A Citation Analysis of the ICER 2005-07 Proceedings

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Abstract

This paper identifies the most commonly cited conferences, journals and books of the 43 papers within the first three ICER proceedings. A large array of conferences, journals, and books were cited. However, only a small set of journals and conferences were cited frequently, and the majority were only cited within a single paper, which is consistent with a power law distribution, as predicted by Zipf's Law. The most commonly cited books are concerned with education in general (29%) or psychology (20%), while 17% of books are concerned with computer science education and 12% with computing content. The citation results for ICER are contrasted with earlier published citation analyses of SIGCSE 2007 and ACE2005–07.

Keywords: Citation analysis, ICER, SIGCSE, ACE.

1 Introduction

If our human bodies are a reflection of what we eat, then an academic community is a reflection of what its members cite. While there are databases that index the citations of academic publications, such as the Science Citation Index® [Thomson Scientific, 2007], computer science journals and conferences are not comprehensively covered by such databases. Furthermore, such indexes do not tell us what types of conferences and journals are cited by a particular community of researchers, especially a small community like the computing education research community. For example, the established indexes cannot be used to determine whether computing educators cite general educational sources, such as the *Journal of Educational Psychology*, more than they cite non-educational computing journals, such as *IEEE Transactions on Software Engineering*.

In this paper, we investigate which conferences, journals, and books have been most commonly cited in the first three ICER proceedings (i.e. 2005–07).

We, the authors of this paper, have already published two citation analyses of computing education conferences. The first was an analysis of the ACE2005–07 proceedings (Lister and Box, 2008a) and the second was an analysis of the SIGCSE2007 proceedings (Lister and Box, 2008b). One of our findings was that SIGCSE 2007 authors emphasized computing content in their citations rather than educational issues. For example, only 2% of all the books cited were concerned with computer science education and 23% with education in general, whereas 57% of books cited were concerned with computing content. From those statistics, we concluded that:

> *The SIGCSE 2007 citations suggest that the educational epistemology of the SIGCSE community is primarily objectivist, with the focus on course content, rather than a constructivist, student-centred focus on learning.*

We found that the authors of papers in the ACE2005–07 proceedings did not place the same emphasis on content. Just over half of all book citations in those ACE proceedings were to books concerned with general education issues (e.g. the classic texts of Biggs, Ramsden and Bloom). However, there was still an emphasis on computing content, with almost one third of all book citations being to computing texts and reference books.

In this paper, we explore whether those citations patterns in the SIGCSE and ACE proceedings are also present in the papers published in the first three International Computing Education Research Workshops (i.e. ICER 2005–07). Both SIGCSE and ACE are primarily concerned with educational practice, while ICER is a research conference. Thus, a comparison of citation patterns in ICER versus ACE and SIGCSE may shed some light upon the differences, if any, between research and practice in computing education.

1.1 Conference and Journal Rankings

Our interest in the differences between computing education research and practice is not simply intellectual curiosity. For several years, the Australian federal government has been developing a process for reviewing the quality and impact of publicly funded Australian research. The review process is known by the name 'Excellence in Research for Australia', or simply ERA (ARC, 2008). As part of the ERA, the Computing Research and Education Association of Australasia (CORE) has developed a ranking scheme for computing-related conferences and journals (CORE, 2007). All computing journals and conferences in which Australian researchers have published in recent years are to be ranked into a four–tier hierarchy.

The Australian computing academics who have been called upon to make these ranking judgments are not themselves active in computing education research. Consequently, they may not be able to distinguish between education research and education practice, and are therefore likely to make negative judgments about computing education research conferences and journals ("that's a paper about teaching, not research"). By carrying out a citation analysis on ICER papers, and comparing the results to those for the SIGCSE 2007 and ACE 2005–07 proceedings, we hope to be able to articulate a clearer distinction between research and practice in computing education.

1.2 An Overview of ICER Citations

At the time this paper was written, there had only been three ICERs held, in 2005, 2006 and 2007. (The fourth ICER was held in Sydney in September 2008.) In these three ICERs, 43 papers appeared, containing 1130 citations, which is an average of 26 citations per publication. On average, SIGCSE and ACE papers made fewer citations. The SIGCSE 2007 proceedings contained 122 publications with 1398 citations, an average of 11.5 per publication, while the ACE 2005–07 proceedings contained 85 papers with 1475 citations, an average of 17.4 per publication.

Table 1 shows a breakdown of the types of sources in the ICER proceedings and, for comparison, the same figures from the SIGCSE and ACE proceedings. The percentage of citations to conferences and books is about the same for all three conferences. ICER authors cite a higher percentage of journals articles than SIGCSE and ACE authors, while SIGCSE and ACE authors cite a far higher percentage of web pages. Thus ICER authors cite a higher percentage of peer reviewed sources than SIGCSE and ACE authors.

The remainder of this paper focuses on citations to conferences, journals and books.

