An analysis of 27 years of research into computer education published in Australian Educational Computing.

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Abstract

Analysis of three decades of publications in Australian Educational Computing (AEC) provides insight into the historical trends in Australian educational computing, highlighting an emphasis on pedagogy, comparatively few articles on educational technologies, and strong research topic alignment with similar international journals. Analysis confirms the cyclical nature of educational research, and the topics of study that have waxed and waned in research popularity, with author contributions and citation rates providing an acknowledgement of the key contributors to computer education research over the past 27 years.

Introduction

Internationally, there has been research conducted recently into publication patterns in computer education journals (e.g. West & Borup, 2013) in order to better understand the field. Australian Educational Computing (ACE) as a journal has been publishing research since 1986 and this study provides an analysis of publication and authorship patterns for research papers published in the journal during the 27 year period 1986-2013. Each paper has been categorised according to its year of publication, topic focus, authorship, and citations; and the findings aggregated to show trends over the last three decades. Key timings for the introduction of new technologies and the dominant pedagogical approaches were identifiable as well as shifts in emphasis over time. AEC initially focused on articles for teachers but as the field and journal matured, became an academic journal and analysis of AEC authorships and article citations provides an overview of key contributors to the field of Australian computer education research during this period.

In exploring current educational technology research trends it is helpful to develop an understanding what research has already been conducted and the patterns and discourses that have developed from such research. Recent studies of educational technology research as published in journals have predominantly analysed authorship and article topic patterns (West & Borup, 2013; Billings, Nielsen, Snyder, Sorensen & West, 2012; Cottle, Aiken, Juncker, & West, 2012; Drysdale, Matthews, Terekhova-Nan, Woodfield & West, 2013; Halverson, Bostwick, Cates & West, 2011; Juncker, Calvert, Clements, Kim, & West, 2013; Mayer, Francis, Harrison, McPhillen & West, 2012; Mott, Ward, Miller, Price, & West, 2012; Oviatt, Burdis & West, 2012; Randall, Skeen, Bishop, Luke & West, 2011). Other studies though have focused on topic trends (Lee, Driscoll and Nelson, 2007), author productivity (Ku, 2009), citations (Gall et al., 2010) journal publication preferences (Carr-Chellman, 2006) or

journal prestige (Ritzhaupt, Sessums and Johnson, 2012, Hannafin, 1991; Holcomb, Bray & Dorr, 2003; Price & Maushak, 2000). Many studies have compared a range of journals, however this study is focused on research published in the Australian Educational Computing journal in order to analyse a single narrative of publications and the relationship of authors with this specific journal. AEC publication data has however been compared in some detail with the findings of a metastudy (West & Borup, 2013) of ten international educational technology journals: Educational Technology Research and Development (ETR&D); American Journal of Distance Education (AJDE); British Journal of Educational Technology (BJET); Contemporary Issues in Technology and Teacher Education (CITE); Distance Education (DE); Internet and Higher Education (IHE); Journal of the Learning Sciences (JLS); Journal of Research on Technology in Education (JRTE); Journal of Technology and Teacher Education (JTATE); and Performance Improvement Quarterly (PIQ).

Method

In examining the body of work published in the Australian Educational Computing journal from 1986 to 2013 there were a total of 323 papers and articles published in 53 editions over 27 volumes. Publications such as "book reviews," "letters," "conference reviews" and "editorial materials" were excluded from this study. A further review was carried out to exclude minor articles reporting or advertising events or projects. While the review predominately includes peer reviewed articles, 32 articles of a general nature have been included where they contributed strongly to identifying issues of interest, particularly in the earlier years of the journal where it was not clear of their review status.

Once authorship was identified, citation data for each paper was collected using Google Scholar as the index most likely to include citations (Harzing, 2010), and each paper classified into a topic focus and authorship was assigned for all named authors. Analysis of publication date, authorship, citation count, and topic focus permitted pivot table comparison and graphing of paper counts, citation counts, author counts, topic counts, topics by year, author by year, and authors per year.

