

ACT to Improve ICT Use for Learning: A synthesis of studies of Teacher Confidence in Using ICT in two Queensland schooling systems

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ABSTRACT

A review of the literature about student use of ICT and the impact of ICT use on learning reveals a complexity of rationales and terminology that underwrite ICT initiatives; various dimensions and stages of integration; inherent methodological difficulties; obstacles to integration such as teacher ICT confidence, expertise and beliefs about the potential for ICT to make a difference to student learning; teacher professional development; school technological infrastructure and support; and the need for ICT leadership (Jamieson-Proctor, Burnett, Finger, & Watson, 2006). This paper investigates the overarching research question - Are ICT initiatives having the desired impact on teaching and learning in schools? It provides a synthesis of the results of recent investigations by us in Queensland State and Catholic schools involving 2652 teachers from 168 schools across the two systems. Significant statistical findings that link teachers' confidence in using ICT with students, to the quantity and quality of students' use of ICT for learning are highlighted. The findings support the hypothesis that current ICT initiatives are having less than the desired result in both Queensland systems. The paper concludes with a call for Australia-wide research to unpack and address the factors, such as teacher confidence, that are currently constraining the use of ICT within Australian schooling systems.

BACKGROUND

While most educators agree that ICT has the potential to transform teaching and learning, few researchers have taken up the challenge of how to measure and evaluate the wide-scale impact that ICT is having on teaching and learning in the 21st century (Jamieson-Proctor, Watson, Finger, Grimbeek, & Burnett, 2007). The chief reason for this seems to be that there is a lack of consensus in the literature about how teachers and students are integrating ICT as a necessary first step in the development of effective measurement procedures and instruments. All Australian states and territories have expended heavily to provide greater access by students to ICT in schools (Finger & Trinidad, 2002). The recently elected Australian Federal Government is ramping up the expenditure on ICT resources even further and has pledged to spend \$1 billion on the information technology plank of its 'education revolution'. A major priority is the provision of laptop and broadband access to all students across Australia in Years 9-12 (Connolly, 2008).

The trend towards the improved provision of ICT access for students is also reflected strongly in international research reports. For example, the OECD's Programme for International Student

Assessment (PISA), in 2000, 2003 and 2006 included questions about student access to and use of computers and their attitudes towards them (OECD, 2005a). The OECD reported that in 2003, 84.19% of students indicated they had access to a computer at school, and 79.44% indicated they had a computer to use at home. The PISA 2006 study reports improved access with 95.57% of Australian students indicating they had a computer for school use and 90.99% had access to the Internet at home (OECD, 2007). However, when frequency of computer use was examined in 2003, only 7.34% of students reported that they used a computer at school 'almost every day' (OECD, 2005b). While improvements have occurred, with 23.31% in 2006 indicating they used a computer at school 'almost every day', this still means that **ICT is integral to learning for only 1 in 5 Australian 15 year old students**. Cuban has noted that the claims for improving student use of computers in schools have been overly optimistic (Cuban, 2000) and refers to computers as being 'oversold and underused' (Cuban, 2001). As Cuban (2000) indicates, in referring to the United States of America:

The facts are clear. Two decades after the introduction of personal computers in the nation, with more and more schools being wired, and billions of dollars being spent, less than two of every ten teachers are serious users of computers in their classrooms (several times a week). Three to four are occasional users (about once a month). The rest--four to five teachers of every ten teachers--never use the machines for instruction. When the type of use is examined, these powerful technologies end up being used most often for word processing and low-end applications in classrooms that maintain rather than alter existing teaching practices.

Thus, while ICT access is expanding exponentially world-wide, it alone does not guarantee student and teacher use of ICT for teaching and learning. Further, the extensive teacher professional development initiatives of the past two decades have apparently not empowered teachers to have the confidence and skills necessary for them to transform their pedagogy by making ICT integral to learning in the 21st century. **If not, why not?** Many researchers are now concluding that immersing teachers in professional development aimed at 're-tooling' them has not resulted in the transformation of pedagogy initially forecast. Consequently, new models of professional development for teachers that move beyond the pervasive 're-tooling' approach to a model that will enable teachers to see the 'transforming' potential of ICT are under investigation (Prestridge, 2008). It is now generally accepted that:

...the potential has not been realised in any significant way, particularly the potential to transform how, what, where and why students learn what they do. While there are only limited examples of the transformative power in the educational sector, experience from industry and other sectors clearly demonstrates that new times need new approaches, and that the nature and application of ICT enable that transformation (DEST, 2002).