2 Conference Papers

ICER authors, like SIGCSE and ACE authors, have cited from a diverse array of conferences. In the 43 ICER papers, there are citations to 59 different conferences, which is a ratio of 1.3 conferences to each ICER paper. As shown in Table 2, 56% of those conferences are cited in only one ICER paper. Table 2 also shows that almost 90% of the conferences cited in ICER papers are cited in less than 10% of ICER papers. SIGCSE 2007 papers contain citations to 104 different conferences, which is 0.9 conferences for each SIGCSE paper, but 79% of those conferences were cited in only one paper. ACE has a similar distribution to SIGCSE.

Table 3 shows the percentage of ICER papers citing papers from the following widely known conferences:

- **SIGCSE:** Technical Symposium on Computer Science Education
- **ITiCSE:** Annual Conference on Innovation and Technology in Computer Science Education

Type of Source	ICER	SIGCSE	ACE
Conference	32%	31%	32%
Journal	38%	23%	29%
Book	21%	23%	17%
Web Page	5%	18%	12%
Other	4%	5%	10%

Table 1: The percentage of each type of source cited in ICER 2005-07, SIGCSE 2007 and ACE2005-07.

Percentage of conferences (n) cited in …	ICER (n=59)	SIGCSE (n=104)	ACE (n=121)
only 1 paper	56%	79%	79%
≤ 2 papers	69%	88%	87%
≤ 3 papers	76%	94%	89%
<10% of papers	86%	97%	96%
< 33% of papers	97%	99%	100%

Table 2: Distribution of all conferences (n) cited in each of ICER 2005–07, SIGCSE 07 and ACE2005–07.

Conference	ICER 43 papers	SIGCSE 122 papers	ACE 85 papers
SIGCSE	84%	63%	38%
ITiCSE	65%	20%	20%
ICER	44%†	2%	<1%
ACE	26%	5%	48%
FIE	14%	10%	19%
Koli	12%	Not available	<1%
PPIG	12%	Not available	<1%

Table 3: The percentage of papers in ICER 2005–07, SIGCSE 2007 and ACE2005–07 that cite at least one paper from each of these popular conferences.

† Unlike other percentages in the 'ICER' column of Table 3, this 44% was calculated from the 27 ICER 06 & 07 papers only, since ICER 05 could not possibly cite ICER papers.

- **ACE:** Australasian Conference on Computing Education
- **FIE:** Frontiers in Education
- **Koli:** Koli Calling International Conference on Computing Education Research
- **PPIG:** Psychology of Programming Interest Group (Annual Workshop of)

Conference	Tier	Cites	CitesXSelf	Papers	PapersXSelf
SIGCSE: ACM Special Interest Group on Computer Science Education Conference	A	122	109	36	35
ITiCSE: Annual Conference on Integrating Technology into Computer Science Education	A	58	50	28	23
ICER: International Computing Education Research Workshop	A	28	26	12	12
ACE: Australasian Conference on Computer Science Education	B	15	14	11	10
FIE: Frontiers in Education	B	9	6	6	5
VL: IEEE Symposium on Visual Languages	B	7	6	5	5
CSCL: Computer Supported Collaborative Learning	A+	4	4	4	4
CHI: International Conference on Human Factors in Computing Systems	A+	7	7	4	4
AVI: International Working Conference on Advanced Visual Interfaces	—	5	5	4	4
ESP: Workshop on Empirical Studies of Programmers	—	10	10	4	4
InSITE: Informing Science and IT Education Conference	B	3	3	3	3
OOPSLA: ACM SIGPLAN Conference on Object Oriented Programming Systems Languages and Applications	A+	3	3	3	3
SOFTVIS: ACM Symposium on Software Visualization	—	4	4	3	3
HICSS: Hawaii International Conference on System Sciences	B	4	3	4	3
VL/HCC: IEEE Symposium on Visual Languages and Human-Centric Computing	A	7	6	4	3
ICSE: International Conference on Software Engineering	A+	3	3	3	3
Koli: Koli Calling	B	5	2	5	2
PPIG: Psychology of Programming Interest Group (Annual Workshop of)	B	6	2	5	2
ICLS: International Conference of the Learning Sciences	—	2	2	2	2
ICFP: International Conference on Functional Programming, ACM SIGPLAN	A+	2	2	2	2
International Seminar on Software Visualization	—	3	3	2	2

Table 4: All conferences cited by more than one paper (excluding self-citations) in the ICER 2005, 2006 and 2007 proceedings. The columns show the CORE tier (a dash appears where CORE have not assigned a tier), total number of citations to the conference ("Cites"), total number of citations to the conference, excluding self-citations ("CitesXSelf"), total number of papers that cited that conference ("Papers"), and total number of papers that cited that conference, excluding self-citations ("PapersXSelf"). The list is ordered (descending) on the last column.

Conference	Average	ICER	SIGCSE	ACE
SIGCSE	90	0.4	0.8	0.3
ITiCSE	53	0.5	0.5	0.5
ACE	38	0.3	0.2	0.8

Table 5: Normalized citation counts in ICER, SIGCSE and ACE (columns) of SIGCSE, ITiCSE and ACE (rows).