Articles were assigned to 15 categories that emerged from title keywords and reflected their main focus: Application, CBL (Computer Based Learning), Cognition, Curriculum, Engagement, Equity, Ethics, Integration, Mobile, Online, PD/ITE (Professional Development / Initial Teacher Education), Pedagogy, Primary, Programming, and Reform. It was then possible to compare trends in AEC with similar international journals with topic trends compared by matching the category terms used in this study and the West and Borup (2013) study. For example, they used the terms Teaching Methods and Collaboration that combined has been matched to the category of Pedagogy; Distance Education and Communication/CMC combined have been matched to the combination of Online, CBL and Mobile; Higher Education, PK12, Subject-Specific Education, Instructional Design, and Adult Education have been combined and matched to a combination of Curriculum and Primary; and, Attitudes and Community/Social Environment have been combined and equated to a combination of Ethics and Equity. A few categories could not be matched,

Foreign Countries and Management/Administration from their study, and the Programming and Engagement categories from this study, had no equivalent categorisations.

Topic Analysis

Counts of article topics identified in AEC data (Figure 1) with the West & Borup (2013) study show a prevalence (>10%) of articles in the categories of Online, Pedagogy and Curriculum. There was a stronger focus internationally on articles concerning Online education (22.8% vs. 17.5%), possibly explained by the specific focus of some selected journals on this topic, while AEC articles had a stronger focus on Pedagogy (17.5% vs. 10.7%). There was roughly the same order and very similar percentages for other categories in the 5% - 10% of articles range, with a slightly stronger focus on PD/ITE in AEC, 13.4% vs. 9.7%. However the West & Borup (2013) review found a much stronger focus on Educational Technology articles published in international journals compared to articles published in AEC, 16.8% and second in frequency vs. 3.4% and one of the lowest in frequency (Applications). This may in part be explained by the availability of the Australian Journal of Educational Technology (AJET) that was established at the same time as AEC and has educational technologies as its focus.
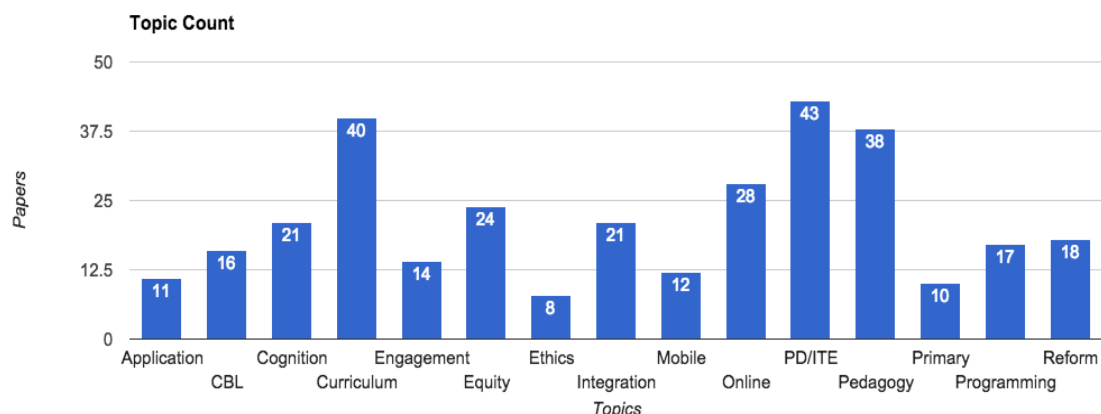

Figure 1. Frequency of papers in AEC for each topic category (1986-2013)

Analysis of topic counts over time provides some insight into when particular concepts were of research interest and the subsequent focus of published papers (Table 1).

Table 1.
Peaks of publication of papers for each topic category.

Peak	Topic	Comment
1986	Application	Peaks in 1986 and 2002
1991	CBL	Wide peak around 1994
1989	Cognition	Strong focus in 1992
1989	Curriculum	Strong peaks 1990, 1999 and 2001
1987	Engagement	Focus in 2010
1986	Equity	Very Strong in the 80's
1992	Ethics	Wide peak around 1994

1987	Integration	Peaks in 1988 and 2007
1996	Mobile	1996 - 2001 Laptops, 2008 - 2013 Mobile Devices
1986	Online	Growing interest to 2010 peak
1988	PD/ITE	Peaks of interest around 1995, 2006 and 2013 (TTF)
1986	Pedagogy	Wide Peak in 1992 and again in the mid 2000's
1987	Primary	Peaks in 1987 and 1997
1986	Programming	Strong interest in 1986 & 1992, but nothing past 2000
1998	Reform	Sporadic papers, particularly associated with ACEC keynotes