Teaching and learning in the 21st Century requires teachers to capitalise upon the relative advantage of using ICT to enhance curriculum, pedagogy and assessment approaches. Unfortunately, as Luehrmann (1994) audaciously suggested, if one's great-grandmother came back to visit earth, she would observe a very different world in terms of technological changes, but would find classrooms had changed little. Further, the challenges to education posed by ICT are reflected in the policies and planning of many educational systems throughout the western world (Becta, 2005; Milken Exchange on Education Technology, 2005; MCEETYA, 2000; Ministry of Education - New Zealand, 2003).

Accompanying these extensive ICT policy developments in Australia and overseas, as well as improved classroom access by students and teachers to ICT, much of the ICT research still relates to two key questions - *why ICT might be used*, and *how ICT might be used* in teaching and learning. While the ICT research to date has provided useful in theorizing about why and how ICT might be used, it has tended to be limited to case studies of ICT use by teachers and schools mostly involving 'lighthouse' projects. These studies provide rich descriptions of those projects, but do little in terms of

contributing large-scale evidence-based data about *student outcomes* derived from using ICT for learning across whole systems or even numbers of schools within a system. Problematically, many attempts at evaluating the impact of ICT use in education have also been limited to noting bandwidth, calculating money expended on hardware and teacher professional development, and calculating student to computer ratios (Proctor, Watson, & Finger, 2003). Aligned with the recent well-documented plethora of initiatives to integrate ICT into the curriculum in many countries have arisen parallel requirements to measure the quantity and quality of ICT integration that students experience, based on equally recent priorities that emphasize *outcomes* (Andrich, 2002) and *accountability* (Mulvenon, Murry, & Ritter, 2001).

Unfortunately, many researchers have adopted methodologies that do little to describe and evaluate the real impact of ICT on contemporary teaching and learning. Simplistic, negative correlations between numbers of classroom computers and standardised literacy and numeracy test results provide headlines for the media world-wide (Harris & Dudley, 2005) but do not illuminate the positive, pervasive impact ICT is having on teaching and learning in 21st Century classrooms. We also believe that testing 'ICT literacy' (MCEETYA, 2007) may answer questions related to *whether or not* students can use ICT tools 'proficiently', but certainly does not provide evidence about *how* students are able to use ICT for learning more broadly. These simplistic measures reflect fundamental problems with the definition and measurement of ICT curriculum integration. Measurement practices that focus purely on 'ICT literacy' which foreground learning *about* ICT, at the expense of learning *with* or *through* ICT, compartmentalise and separate ICT use from the students' other learning.

Obviously how something is understood and defined determines how it should be measured. Though *ICT integration* has been an aim of educational systems for some time, it is difficult to locate a direct and consistently applied definition of the term to underpin evaluation methodologies (Lloyd, 2006). Further, despite the lack of a clear definition, 'ICT integration' is seen as a key outcome of learning in most countries around the world, including Australia. It is generally agreed that to integrate is to seamlessly embed components, parts or elements into a complex yet harmonious whole. **Is that what is happening with curriculum integration of ICT in Australian educational contexts?**

Concurrently, Australian researchers have been developing diverse investigative approaches to answer this question (Fitzallan, 2004; Jamieson-Proctor, Watson, & Finger, 2003; Jamieson-Proctor et al., 2007; Trinidad, Clarkson, & Newhouse, 2006). A review of these studies reveals an understanding of ICT integration that is complex and multi-dimensional.

We believe that measuring the impact of ICT integration on teaching and learning based on a definition of ICT as 'integral' to, and 'embedded' within the curriculum, requires measurement methodologies that consider the extent of ICT use and its centrality to the learning environment. Importantly, the measurement of ICT use in schools should **focus on student outcomes** as a result of ICT use in the curriculum. This approach is aimed at determining the quality of learning *outcomes* for students as a result of ICT use, rather than the quantity of *input* measures by a school or education system (e.g. numbers of computers, funding for teacher professional development) and foregrounds learning with and through, rather than about ICT.

Since 2003, we have investigated student outcomes as a result of ICT integration in classrooms in both the State education system (Jamieson-Proctor, et al., 2006) and the Catholic education system (Jamieson-Proctor & Finger, 2007) in Queensland. This paper reviews and synthesises the results from these research studies and aims to address the overarching question: ***Are ICT initiatives having the desired impact on teaching and learning in schools?***

APPROACH

The approach used here is firstly to compare the studies' individual findings with respect to the relationship between teacher confidence and student use of ICT, and then merge and reanalyse the combined data set in order to better understand the impact teacher confidence has on student use of ICT to enhance and transform learning in Queensland State and Catholic schools.