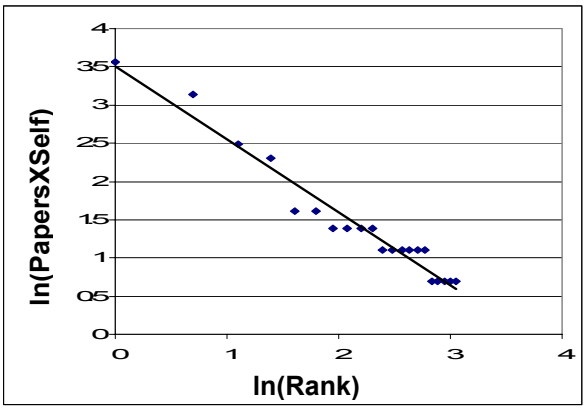

Figure 1: A plot of the logarithm of PapersXSelf vs. the logarithm of the rank of the 21 conferences from Table 4.

Table 3 shows that SIGCSE was the most cited conference by both ICER and SIGSCE 2007 authors. For ACE authors, ACE itself was the most popular conference to cite, but when self-citations are ignored, the citation rate by ACE authors to ACE papers drops from the 48% to 32%, and thus when self-citations are ignored SIGCSE is also the most popular conference to cite for ACE authors.

Among SIGCSE 2007 papers, conference citations to SIGCSE papers are not simply the most frequent—SIGCSE citations are dominant, with the percentage of SIGCSE citations being 3 times higher than the next most popular conference. While ICER authors cited SIGCSE papers even more often than SIGCSE 2007 authors, ICER authors also cited several other conferences extensively.

When considering citation data to determine the popularity of conferences, allowance should be made for two possible sources of distortion, especially for a small, young conference like ICER. Self citation is one source of possible distortion. (The data presented in Tables 1, 2 and 3 includes self citations.) Another source of distortion is the possibility that a conference may be cited in only one paper (or a very small number of papers) but that paper cites several papers from that same conference. Table 4 presents alternate forms of citation data, showing the effect of these forms of distortion on ICER data. With regard to the first source of distortion, self citation rates are not high. With regard to the second source of distortion, it appears that, when an ICER author cites a paper from a popular conference series, they often cite other papers from that same conference series. For example, among the 36 ICER papers that cite a least one SIGCSE, there is an average of 3.4 citations to SIGCSE papers.

When considering citation data to determine the popularity of conferences, allowance should also be made for the differing sizes of conferences—a large conference might have more papers cited than a small conference simply because the larger conference has more papers. In our earlier paper on the citation analysis of SIGCSE 2007, we calculated the average number of papers per year for SIGCSE, ITiCSE, and ACE, in the three years 2003─05, which were 90, 53 and 38 papers respectively. (In more recent years, the typical number of papers in ACE has fallen, but that does not significantly affect our citation analysis here). In this paper, we use those average yearly figures to calculate normalized citation data for SIGCSE, ITiCSE, and ACE. For example, Table 3 shows that 84% of the 43 ICER papers (i.e. 36 ICER papers) cited at least one SIGCSE paper. Those 36 papers are 0.4 of the average number of papers per year for SIGCSE (i.e. 0.4 of 90). Table 5 presents all the data normalized in this way. With this correction made for the size of the conferences, it can be seen that ITiCSE is a more popular source of citations for ICER authors than SIGCSE, and even ACE is three quarters as popular as SIGCSE. Also, ITiCSE is more popular than SIGCSE as a source of citations for ACE authors.

Figure 1 is a log-log plot (to base e) of the PapersXSelf column of Table 4 versus the rank of the 21 conferences from Table 4 (i.e. ranked on PapersXSelf). The plotted points are a good fit to a regression line, which suggests that the distribution of the number of ICER papers citing a particular conference is broadly consistent with the well known power law distribution for citations (Redner, 1998; Tsallis & de Albuquerque, 2000). Such power law distributions are often referred to as Zipf's Law. In Figure 1, the slope of the line of best fit is approximately -1.

2.1 Discussion of Conference Paper Results

In our paper on the SIGCSE 2007 citation analysis, as a consequence of finding this great diversity of citation sources, and also as consequence of the influence upon us of Becher and Trowler (2001), we made the following conclusion :

> *... computer science education (at least how it is practiced by SIGCSE 2007 authors) is a less highly structured, less specialized and slower moving sub-discipline than other aspects of computing.*

We now retract that conclusion, or at least we retract that the diversity of citations in SIGCSE 2007 is evidence that computer science education is a less highly structured, less specialized and slower moving than other aspects of computing. Since writing the above conclusion, we have carried out similar citation analyses for three other conferences, all non-education conferences that are part of the Australasian Computer Science Week (ACSC, ADC and AUIC). For details of the analysis of those other three conferences, see the papers appearing in those respective conference proceedings (Lister & Box, 2009a, 2009b, and 2009c). For each of the six conferences we have analysed—

SIGCSE, ACE, ICER, ACSC, ADC and AUIC—the number of papers citing a particular conference is broadly consistent with a power law distribution. Such a distribution is known to be a property of many conferences, across many disciplines.

