches, and also identifies some inherent deficiencies in a database search strategy.

3.4.1 SODIS SEPIA

This collaborative international project investigating the notion of Software Development Impact Statements, originated from the 2001 NACCQ conference keynote presentation by Professor Donald Gotterbarn of East Tennessee State University (Gotterbarn, 2001). The subsequent NACCQ & CITRUS initiative, the Software Practice Improvement Alliance (SEPIA) has been profiled in Clear, McHaney & Gotterbarn, (2004).

This programme of work in New Zealand has now resulted in over 30 publications including conference papers, journal articles, and consultancy reports. It has involved more than six NACCQ sector institutions, working with Tongan, Australian, UK and US based collaborators. The SoDIS process has become embedded in several course curricula across these institutions, and in an international curriculum specification covering more than 70 countries (Institute for the Management of Information Systems). A postgraduate thesis towards an M. Ed. is under examination at AUT (cf. Hitchcock, 2005).

Professor Gotterbarn spent the 2003-2004 academic year at AUT University as a visiting Professor of Software Engineering Ethics. The co-originator of the SODIS process, Simon Rogerson Director of the Centre for Computing and Social Responsibility at De Montfort University, UK, who is Europe's first Professor in Computer Ethics, attended the 2005 NACCQ conference as a keynote speaker.

The project has involved a partnership between industry, local and international academics and students, in developing and refining the process through an active action research programme. To date seven bi-annual symposia have been held since 2002, with four of these gaining industry sponsorship. Research grants and sponsorships totalling some $NZD30, 000 have been gained toward the work in New Zealand.

The major academic successes have seen a paper profiling the process published in the influential journal Communications of the AIS (Gotterbarn & Rogerson, 2005). This publication cites a prior NACCQ conference paper. This year has also seen a New Zealand specific article addressing SoDIS in a bi-cultural context, published in the International Journal of Technology and Human Interaction (Gotterbarn, Clear, Gray & Houliston, 2006). This paper originating from use of SODIS in a capstone project, involves two students as co-authors, one undergraduate capstone project student and one postgraduate student working as a research assistant on the analysis. The paper by Hitchcock (2005) in the SIGCSE Bulletin, is the first international research article exploring a certification programme for the SODIS process. A further joint article covering the nature of SODIS inspections is currently under review by Communications of the AIS.

In addition to the growing international academic acceptance of the process which the project has supported, there is a current proposal being developed to commercialise the process in New Zealand. Therefore the work initiated within the NACCQ sector has built New Zealand's leadership profile in the SODIS research programme.

3.4.2 POVERTY ALLEVIATION IN PERU

The Poverty Alleviation in Peru project was initiated through the Unitec Citrus Research and Development

Centre and was the first major CITRUS project to receive significant external funding. The project was initially funded by NZAid for $500,000 and involved setting up computers, networks and communication in remote areas of Peru to empower the people of the region to build their own economies which had been seriously eroded by western influences. The project has resulted in over 40,000 people in four remote regions and hundreds of communities being able to increase their standard of living and communicate with the suppliers and advisors in the major cities and research centres.

The project has also contributed to the research literature including a doctoral thesis (Muller, 2005) and many invitations to speak at national and international conferences in at least six countries. The project has also been highlighted in popular magazine articles in both New Zealand and Peru. A Masters thesis evaluating the impact of the project (Newman, 2006) has also been sponsored by an NZAID Postgraduate Field Research Award 2005/06.

The theoretical model for ICT to help alleviate poverty that was developed and proven in this project has now become the basis of two further projects in other poverty stricken areas of the world (Asia, Africa and South America) with funding of over $3 million being sought.