Measurement instrument and procedures

The studies used the same instrument, namely: *Learning with ICTs: Measuring ICT Use in the Curriculum* which was initially developed and then evaluated for Education Queensland (Jamieson-Proctor, et al., 2003; Jamieson-Proctor, et al., 2007). This teacher survey instrument is available online (DETA, 2005) and elicits demographic data on teachers such as gender, school type, years of teaching experience, confidence to use ICT with students for teaching and learning, year levels and curriculum areas currently taught, as well as responses to 20 items, using a 4-point Likert scale ranging from Never (1) to Very Often (4), that investigate both the quantity and quality of student use of ICT for learning in classrooms. Each of the 20 statements starts with the item stem: *In my class students use ICT to...* in order to focus the teachers' attention on how their students use ICT rather than on how they use ICT. Two frequency-of-use scales are used to reflect the 'current' and 'preferred' teacher perceptions of ICT use by students. The instrument was found to contain two strong factors in all studies. The first factor is comprised of 14 items that define ICT as a tool for the development of ICT-related skills and the *enhancement* of curriculum learning outcomes ($\alpha = 0.94$). The second factor comprises 6 items that define ICT as an integral component of reforms that *transform* what students learn and how school is structured and organised ($\alpha = 0.86$). The complete validation data for the instrument has been previously reported (Jamieson-Proctor, Watson, & Finger, 2005; Jamieson-Proctor, et al., 2007).

Subjects

Table 1 displays the demographic data for the 2652 teachers from both the State and Catholic systems in Queensland who have completed the instrument. As can be seen in the table, there are uncanny similarities in composition between the two groups of teachers, all of who volunteered to complete the instrument for their particular education system.

Table 1: Demographic information detailing teacher numbers (%) by gender, school type, years of teaching experience, and confidence in using ICT with students for teaching and learning (N = 2652)

Demographic Descriptor	Number (%) of teachers in Catholic schools	Number (%) of teachers in State schools
Gender:		
Female	1272 (74)	706 (76)
Male	451 (26)	223 (24)
School Type:		
Primary with Prep or Pre-school	902 (52.4)	539 (57.7)
Secondary	666 (38.7)	360 (38.5)
P-12, P-10	96 (5.6)	
Middle School	11 (0.6)	
Special Education Unit	1 (0.1)	29 (3.1)
Other	47 (2.7)	1 (0.1)
Years of Teaching Experience:		
0-5 years	433 (25.1)	239 (25.6)
6-10 years	287 (16.7)	154 (16.5)
11-20 years	440 (25.5)	277 (29.7)
21-30 years	389 (22.6)	193 (20.7)
More than 30 years	174 (10.1)	66 (7.1)
Confidence to use ICT for Teaching and Learning:		
Very little confidence	148 (8.6)	84 (9.0)
Some confidence	616 (35.8)	312 (33.4)
Reasonably confident	680 (39.5)	406 (43.5)
Very confident	279 (16.2)	127 (13.6)
Totals	1723 (100)	929 (100)

The following discussion highlights the similarities between the two teacher groups specifically with respect to teacher confidence. The two data sets were also combined and reanalysed to synthesise an understanding of how teacher confidence impacted on the quantity and quality of student use of ICT for learning. Detailed results from each individual study can be obtained from the References to this paper.

Teacher gender as it relates to teacher confidence and student use of ICT for learning

The previous independent studies found that female teachers from both the State and Catholic education systems in Queensland were more likely to indicate Very little or Some confidence, while male teachers were more likely to indicate that they were Very confident to use ICT with students for teaching and learning. Table 2 displays the frequencies for each confidence level by teacher gender from these studies.

Table 2: Frequency of confidence in using ICT with students for teaching and learning for male and female teachers from the Catholic and State education systems in Queensland (N=2652)

	Catholic System Teacher Gender			State System Teacher Gender		
	% Female	% Male	% of Total	% Female	% Male	% of Total
Very little confidence	9.4	6.5	8.6	9.6	7.2	9
Some confidence	40	23.9	35.8	35.8	26.5	33.6
Reasonably confident	39.4	39.4	39.4	42.8	46.6	43.7
Very confident	11.2	30.2	16.1	11.8	19.7	13.7

Total %	100	100	100	100	100	100
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When the two education systems data sets were amalgamated, the Pearson Chi-square test of significance, confirmed a significant difference between genders for confidence to use ICT with students for teaching and learning, $\chi^2(3, N = 2652) = 109.08, p = .000$. Female teachers were more likely to indicate Very little or Some confidence, while male teachers were more likely to indicate that they were Very confident. Table 3 displays the frequencies for each confidence category for the combined data.