Table 4 demonstrates a positive relationship between the CORE conference rankings and the citation rates to conferences from the ICER 2005–07 papers. For example, the three most cited conferences (SIGCSE, ITiCSE and ICER) are all ranked "A" by CORE, which is the second highest category of the five conference rankings (A+, A, B, C and L(ocal)).

3 Journal Papers

As was the case with citations to conferences, ICER, ACE and SIGCSE authors cite from a diverse array of journals. In the 43 ICER papers, there are citations to 132 different journals, but Table 6 shows that just over half of those journals (56%) received exactly one citation in ICER papers, and 90% of journals were cited in less than 10% of the ICER papers. SIGCSE and ACE citations exhibit a similar distribution.

Not only do ICER authors cite more journal papers than SIGSCE 2007 authors (1.7 times as many; see Table 1), but ICER authors also cite the popular journals more often than SIGSCE 2007 authors cite those same journals. This is illustrated in Table 7, which shows that no single journal is cited in more than 20% of SIGCSE 2007 papers, whereas one journal (SIGCSE Bulletin) is cited in more than half of ICER papers and three journals are cited in more than a third of ICER papers. ACE authors also cite SIGCSE Bulletin much more often than SIGCSE authors.

Table 8 shows more comprehensive information about a larger list of journals cited in ICER papers. That table provides for an assessment of the degree of possible distortions due to self-citation, or to multiple citations of the same journal in one paper. Neither form of distortion has a marked effect on the analysis below.

3.1 The SIGCSE Bulletin (Non-Conference)

For ICER, SIGSCE and ACE, the most popular journal is the SIGCE Bulletin. (In this subsection, we ignore the Journal of Computing Science in Colleges, which is cited in 20% of SIGCSE 2007 papers, for reasons discussed below in the subsection devoted to that quasi-journal.).

The SIGCSE Bulletin appears four times a year, but two of those issues are the "conference issues", the SIGCSE and ITiCSE conference proceedings. The results in Tables 6, 7, 8 and 9, are calculated from the two "non-conference issues" of the SIGCSE Bulletin.

Only 17% of SIGCSE 2007 papers cited a paper from the non-conference issues of the SIGCSE Bulletin, which is close to the 20% figure (from Table 3) of SIGCSE 2007 papers that cite the ITiCSE conference proceedings. Both of those percentages are far below the 63% (from Table 3) of SIGCSE 2007 papers that cite papers from earlier SIGCSE conferences. This is surprising, given that all SIGCSE members receive each year all four issues of SIGCSE Bulletin. Either many SIGCSE 2007 authors are not SIGSCE members (which seems unlikely) or they are regular SIGCSE conference attendees who pay more attention to the papers they hear at the conference than the papers that arrive in the post. In the first instance, it is only human to pay greater attention to what we hear than what arrives in our over-flowing post boxes (and which may never be opened). However, as part of writing a paper, one would have expected a SIGCSE 2007 author to perform at least a small literature search, and the SIGCSE Bulletin issues that arrive in the post would be an easy and logical place to start.

Table 7 (when compared to the ICER data in Table 3) shows that ICER authors, like SIGCSE 2007 authors, have a preference for the SIGCSE conference proceedings, but not to the same degree as SIGCSE 2007 authors. Table 3 shows that 84% of ICER papers cite a paper from SIGCSE conference proceedings, and Table 7 shows that 63% of ICER papers cite a paper from the non-conference issues of the SIGCSE Bulletin—a difference of approximately 20% for ICER papers, compared to a difference of almost 50% for SIGCSE 2007 papers. Also, this 63% is very close to the percentage of ICER papers that cite the ITiCSE conference (65%, from Table 3), which might indicate that ICER authors do read the issues of the SIGCSE Bulletin that arrive in their post box.

Percentage Cited In …	ICER (n=132)	SIGCSE (n=135)	ACE (n = 190)
Only 1 paper	56%	77%	69%
≤ 2 papers	76%	89%	87%
≤ 3 papers	86%	93%	92%
< 10% of papers	90%	98%	99%
< 33% of papers	98%	100%	100%

Table 6: Distribution of all journals (n) cited in each of ICER 2005–07, SIGCSE 07 and ACE2005–07.

Journal	ICER 43 papers	SIGCSE 122 papers	ACE 85 papers
SIGCSE Bull.	63%	17%	34%
CACM	40%	17%	12%
Comp. Sci. Education	37%	10%	14%
J.Educ. Psychology	16%	3%	—
Comp. Res. News	9%	8%	—
IEEE Computer	7%	6%	7%
JERIC	7%	5%	—
J. Comp. Sci. in Colleges	5%	20%	11%

Table 7: The percentage of papers in ICER 05–07, SIGCSE 07 & ACE 2005–07 that cite at least one paper from each of the popular journals