3.4.3 BRACELet

This project builds upon the earlier BRACE and Leeds working group research (cf. Fincher, Lister, Clear, Robins, Tenenberg & Petre, 2005), with the aim of developing a community in New Zealand and wider afield researching the issues associated with the ability of novice programmers at comprehending and writing programs. This programme of multi-institutional, multi-national studies in computer science education research, has originated from a collaboration based upon the work of Sally Fincher and Raymond Lister (both keynote speakers at successive NACCQ conferences). The first BRACELet workshop was held at AUT University in December 2004, with ten institutions taking part. The project has seen several institutions develop and trial a joint instrument for assessing novice programmers comprehension, with a population of more than 200 students. To date the project has been profiled in two international conferences, mentioned in a SIGCSE Bulletin column, and several further publications are under review. Other international partners have been enlisted and protocols for joint but separate research under the umbrella of the programme are being developed.

4 Discussion & Implications

As indicated by table 8 below NACCQ research has been cited in a very wide range of publications. This very diversity and the large penetration into the global literature in several fields, has surprised the authors of the study. The sheer number of international journals in which NACCQ researchers have been cited itself came as an unexpected outcome of the study.

The impact of NACCQ research within the computing disciplines has been global as demonstrated by the number of countries in which the research has been cited, or in which the projects have made their impact. There is evidence of a strong contribution to the computer science; software engineering; information technology and information systems disciplines as defined in the ACM curricula 2005 report (Shackleford et al., 2005); to computer science education research; and to educational technology and e-learning research. In addition citations have been noted in the disciplines of anthropology, nursing, business, education, and music.

Key scholarly communities within which NACCQ research has been cited include the:

ACM, (SIGCSE Bulletin, SIGCAS, SIGITE newsletter, Technical symposium and ITiCSE conferences)

IEEE (Software, FIE, AUTO'ID, AINA, SMI, ICALT, HICSS, Learning Technology)

AACE, (Ed-Media, International Journal on e-learning)

ASCILITE, (ASCILITE and AJET)

ACSW (CRPIT & ACE).

Relative frequency of citation of NACCQ sources raises some further issues. The predominance of citations of the annual conference proceedings may be partially explained by the greater overall number of papers involved. However the notable increase in citations gleaned from the web search extension within the SCOPUS database searches and the rising influence of search engines such as Google and Google Scholar argue strongly for the value of an accessible web version of all NACCQ sector publications. The rapid dissemination of research and subsequent citations through online availability is also significant, with one example of a Bulletin (BACIT) article published in May 2005 receiving citations in two separate papers at an international conference held some five months later.

Yet another explanatory factor may be the very culture of the computing disciplines, as earlier noted by Moed (2005) and Callaghan (Gerritsen, 2004), through the noted preference for conference proceedings as a mechanism for the exchange of information within the computing field.

4.1 Future Directions in Bibliometric Analysis

A related development, not addressed in this study is the growing significance of such major electronic repositories of computing publications as the ACM digital library and the IEEE explore database. Such databases cannot be underestimated in any analysis of research performance in the computing field. For effective evaluation of research performance in the computing related fields therefore, any research evaluation process must take these sources into account. Here it is worthy of note that NACCQ proceedings will be incorporated into the ACM digital library through the status of "in cooperation with ACM" for the NACCQ conference gained from 2006. This echoes a trend for national and regional conferences such as the Australian and Baltic Sea conferences to

contribute their proceedings to the global repository of the ACM digital library.

There appears to be a growing trend towards bibliometric analysis to at least augment the work of, if not to fully replace, costly peer review panels. For instance as being advocated in the UK to replace the Research Assessment Exercise (RAE) (cf. Hero, 2006), and in Australia with the incoming Research Quality framework (RQF) (cf. Clear, 2006). Those seeking to apply bibliometric analysis in the computing field, then would be well advised to extend beyond the ISI citation indexes, and perhaps conduct the forms of expanded citation analysis supplemented by peer review suggested by Moed (2005). A "target expanded citation analysis also determines the citation impact of *targets* [cited publications] published in non ISI media such as books and conference proceedings". The role of search engines such as Google Scholar, electronic databases such as SCOPUS and the ACM & IEEE digital libraries with their extensive computing coverage, will be significant in enabling such expanded analyses to be performed. The EdITLib Digital Library for Information Technology and Education (AACE, 2006), is a further educational technology source which could be included in an expanded study.