Table 3: Frequency of confidence in using ICT with students for teaching and learning for male and female teachers (N=2652)

	Teacher Gender		% Of Total
	% Female	% Male	
Very little confidence	9.5	6.7	8.7
Some confidence	38.5	24.6	35.0
Reasonably confident	40.6	42.0	41.0
Very confident	11.4	26.7	15.3
Total %	100	100	100

Also, with respect to how teacher gender was related to student use of ICT, it was found in both the two previous studies that the students of male teachers currently used ICT more frequently than the students of female teachers for both the curriculum enhancement and transformation dimensions of ICT use. There was however no significant difference between male and female State school teachers with respect to how they preferred their students to use ICT for either dimension of use. Interestingly though, female teachers in the Catholic system preferred their students to use ICT more in order to transform teaching and learning than was the case for male teachers, while male teachers preferred their students to use ICT more to enhance the curriculum. Table 4 displays these individual results.

Table 4: A comparison of means (with Standard Deviations) for male and female teachers for the two dimensions of ICT use by students for both the Current and Preferred scales for both Catholic and State system teachers (N=2652)

Teacher Gender & School System	Dimension 1 (Enhance)	Dimension 1 (Enhance)	Dimension 2 (Transform)	Dimension 2 (Transform)
	Current Use	Preferred Use	Current Use	Preferred Use
Female (C) n=1723	2.05 (0.02)#	2.82 (0.02) #	1.68 (0.01) #	5.54 (0.02) #
Female (S) n=929	1.97 (0.61)*	2.75 (0.62)	1.58 (0.54)*	2.47 (0.70)
Male (C) n=1723	2.21 (0.03) #	2.92 (0.03) #	1.88 (0.02) #	2.67 (0.03) #
Male (S) n=929	2.1 (0.60)*	2.81 (0.59)	1.68 (0.56)*	2.47 (0.67)

and * indicates significance at $p < .05$; C=Catholic System; S=Sate System

The combined data sets told a fairly similar story. The MANOVA was significant for gender, Pillai's Trace = .02, $F = 14.82, df = (4,2647), p = .000$, indicating different levels of student ICT use for male and female teachers. The univariate F tests showed there was a significant difference between males and females for D1, $F = 35.31, df = (1,2650), p = .000$; and D2, $F = 53.33, df = (1,2650), p = .000$ with respect to how frequently their students *currently* use ICT. They also differed with respect to how they *preferred* their students to use ICT for both dimensions: D1, $F = 11.50, df = (1,2650), p = .001$; and D2, $F = 8.78, df = (1,2650), p = .003$. These data are displayed in Table 5.

Table 5: A comparison of means (with Standard Error) for male and female teachers for the two dimensions of ICT use by students for both the Current and Preferred scales for the combined data (N = 2652)

Teacher Gender	Dimension 1 (Enhance)	Dimension 1 (Enhance)	Dimension 2 (Transform)	Dimension 2 (Transform)
	Current Use	Preferred Use	Current Use	Preferred Use
Female	2.02 (.013)*	2.79 (.013)*	1.64 (0.12)*	2.52 (.014)*
Male	2.17 (.022)*	2.88 (.022)*	1.82 (.02)*	2.60 (.025)*

* indicates significance at $p < .05$

Thus, across both the Catholic and State education systems in Queensland, when the data are combined, the students of male teachers are currently using ICT more frequently to both enhance and transform the curriculum, teaching and learning than are the students of female teachers. Further, it seems that male teachers would prefer their students to use ICT more for both dimensions than would their female colleagues.

Teacher confidence as it relates to student use of ICT for learning

The results from the two independent studies indicated that for both dimensions of ICT use in each schooling system, teachers who felt more confident to use ICT with their students for teaching and learning reported that their students currently used ICT more than the students of less confident teachers. Further, more confident teachers also preferred their students to use ICT more for teaching and learning than did less confident teachers.