Journal	Tier	Author	Cites	CitesXSelf	Papers	PapersXSelf
SIGCSE Bulletin	C	✓✓	59	53	27	25
Communications of the ACM	B		31	31	17	17
Computer Science Education	A	✓✓	26	21	16	14
Journal of Educational Psychology	—		16	16	7	7
ACM Computing Surveys	A*		6	6	6	6
Journal of Visual Languages and Computing	A		16	13	7	6
Journal of Computer Science Education	—	✓	6	5	5	5
Journal of Educational Computing Research	C	✓	10	9	5	5
International Journal of Human-Computer Studies	A		5	5	5	5
Computers and Education	A	✓	9	7	6	5
Cognitive Science	—		10	10	5	5
Educational Psychologist	—		8	8	5	5
J. Computing in Small Colleges / J. Computing Science in Colleges	—	✓✓	4	4	4	4
J. Experimental Psychology: Learning, Memory, and Cognition	—		4	4	4	4
Journal of the Learning Sciences, The	—		4	4	4	4
Expert Systems	C		10	9	4	4
Informatics in Education, An International Journal	C	✓✓	5	4	4	4
IEEE Transactions on Education	B	✓✓	5	4	5	4
Computing Research News	—		5	5	4	4
American Psychologist	—		3	3	3	3
IEEE Computer	B		3	3	3	3
Journal of Computers in Maths and Science Teaching	—	✓	3	3	3	3
Psychological Review	—		3	3	3	3
Review of Educational Research	—		3	3	3	3
Studies in Higher Education	—		3	3	3	3
Contemporary Educational Psychology	—		5	5	3	3
Human-Computer Interaction	A*		3	3	3	3
IEEE Transactions on Software Engineering	A*		3	3	3	3
Cognitive Psychology	—		3	3	3	3
Computers in Human Behaviour	—		3	3	3	3

Table 8: All journals cited by three or more papers (excluding self-citations) in the ICER 2005, 2006 and 2007 proceedings. The columns show the CORE tier ("—" where CORE have not assigned a tier), (column "Author" is explained in the text), total number of citations to the journal ("Cites"), total number of citations to the journal, excluding self-citations ("CitesXSelf"), total number of papers that cited that journal (column "Papers"), and total number of papers that cited that journal, excluding self-citations ("PapersXSelf"). The list is ordered (descending) on the last column.

Journal	Avg	ICER	SIGCSE	ACE
Computer Science Education	15	1.1	0.8	0.8
SIGCSE Bulletin (refereed)	43	0.6	0.5	0.7
SIGCSE Bulletin (all)	69	0.4	0.3	0.4
J. of Comp. Sci. in Colleges	272	0.01	0.1	0.0

Table 9: Normalized citation counts in ICER, SIGCSE and ACE of three computing education journals.

3.2 Computer Science Education

Table 7 shows that the second most cited specialist computer science education journal is Computer Science Education, by ICER, SIGCSE and ACE authors. (CACM is not a specialist computer education journal, and it is discussed separately, below). While 37% of ICER papers cited a paper from Computer Science Education, only 10% of SIGCSE 2007 papers and 14% of ACE papers did the same.

Of course — as was also the case with conference citations—a large journal might have more papers cited than a small journal simply because the larger journal has more papers. In our earlier paper on the citation analysis of SIGCSE 2007, we calculated the average number of papers per year, over the three years 2003─05, for the three journals listed in Table 9. For example, Table 9 shows that Computer Science Education published an average of 15 papers a year over 2003–05. In this paper, we use those average yearly figures to calculate normalized citation data for the three journals in Table 9. We calculated two averages for SIGCSE Bulletin. One of the averages is for all papers published (see "SIGCSE Bulletin (all)" in Table 9). The other average excludes articles like the invited columns and is just for the refereed papers, including the working group papers (see "SIGCSE Bulletin (refereed)" in Table 9). With the citation data thus normalized for the size of each journal, it is clear from Table 9 that Computer Science Education is the most popular source of citations for ICER, SIGCSE and ACE authors.

3.3 Journal of Computing Sciences in Colleges

The Journal of Computing Science in Colleges began with a different name—Journal of Computing in Small Colleges. In this analysis, we use its current name to refer to papers published under either name.

Despite its name commencing with the word "Journal", the Journal of Computing Sciences in Colleges is really an aggregated set of conference proceedings. It contains the proceedings for each of the ten regional journals sponsored by the Consortium for Computing Sciences in Colleges. It is therefore not clear whether the analysis of citations to it should be included in the journal analysis, or should instead be included in the conference analysis. We have chosen arbitrarily to include it as part of the journal analysis.

In terms of the absolute number of citations, the Journal of Computer Science in Colleges is the most cited journal in SIGCSE 2007 papers (20%, see Table 7), but it also publishes far more papers than the other journals, and when citation rates are normalized, this journal ranks lowest among the journals listed in Table 9. Even when normalized, the Journal of Computer Science in Colleges remains a significant source of citations in SIGSCE 2007 papers, but it barely registers as a source of citations for ICER authors.

3.4 Communications of the ACM

We were surprised by the prevalence of citations to CACM articles in the ICER papers, just as we were surprised by its prevalence in our earlier analyses of SIGCSE and ACE. Since then, we have found that CACM is also highly cited in ACSC, ADC and AUIC (Lister and Box, 2009a, 2009b, and 2009c).