Papers focused on specific computer applications have had peaks in 1986 and 2002, though increasing interest in Mobile from 2008 have included papers on mobile device applications or apps. A cluster of Mobile articles from 1996 to 2001 represented interest in laptop devices, while articles from 2007 to 2013 generally comprised articles on the educational use of handheld devices (Figure 2).
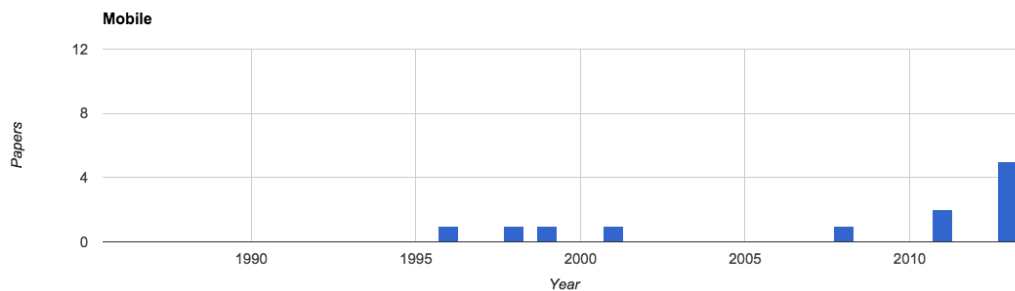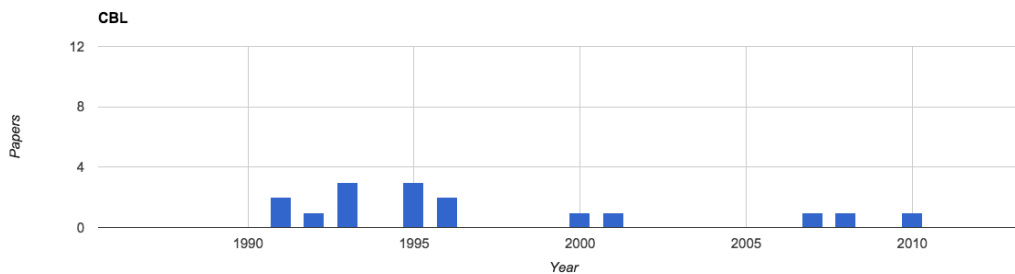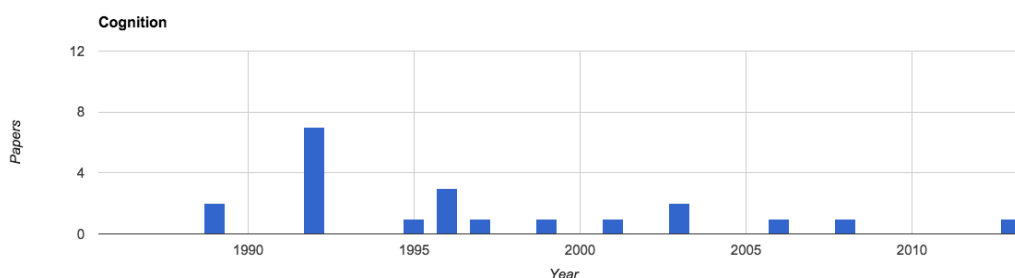
Figure 2. Mobile

Figure 3. CBL

Computer Based Learning (CBL) focused articles were particularly popular in the 90's, but interest in this area of educational computing then waned, possibly as pedagogy became an all encompassing topic, subsuming specific articles on CBL (Figure 3).

Figure 4. Cognition

Similarly, articles exploring technologies to improve students cognitive understanding of concepts, was particularly strong in the 90's, especially following Papert's ACEC keynote in 1990 (Papert, 1990) but this focused interest was not sustained (Figure 4).

Figure 5. Programming
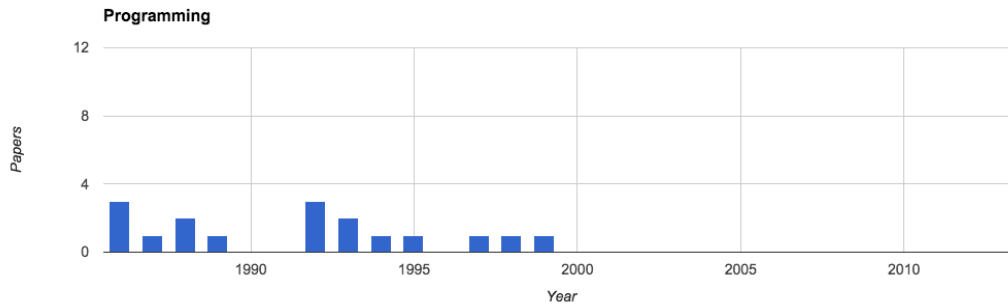
Computer programming was also a strong topic until 2000 but there have been notably no programming related papers since then (Figure 5), suggesting a shift from computer science to ICT integration from this period.