The challenge of determining how best to combine such sources and verify the validity of the outcomes of these expanded citation analyses, points to a fruitful new area for bibliometric research. This would enable more effective quantitative performance evaluation in the computing related disciplines in particular, but is an approach well capable of extension to further research disciplines.

4.2 Limitations of the study

This study has taken a relatively pragmatic approach to assessing the impact of NACCQ sector research. Nonetheless it has broadly profiled research conducted within the NACCQ sector and the diverse range of outlets in which it is being cited. This exploratory study has identified broad but distinct patterns of research influence in: the computing disciplines; computing education research; and educational technology/eLearning fields.

It has not applied certain traditional research impact metrics, in the manner advocated by Katerattanakul et al., (2003), for reasons of difficulty of identifying such measures as "current article impact" for the publication sources identified here, and their inappropriateness for a study involving less established scholars, who have not built over time a track record of citation in the most prestigious journals.

Identifying proxies for journal or conference quality such as "some with especially low acceptance rates…especially in the computer and information sciences" (TEC, 2005, p.119) was another alternative for which data would have proven difficult to gather, given the disparate range of publication avenues in which NACCQ research has been cited. Subsequent work in Australia in preparation for the RQF introduction (cf, Clear, 2006, Monash, 2006) may produce an agreed list of ranked computing related conferences. Initial drafts indicated four tiers from most prestigious to least. Obviously such ranking tables will be highly contentious, but they may make a contribution to quality assessment.

Again unlike Katerattanakul et al., (2003), the degree of "self-citations" is not addressed in this study, and metrics such as "un-cited ratio" have not been calculated. However the latter study specifically addressed objective measures of journal quality, which is a different question from that which this study has sought to address.

This research could fruitfully be augmented by a follow-up study along the lines of those by Glass et al., (2002) and Ramesh et al., (2004) in which they applied a comprehensive classification scheme to their analyses. That classification scheme included an analysis of research conducted in the disciplines of software engineering and computer science by: topic; research approach; research methods; reference disciplines; levels/units of analysis; and by journal.

5 Conclusion

The NACCQ sector represents a youthful research community in New Zealand, which is not well resourced relative to more established research groups and institutions. Yet as the above study demonstrates, the work of NACCQ sector scholars is gaining recognition, it is now being cited in several international conferences and journals. The cited NACCQ and CITRUS sponsored projects have made significant contributions in their respective areas of: software engineering ethics and risk assessment; ICT enabled sustainable economic development; and computer science education research into novice programmers. As was noted in Clear & Young (2006) NACCQ research has been cited in publication avenues in every continent on the globe - bar Antarctica. Table 8 in Appendix A, gives a cut down version of table 7 from Clear & Young (2006), indicating some of the publications in which NACCQ research has been cited. We conclude that NACCQ sector research is making a distinct contribution to various studies in the computing and other aligned disciplines. This is an encouraging set of findings from this first such exploratory study into the impact of research in the sector.

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7 References

AACE. (2006). EdITLib Digital Library for Information Technology and Education. Retrieved Sep. 29, 2006, from http://www.editlib.org/

Clear, T., McHaney, R., & Gotterbarn, D. (2004). SoDIS SEPIA -Collaborative Partnerships in Software Engineering Research. *NZ Journal of Applied Computing and IT, 8*(1), 2-7.

Clear, T., & Young, A. (2006). An Exploratory Study into the Impact of NACCQ Research. In S. Mann & N. Bridgeman (Eds.), *19th Annual NACCQ Conference* (Vol. 1, pp. 45-52). Wellington, New Zealand: NACCQ.

Clear, T. (2006, Nov 9-12). *Valuing Computer Science Education Research.* Paper presented at the Koli Calling Conference on Computer Science Education [Forthcoming], Koli, Finland.

Ferguson, P. (1999). Developing a Research Culture in a Polytechnic: An Action Research Case Study. Unpublished PhD Thesis, Waikato University, Hamilton.

Fincher, S., Lister R. Clear T., Robins, A., Tenenberg, J., & Petre, M. (2005). Multi-Institutional, Multi-National Studies in CSEd Research: Some Design Considerations and Trade-offs. In R. Anderson, S. Fincher & M. Guzdial (Eds.), *The First International Computing Education Research Workshop* (pp. 111-121). University of Washington, Seattle, WA: ACM.