The complete set of 23 CACM articles cited in the ICER papers is:

- **Brooks** (April 1980) *Studying programmer behavior experimentally: the problems of proper methodology*
- **Bayman & Mayer** (September 1983) *A diagnosis of beginning programmers' misconceptions of BASIC programming statements.*
- **Camp** (October 1997) *The incredible shrinking pipeline.*
- **Campbell & McCabe** (March 1985) *Predicting the success of freshmen in a computer science major.*
- **Denning** (December 1989) *A debate on teaching computing science.*
- **Denning** (August 1981) *Smart editors.*
- **Denning** (November 2003) *Great principles of computing.*
- **Denning & McGettrick**. (November 2005) *Recentering computer science.*
- **Dijkstra** (December 1989) *On the cruelty of really teaching computing science.* Cited twice.
- **Goldberg et al**. (December 1992) *Using collaborative filtering to weave an information tapestry.*
- **Evans & Simkin** (November 1989) *What best predicts computer proficiency?* Cited twice.
- **Guzdial & Soloway** (April 2002) *Teaching the Nintendo generation to program.* Cited four times.
- **Hu** (February 2005) *Dataless objects considered harmful.*
- **Kramer** (April 2007) *Is abstraction the key to computing?*
- **Mayer** (November 1979) *A psychology of learning BASIC.*
- **McDowell et al.** (August 2006) *Pair programming improves student retention, confidence, and program quality.* Cited twice.
- **Moulton & Muller** (January 1967) *DITRAN—a compiler emphasizing diagnostics.*
- **Shantz et al.** (January 1967) *WATFOR—The University of Waterloo FORTRAN IV compiler.*

- **Shneiderman et al.** (June 1977) *Experimental investigations of the utility of detailed flowcharts in programming.*
- **Soloway** (September 1986) *Learning to program = learning to construct mechanisms and explanation.* Cited twice.
- **Soloway, Bonar & Ehrlich** (November 1983) *Cognitive strategies and looping constructs: an empirical study.* Cited twice.
- **Teitelbaum & Reps** (September 1981) *The Cornell program synthesizer: a syntax-directed programming environment.*
- **Westfall** (October 2001) *Hello, world considered harmful.*

Of these 23 CACM articles, we regard 10 of them as a being education research papers, either reporting an original research result, or reviewing the outcome of research. Another 9 of these CACM articles are not research papers, but are opinion pieces, often written by prominent members of the computing education community (with several of these articles articulating quite sophisticated pedagogical opinions). The remaining 4 of the above 23 CACM articles are technical perspectives, usually about a piece of software that may be helpful for teaching.

Many of the above 23 CACM articles are old. Half of the articles are from 1989 or earlier, with four published before 1980. Only 2 of these articles were published in the 1990s, and 7 were published in this millennium.

3.5 Discussion of Journal Paper Results

A sharp difference between ICER and SIGCSE 2007 citation patterns is the frequency of citations to journals. Only 17% of SIGCSE 2007 papers cite the two most popular computing education journals, SIGCSE Bulletin or Computer Science Education.

Figure 2 is a log-log plot (to base e) of the PapersXSelf column of Table 8 versus the rank of the 30 journals from Table 8 (i.e. ranked on PapersXSelf). The plotted points are a good fit to a regression line, which suggests that—like the earlier plot for conferences—the distribution of the number of ICER papers citing a particular journal is broadly consistent with a power law distribution. In Figure 2, the slope of the line of best fit is approximately -0.7.

3.6 Publishing and the CORE Rankings

In Table 8, the column headed "Author" indicates the suitability of each of these journals for a computing education researcher seeking to publish a paper. Two

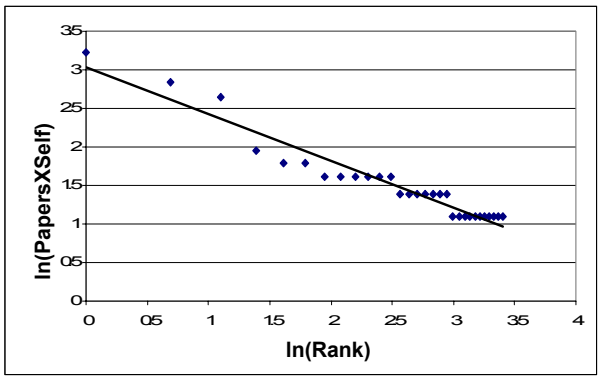

Figure 2: A plot of the logarithm of PapersXSelf vs. the logarithm of the rank of the 25 journals from Table 8.

ticks indicate that the journal is highly suited to a paper on computing education research. One tick indicates that a computing education research paper could appear in that journal, but the journal is more focussed upon the use of computers in education, possibly in any discipline, and not with the teaching of computing.

The journal 'Computer Science Education' is both highly suited and is ranked as a tier 'A' journal by CORE. It is therefore the journal in which most Australian computer education researchers will aspire to publish. However, as this journal only publishes around 15 papers each year, it will also be a very hard place to publish, and Australian computer education researchers will need to look for other journals.