Figure 6. Curriculum
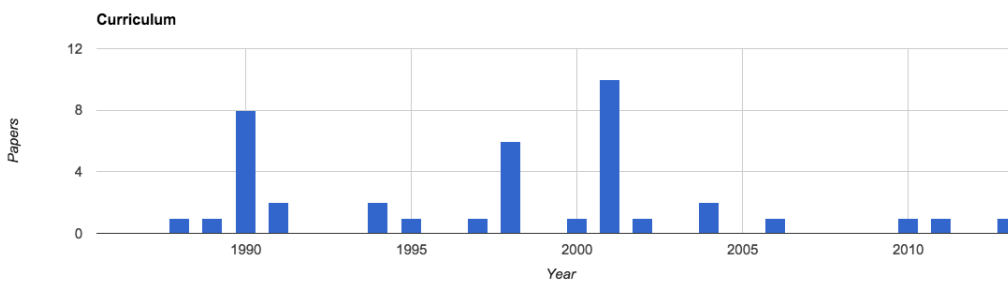
The cyclical nature of curriculum change in computer education can be seen occurring with an interval of 10-12 years (Figure 6), with peaks in curriculum change focused articles occurring in 1990, 2000 (1999-2001), but interestingly there has been little focus as yet on current curriculum changes regarding the Australian Curriculum, with the current gap of 14-15 years being an extended period without substantial academic contribution to curriculum changes.

Figure 7. Pedagogy
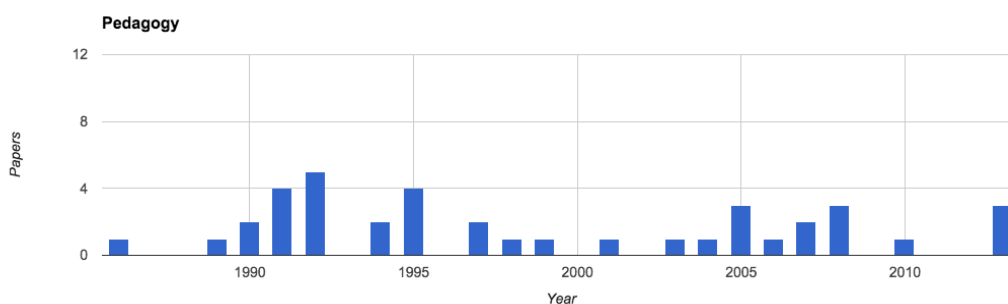
Articles focused on pedagogy have always been popular in AEC (Figure 7), with a wide peak in the 90's but interest in pedagogy in computer education has been strongly sustained and compared to international research, remains a particular strength of AEC.

Conversely, while reform of the education system was of interest in the early 90's but it has since tended to be represented only by conference keynote papers and not as a general topic for papers in AEC. Likewise issues of equity and ethics were of concern in the 80's and 90's, and while an ongoing topic of research, are no longer a focus of interest.

Figure 8. PD/ITE
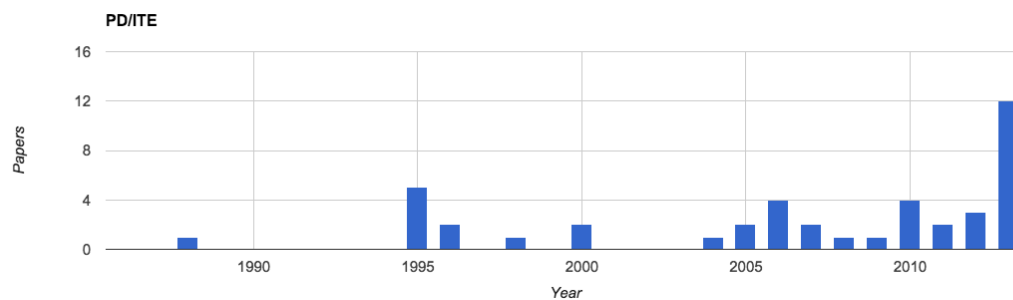
Online as a topic however has maintained a steadily growing interest from 2003 to a peak in 2010, and Professional Development (PD) and Initial Teacher Education (ITE) focused articles have increased from the mid 90's to being currently one of the strongest areas of the AEC journal (Figure 8), with a particular peak in 2013 as a result of a special edition on the Teaching Teachers for the Future project (*Australian Educational Computing, 27*(3)).