Geary, J., Marriott, L., & Rowlinson, M. (2004). Journal Rankings in Business and Management and the 2001 Research Assessment Exercise in the UK. *British Journal of Management, 15*, 95-141.

Gerritsen, J. (2004). Consistency between PBRF panels defended. *Education Review, May 5-11,* 3.

Glass, R. and Chen, T. (2001) An assessment of Systems and Software Engineering scholars and institutions, *The Journal of Systems & Software*, **59,** 107-113.

Glass, R., Vessey, I. and Ramesh, V. (2002) Research in software engineering: an analysis of the literature, *Information & Software Technology*, **44,** 491-506.

Glass, R., Ramesh, V., & Vessey, I. (2004). An Analysis of Research in computing disciplines. *Communications of the ACM, 47*(6), 89-94.

Gotterbarn, D. (2001). Keynote: Understanding and Reducing Project Failure: The Ethics of Project Management. In S. Mann (Ed.), *Proceedings of the 14th Annual NACCQ Conference* (pp. 41-51). Napier, New Zealand: NACCQ.

Gotterbarn, D., Clear, T., Gray, W., & Houliston, B. (2006). Developing Software in a Bicultural Context: The Role of a SoDIS® Inspection. *International Journal of Technology and Human Interaction, 2*(2), 1-21.

Gotterbarn, D., & Rogerson, S. (2005). Responsible Risk Analysis for Software Development: Creating The Software Development Impact Statement. Communications of the AIS, 15, 730-750.

Harzing, A. (2006). *Journal Quality List - Nineteenth Edition* (Technical Report). Melbourne: University of Melbourne. Retrieved Mar 20, 2006, from http://www.harzing.com.

Hero. (2006). Research Assessment Exercise (RAE). Retrieved Sep 29, 2006, from http://www.hero.ac.uk/uk/research/research_assessment_exercise_2485.cfm

Hitchcock, L. (2005). Industry Certification: Value, Validity and a Place for SoDIS. *SIGCSE Bulletin, 37*(4), 59-63.

Katerattanakul, P., Han, B., & Hong, S. (2003). Objective Quality Ranking of Computing Journals. *Communications of the ACM, 46*(10), 111-114.

Moed, H. (2005). *Citation Analysis in Research Evaluation*. Dordrecht: Springer.

Monash. (2006). Monash University, Information Technology - Journal and Conference Ranking Lists. Retrieved Sep 30, 2006, from http://www.infotech.monash.edu.au/non-cms/research/internal-info/ranking-list/

Muller, L. (2005). *Human Social values as drivers of sustainable business.* Unpublished PhD Thesis, Kennedy Western University, Los Angeles, CA.

Mylonopoulos, N., & Theoharakis, V. (2001). Global Perceptions of IS Journals. *Communications of the ACM, 44*(9), 29-33.

NACCQ. (2006). *The National Advisory Committee on Computing Qualifications (NACCQ) Website*. Retrieved 1 Mar, 2006, from http://www.naccq.ac.nz

Newman, N. (2006). *Poverty Alleviation in the Andes: the use of ICT as a tool. Apurimac and Huancavelica Departments Peru.* Unpublished Master of Development Studies Thesis, Victoria University, Wellington.

Ramesh, V., Glass, R., & Vessey, I. (2004). Research in computer science:an empirical study. *The Journal of Systems & Software, 70*, 165-176.

SCOPUS. (2006). *SCOPUS Info*. Retrieved Mar 1, 2006, from http://info.scopus.com/overview/what/

Shackelford, R., Cassel, L., Cross, J., Davies, G., Impagliazzo, J., Kamali, R., et al. (2005). *Computing Curricula 2005 The Overview Report including The Guide to Undergraduate Degree Programs in Computing.* (Curriculum Report). New York: Joint Task Force ACM, AIS, IEEE-CS. Retrieved Jul 21, 2005 from http://www.acm.org/education/Draft_5-23-051.pdf.