The 'Journal of Computer Science Education' is not the same as the journal discussed above. According to Ulrich's Periodical Directory (Ulrich, 2008) papers in this journal are aimed at those teaching computer science at the pre- college level.

Other computing education journals not listed in Table 8 include:

- Journal of Information Technology Education, ranked 'B'
- ACM Journal on Educational Resources in Computing, ranked 'C'.
- International Journal of Information and Communication Technology Education, ranked 'C'
- International Journal of Information Technology Education, ranked 'C'
- Journal of Informatics Education and Research, ranked 'C'
- Journal of Information Systems Education, ranked 'C'.

Type of Book	ICER	SIGCSE	ACE
Education	28%	23%	51%
Psychology	20%	6%	6%
Computing Content	17%	57%	29%
CS Education	17%	2%	3%
Research Methods	9%	3%	4%
Social	3%	5%	7%
Other	7%	9%	1%

Table 10: The frequency distribution of different types of books cited in the ICER and SIGCSE 2007 proceedings.

Times Book Cited	No. of Books		Cum. %age
1	143		82%
2	20		93%
3	6		97%
4 (10% of the 43 ICER papers)	2	Bransford, Brown, and Cocking (2000) *How People Learn* [education] Hoc, Green, Samurcay & Gilmore (1990) *Psychology of Programming* [CS education]	98%
5	1	Fincher and Petre (2004) *Computer Science Education Research* [CS education]	98%
6	1	Margolis, J. and Fisher, A. (2002). *Unlocking the Clubhouse* [CS education].	98%
8	1	Soloway and Spohrer (1989) *Studying the Novice Programmer* [CS education]	99%
10 (23% of the papers)	1	Bloom, Mesia and Krathwohl (1956) *Taxonomy of Educational Objectives* [education]	100%
Total 239	**176**	**Different Books** (4.1 different books per paper)	

Table 11: The frequency distribution of all books cited in the ICER 2005, 2006 & 2007 proceedings.

4 Books

In this citation analysis, we include as "books" both citations to complete books and citations to chapters within edited volumes, as in our earlier analysis of SIGCSE 2007.

As with ICER citations to conferences and journals the majority of books (82%) were cited by only one ICER paper.

Using the same categorization of books we used for our earlier analysis of SIGSCE 2007, we placed ICER citations to books into one of six categories:

- **Education:** Books that discuss teaching and learning issues in a non-disciplinary specific fashion.
- **Psychology:** Usually educational psychology.
- **Computing Content:** Many of these books were class textbooks, while others were manuals.
- **CS Education:** Books specific to education issues within the computing discipline.
- **Research Methods:** for example, books on statistics, or qualitative research. ICER authors mostly cited qualitative research method books.
- **Social:** Books not concerned specifically with issues in education, psychology, or computing, such as gender issues in the broad context.

Table 10 summarizes our categorization of all books into one of the six categories. The majority of books cited by ICER authors are either concerned with education (28%) or psychology (20%) compared with SIGCSE where the majority (57%) are concerned with computing content. Only 2% of books concerned specifically with computer science education were cited in SIGCSE compared with 17% in ICER.

Table 11 lists the most highly cited books in the ICER proceedings.

5 Age of Citations

Figure 3 shows the number of citations in the ICER papers, for conferences, journals and books, for each year since 1983. Figure 4 shows the same data, cumulatively. Citations drop precipitously for conferences held before 2003, and there are very few citations to conferences held earlier than 1983. Citations to journal papers also drop quickly for papers published before 2003, but not as quickly as conferences. Book citations decline very slowly with age. Inspection of data for the years before 1983 shows a steady trickle of citations to journals and books going back to the 1950s, with a very small number of even older citations. These characteristics of the age of citations are substantially the same as what we observed in our earlier analysis of SIGCSE 2007 papers.

6 Conclusion

ICER authors cite a greater variety of conferences than SIGSCE 2007 authors, who are very focused on the SIGSCE conference series. ICER authors cite more journal papers, from a greater variety of journals, than SIGCSE 2007 authors. In fact, SIGCSE 2007 authors cite comparatively few journals articles.

The most important difference in citations between ICER papers and SIGCSE 2007 papers is in the type of sources that the authors cite. SIGCSE 2007 authors place most emphasis on computing content—curriculum—whereas ICER authors place greater emphasis on citing educational and psychological sources. In our earlier analysis of SIGCSE 2007, we concluded that the SIGCSE 2007 citations suggested an educational epistemology within that community of practice that is primarily objectivist, with the focus on course content. In contrast, our analysis of ICER citations suggests that the education research community is more focussed on students and learning.

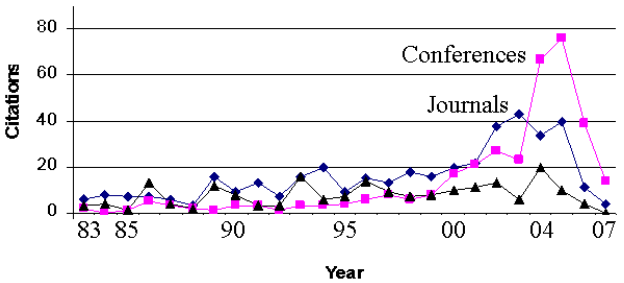

Figure 3: The frequency of citations to books, journals and conferences in the period 1983-2007.