Table 6: Comparison of means (with Standard Deviations) for unconfident and confident teachers for the two dimensions of ICT used by students on both the Current and Preferred scales in both school systems (N=2652)

Teacher Confidence Level	Dimension 1 (Enhance)	Dimension 1 (Enhance)	Dimension 2 (Transform)	Dimension 2 (Transform)
	Current Use	Preferred Use	Current Use	Preferred Use
Unconfident (C) n=1723	1.92 (0.02) #	2.68 (0.02) #	1.60 (0.02) #	2.42 (0.02) #
Unconfident (S) n=929	1.77 (0.51)*	2.59 (0.60)*	1.44 (0.47)*	2.33 (0.70)*
Confident (C) n=1723	2.22 (0.02) #	2.97 (0.02) #	1.84 (0.02) #	2.70 (0.02) #
Confident (S) n=929	2.17 (0.63)*	2.89 (0.59)*	1.72 (0.58)*	2.57 (0.67)*

and * indicates significance at $p < .05$; C=Catholic System; S=Sate System

Further, an analysis of the combined data also showed that less confident teachers indicated that their students currently use ICT less frequently to both enhance and transform the curriculum, teaching and learning than do the students of their more confident colleagues.

The MANOVA was significant for confidence, Pillai's Trace = .09, $F = 66.81$, $df = (4,2647)$, $p = .000$, indicating a general difference in the level of student use of ICT between unconfident and confident

(female and male) teachers. The univariate F tests showed there was a significant difference between unconfident and confident teachers for D1, $F = 244.12$, $df=(1,2650)$, $p = .000$, and D2, $F = 153.85$, $df=(1,2650)$, $p = .000$, with respect to how frequently students *currently* use ICT. The univariate F tests also indicated a significant difference between confident and less confident teachers for D1, $F = 174.22$, $df=(1,2650)$, $p = .000$, and D2, $F = 110.10$, $df=(1,2650)$, $p = .000$, with respect to how frequently they *preferred* their students to use ICT.

Table 7: Comparison of means (with Standard Error) for unconfident and confident teachers for two dimensions of ICT use by students for both the Current and Preferred scales of the combined data (N = 2652)

Teacher Confidence Level	Dimension 1	Dimension 1	Dimension 2	Dimension 2
	(Enhance) Current Use	(Enhance) Preferred Use	(Transform) Current Use	(Transform) Preferred Use
Unconfident	1.87 (.016)*	2.65 (.017)*	1.54 (.015)*	2.39 (.019)*
Confident	2.20 (.014)*	2.97 (.015)*	1.79 (.014)*	2.65 (.016)*

* indicates significance at $p < .05$

Therefore, across both the State and Catholic education systems in Queensland, the students of more confident teachers are currently using ICT more frequently to both enhance and transform the curriculum, teaching and learning than are the students of less confident teachers. Probably more significantly for their students' future outcomes, more confident teachers indicated that they would prefer their students to use ICT more when compared to less confident teachers.

CONCLUSION

This paper specifically focussed on the impact of teacher confidence on student use of ICT. The paper synthesised, merged and reanalysed data from 2652 teachers working in the Catholic and State systems in Queensland. The results from both independent studies and the analysis of the amalgamated data suggest that teacher gender is significantly related to teacher confidence to use ICT with students for teaching and learning and both teacher gender and teacher confidence have a direct positive relationship with the quantity and quality of student use of ICT. The students of male teachers or more confident teachers are reportedly using ICT more to both enhance and transform the curriculum, teaching and learning in Queensland State and Catholic schools.

These results should be ringing equity bells very loudly for the two Queensland systems concerned and perhaps also for educators across Australia, if one assumes that Queensland is not all that different from the other states and territories. Given that more than 70% of Australian teachers are female, it might be inferred that 70% of students are being taught by female teachers, many of whom are less confident than their male colleagues. The reasons why female teachers are less confident and the strategies which might be adopted to improve their confidence levels need urgent exploration.

One hypothesis emerging from these studies is that a one-size-fits-all teacher professional development model for ICT is not appropriate. Male and female teachers have been receiving the same ICT professional development for two decades. Why are female teachers still less confident than male teachers? It would also certainly not be out of the realms of possibility to suggest that current ICT initiatives are probably having less than the desired result for student learning in schools. If the aim of current ICT initiatives is to make ICT integral to learning, female teachers and their students are

probably not achieving this aim to the same extent as male teachers and their students. It has been recognised and strongly supported in the recent Australian and international literature that unless research is undertaken to unpack and address the factors that are currently constraining the use of ICT within schooling systems, it is unlikely that the current, costly initiatives being undertaken by education systems in all Australian states will achieve their desired student outcomes (Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Prestridge, 2008).

These results indicate that policies, and obviously current and past professional development initiatives, are insufficient to ensure that student learning is either enhanced or transformed by ICT use. Research is long overdue that identifies the extent to which *students use ICT* and *how students use ICT* for learning in schools across Australia, and more importantly, to unpack the factors that are seriously jeopardising the ICT initiatives that aim to make ICT integral to learning in the 21st Century.

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