TEC. (2005). *Performance-based Research Fund Guidelines 2006*. Wellington: Tertiary Education Commission.

Thomson. (2006). ISI Web of Knowledge. Retrieved Mar 3, 2006, from http://www.isiwebofknowledge.com/

Yan, J., & Liu, Z. (2006). Development of, and Trends in, Scholarly Communication in China. In H. Ching, P. Poon & C. McNaught (Eds.), *eLearning and Digital Publishing* (pp. 246). Dordrecht: Springer.

Appendix A

Table 8: Selected "NACCQ" Sources & Citings From Google Scholar

NACCQ Source Publication	Publication in which cited	Publication category
Proceedings 2001, 2002	ACM SIGITE Newsletter, 2005	Int'l Journal/Magazine
Proceedings 2001	ACM SIGCAS Computers and Society, 2002	Int'l Journal
Proceedings 1998 - 2004	ACM SIGCSE Bulletin 1998 - 2004	Int'l Journal
Proceedings 2000	African and Asian Studies (2003)	Int'l Journal
Proceedings 1997, 1999, 2000	ALTJ 2001	Int'l Journal
Bulletin of Applied Computing http://www.naccq.ac.nz/bacit/	Australasian Journal of Educational Technology, 2005	Int'l Journal
Proceedings 2000	Australian Journal Of Information Systems, 2001	Int'l Journal
Proceedings 1999, 2001, 2002, 2003	CRPIT v. 30 - ACE 2004, Dunedin	Int'l Journal
Proceedings 2002, 2003, 2004	CRPIT, v. 52, ACE 2006, Hobart	Int'l Journal
Proceedings 2000	Education for Information, 2002	Int'l Journal
Proceedings 2003	e-Journal of Instructional Science and Technology (e-JIST) 2004	Int'l Journal
Proceedings 2000	IEEE Software, 2002	Int'l Journal
Proceedings 2001	Int'l Jrnl. of Information and Communication Technology Education, 2005	Int'l Journal
BACIT, 2004	International Journal of Education and Development using ICT, 2005	Int'l Journal
Proceedings 2001	International Journal of Education and Development using ICT, 2005	Int'l Journal
Proceedings 1999	International Journal on e-Learning (AACE)	Int'l journal
Proceedings 2001, 2003	Issues in Informing science 2004, 2005	Int'l Journal
Proceedings 2002	Journal of Information Technology Education, 2003 -	Int'l Journal
Proceedings 2000, 2001	Journal of Information Technology Education, 2003, 2005	Int'l Journal
Proceedings 2000	Journal of Information Technology, 2004	Int'l Journal
Proceedings 2001	Learning Technology, 2001, [IEEE-CS Learning Technology Taskforce]	Int'l Journal
Proceedings 2000	Nurse Education Today, 2004	Int'l Journal
Proceedings 2002	The Pantaneto Forum, 2002	Int'l Journal
Proceedings 2001	The Pantaneto Forum, 2002	Int'l Journal
Proceedings 2000	Knowledge-Based Virtual Education: User-Centred Paradigms edited by Claude Ghaoui, Mitu Jain, Vivek Bannore, Lakhmi C Jain (2005)	Edited Book
Proceedings 1999	Doctoral Thesis Griffith University, Dept of Mgt	Doctoral Thesis
Proceedings 1998	PhD Thesis, Dept of Computer and Systems Sciences - The Royal Inst of Technology and Stockholm Univ Graduate School for Human-Machine Interaction (HMI)	Doctoral Thesis
Proceedings 2000	Academic dissertation University of Helsinki (2004) Dept. of Musicology	Doctoral Dissertation
BACIT, 2003 UNITEC CITRUS Report, 2003	Victoria University Research Report, 2004 Wellington	Commissioned Report
Proceedings 1999, 2001	Advances in Web-Based Education - Gender Differences and Hypermedia Navigation, Idea group, 2006	Book Chapter
Proceedings 2000	CSR Academy website doc http://www.csr-academy.com/english/elib.htm	Book Chapter