Authorship and Citation Analysis

Authorship data compares favourably with international studies (West & Borup, 2013), with 306 authors (82%) publishing once in AEC, 47 (12.5%) have published twice, 12 (3%) have published three papers, 9 (2%) four papers, one author of 5 papers, three of 6 papers, two of 7 papers and one of 9 papers. The most prolific authors (>2 papers) (Table 2) account for 7% of AEC articles.

Table 2.
Authorships of papers published in AEC.

Author	Paper Count
Glenn Finger	9
Paul Newhouse	7
Michelle Williams	7
Margaret Lloyd	6
Geoff Romeo	6
Trudy Sweeney	6
Sue Trinidad	5

Peter Albion	4
Neil Anderson	4
Geoff Cumming	4
Toni Downes	4
Michael Henderson	4
John King	4
Anne McDougall	4
Ron Oliver	4
Chris Reading	4

Citation data, representing how many times an article is cited by other authors, was generated using Google Scholar, and for each AEC article a total citation count for articles published in AEC was produced for each published author. Of 509 individual article authorships, given that some articles had multiple authors, for which 1366 citations could be attributed, 316 (62%) had no citation, 23 had one citation (4.5%), 35 (6.9%) had two citations, 26 (5%) had three citations. 12 (2%) had four citations, 12 (2%) had five citations, 5 (1%) had six citations, 5 (1%) had seven citations, 13 (2.5%) had eight citations, 12 (2.5%) had nine citations, 7 (1%) had ten citations, 4 (1%) had eleven citations, 6 (1%) had twelve citations, 4 had thirteen, 2 fourteen, 7 sixteen, 3 seventeen, 1 eighteen, 1 nineteen, 3 twenty, one each of 21, 22, 24, 26, and 27 citations, and one article had 48 citations.

AEC citation numbers compare favourably to many social science journals (Remler, 2014), where single citations for articles can be well below 10% (Larivière, Gingras & Archambault, 2009) compared to AEC articles where 38% have at least one citation. While statements such as "90% of papers that have been published in academic journals are never cited… 50% of papers are never read by anyone other than their authors, referees and journal editors." (Meho, 2007) are over dramatic, the contribution of AEC to the field of Australian educational computing, as with many academic publications, is often through indirect means and influence. AEC has provided a strong foundation over many decades for our leading academics to inform each other, and the wider educational computing community, of the results of their research, and aggregating authorship citations to generate total citations for all of the papers published by each author in AEC provides an indicator, based on AEC publications and their citations alone, of influential authors over the last 27 years of publication history (Table 3).

Table 3
Total number of citations and papers cited by each author.

Author	# Papers	Citations
Glenn Finger	5	63
Rebecca Callaway	1	48

Emese Felvegi	1	48
Kathryn Matthew	1	48
Cheryl Godfrey	2	39
Bruce Mann	2	39
Paul Newhouse	4	38
Sue Trinidad	4	35
Romina Jamieson-Proctor	4	33
Ron Oliver	2	33
Peter Albion	2	30
Sandy Schuck	3	28
Neil Anderson	4	24
Matthew Kearney	2	24
Seymour Papert	1	24

Author citations shows the influence of key papers and their growing influence over time, however three of the top four authors by citation arose from a single co-authored paper, and highlights the significant impact an individual paper, such as Papert's can have on the field.

27 Years of computer education research

A decade ago, the June 2002 edition of AEC, *17*(1) conducted a brief retrospective of the body of academic work published to date in the AEC journal. Now with twenty seven years and a collection of 323 articles, AEC provides a significant overview of the issues and topics of interest to authors from 1986 to 2013. The topics selected for research published during this period provide some insight into the trends and points of emphasis over the last three decades of computer education research. While a clear differentiation was identifiable in the importance of local research on pedagogy, and that international research had a much stronger focus on educational technologies, there was nevertheless general alignment between the research published in AEC and similar international publications. Analysis of topic publications over time highlights the cyclical nature of educational research, but also the change in emphasis of some topics as their influence on educational discourse has waxed and waned. Finally, analysis of author contributions and citation rates provides a metric, as measured through AEC publications, of key authors, and an acknowledgement of their contribution to computer education research over the last twenty seven years.

The AEC 1986 to 2013 (27 years) Database used in this study is made available under the Open Database License: http://opendatacommons.org/licenses/odbl/1.0/.

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