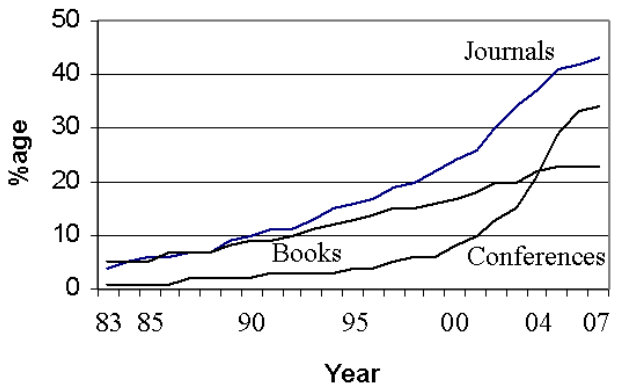

Figure 4: The cumulative frequency of ICER citations to books, journals and conferences in the period 1983-2007.

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ACE2009

in cooperation with

The Eleventh Australasian Computing Education Conference

Wellington, New Zealand from Jan 20 - Jan 23, 2009.

http://www.cs.rmit.edu.au/conf/ace_2009/ACE2009.php

The **Eleventh Australasian Computing Education Conference** (**ACE2009**) is a conference on research and innovation in computing education in its various aspects, at all levels and in all contexts. ACE2009 is the only Australasian conference devoted entirely to education in computer science, information systems, software engineering and information technology. ACE2009 is held in conjunction with Australasian Computer Science Week 2009 (ACSW 2009). ACSW 2009 arranges the venues and registrations for all ACSW 2009 conferences.

ACSW 2009

Important Dates

Sunday 7th September 2008: Submission Deadline

Monday 3rd November 2008: Notification of Acceptance

Monday 24th November 2008: Camera-ready Copy and Author Registration

Call for Papers for ACE2009

Topics of interest for the conference include, but are not limited to: the use of technology in education, course content, curriculum structure, methods of assessment, mobile, flexible, online learning, and evaluations of alternative approaches.

These innovations may be in the context of formal courses or self-directed learning; they may involve, for example, introductory programming, service courses, specialist undergraduate or postgraduate topics, industry-related short courses. We welcome submissions directed at issues of current and local importance, as well as topics of international interest. Such topics may include transition from school to university, articulation between vocational and university education, quality management in teaching, teaching people from other cultures, attracting and retaining female students, online, mobile and blended learning.

The Program Committee will select the papers to appear based on their potential to enhance learning outcomes in computing courses. All papers will be fully refereed using a double blind reviewing process. Papers must be between 4 and 10 pages long. For detailed instructions on the required format, see the Guidelines for authors on conference web site, at the above URL. ACE2009 proceedings will be published through the Australian Computer Society in the Conferences in Research and Practice in Information Technology (CRPIT) series.

Submission of papers will be managed through EasyChair, http://www.easychair.org/conferences/?conf=ace2009, a comprehensive conference paper management system. First create your own account there and then login and follow the prompts to submit your anonymous paper for double blind reviewing. If there are any issues with submission, please email ACE2009@rmit.edu.au.

ACE2009: Program Committee

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Sally Fincher, University of Kent, UK
Simon,University of Newcastle, Australia.

ACE2009: Keynote

***Mark Guzdial* will be the keynote speaker for the eleventh Australasian Computing Education Conference.**

Prof Mark Guzdial, from Georgia Tech, is the inventor of the Media Computation approach to learning introductory computing, which uses contextualized computing education to attract and retain students. He is currently vice-chair of the ACM Education Board and was the original developer of the CoWeb (or Swiki), which is now one of the most widely used Wiki engines in Universities around the world. He developed Emile, an environment for high school science learners programming multimedia demonstrations and physics simulations.

ACE2009: Pre-Conference Workshop

Contextualized Approaches to Computing Education

Sunday 18 and Monday 19 January, 2009

Presenters: Barbara Ericson and Mark Guzdial

This workshop will present participants with some contextualized approaches to computing education, particularly emphasizing media – image, sound, video, websites. Research results will be presented on several different contextualized approaches, including media computation, robotics for CS1, and engineering approaches to CS1. The workshop aims to introduce media computation, python, Alice and develop a better understanding of the importance of context. This introduction to media computation also aims to define the Australasian context, to apply media computation to changing computing contexts and consider applications for research with lots of discussion.

ACE2009: Post-Conference Workshop

BRACElet Workshop

As happened with ACE2008, a BRACElet workshop will follow ACE2009. BRACElet is a multi-institutional research study of how novice programmers comprehend and write computer programs. While it is research project, BRACElet remains close to educational practice, with much of the data analysed coming from exam papers sat by first year undergraduates at the participating universities.

Further information available at ACE2009 website:
http://www.cs.rmit.edu.au/conf/ace_2009/ACE2009.php, or
by emailing ACE2009@rmit.edu.au.

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