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The beliefs behind the teacher that influences their ICT practices

Abstract

This paper explores teacher beliefs that influence the ways Information and Communications Technologies (ICT) are used in learning contexts. Much has been written about the impact of teachers' beliefs and attitudes to ICT as 'barriers' to ICT integration (Ertmer, Ottenbreit-Leftwich & York, 2007; Higgins & Moseley, 2001; Loveless, 2003). This paper takes a closer look at the types of beliefs that influence ICT practices in classrooms and the alignment of these beliefs to current pedagogical reform in Australia. The paper draws on data collected through the initial phase of a research project that involved an Industry Collaborative of four Catholic primary schools (prep - grade 7). Data are drawn from teacher surveys, interviews and document analysis. The results present specific links between ICT beliefs that are informing teachers' practices. ICT beliefs and practices are aligned to reform agenda for digital pedagogies. The findings of this research inform teacher ICT practice and requirements for ICT professional development.

Keywords: Teacher beliefs, technology integration, teacher ICT use, digital pedagogy

1. Introduction

It can be simply stated that teachers' pedagogical beliefs affect their teaching behaviours in the classroom (Bandura, 1986; Clark & Peterson, 1986). With the advent of Information and Communications Technologies (ICT) in education, teachers form their own beliefs about the role of ICT as a teaching tool, the value of ICT for student learning outcomes and their own personal confidence and competency. These beliefs intersect with teachers' established pedagogical beliefs. This intersection can be a 'collision' or 'collusion', both having implications on how ICT is used in the classroom, as an add-on to established curriculum practices or as a tool that effects change in their practice (Prestridge, 2007). Teachers are likely to plan and implement practices with technologies that reflect their beliefs about teaching and learning (Drenoyianni & Selwood, 1998).

Teacher beliefs have been identified as a 'second-order' barrier to the integration of ICT in teaching and learning (Ertmer, 2005). First-order barriers are extrinsic to the teacher and include lack of resources, time, access and technical support. As part of current educational reforms, such as The Digital Education Revolution 2008-2011 in Australia (Department of Education, Employment and Workplace Relations (DEEWR, 2009), The National Education Technology Plan in America (U.S. Department of Education, 2006) and the Every Child Matters programme of change in the United Kingdom (Department of Children Schools and Families (DCSF, 2009) technological infrastructure such as broadband internet, as well as new ICT equipment, online curriculum resources and ICT training for teachers is being delivered. Regardless of place, sentiment such as this is leading these reforms:

'Australia will have technology enriched learning environments that enable students to achieve high quality learning outcomes and productively contribute to our society and economy' (DEEWR, 2008, p.4).

First-order barriers, consequently, are being overcome. Teachers are gaining access to ICT, professional development is available, and digital curriculum resources are accessible and are continually being developed- the digital classroom is a reality. However, teachers' ability to use these digital tools in their classrooms, that is, the digital pedagogies required for the

effective implementation of ICT, have not been adopted by the majority of teachers (Scrimshaw, 2004) and there still exists a division between the input of the early adopters and the reality of a more widespread implementation of ICT (Watson, 2006). Tondeur, van Braak and Valcke's (2006) research on the impact of a national curriculum on the use of ICT in primary schools found that Flemish primary school teachers still stress, to a large extent, technical ICT skills. Smeets (2005) also argues that current ICT integration in Dutch primary schools reflects traditional pedagogical approaches that emphasise skill-oriented instructional use of ICT. Similarly, evident in Prestridge's (2007) examination of curriculum reform in Australian primary schools, the majority of teachers were expected to reach targets aimed at augmenting the existing curriculum, in other words, adding-on ICT or assimilating ICT as traditional teaching that has been technologised (Lankshear & Bigum, 1998). The Digital Education Revolution in Australia is a response to the finding that even though most teachers and students benefit from access to computers and online resources 'only a minority are reaping the benefits of the information technology revolution' (DEEWR, 2008, p. 3) by using digital pedagogies.

Current reform agenda in Australia suggests a 'meaningful change to teaching and learning' described as 'student centric programs of learning' that 'employ contemporary learning resources and activities' (DEEWR, 2008, p.4). Student-centred activities that utilise digital resources can be described as 'Digital pedagogies'- teaching and learning practices that engage with digital technologies. Exemplary teachers who embed ICT in a seamless fashion have been defined as those who use ICT in learner-centred constructivist environments as opposed to traditional teacher-directed environments (Ertmer et al., 2007). This does not imply that direct instruction is not appropriate, as Gibson (2001) points out that the most effective learning environment is 'that in which the teacher, the facilitator, the guide, the instructor is capable of selecting the most appropriate strategy', knowledge instruction or knowledge construction, and that ICT must be 'transparent to the learner and allow for ubiquitous learning opportunities' (p.56). Consequently, if teachers are required to implement the kind of pedagogical change indicated in current educational reform agendas, professional development programs must look beyond first-order barriers to the intrinsic, more complex second-order barriers of teacher beliefs and how they influence ICT implementation in the classroom. This paper provides an examination of teachers' pedagogical beliefs about ICT that inform their classroom practices in the context of digital pedagogies.

2. Theoretical Framework

This section will explore theoretical underpinnings in regard to teacher beliefs followed by a review of the literature linking teacher beliefs and ICT practices.

2.1 Teacher beliefs

As beliefs are implicit, unobservable and complex in relation to what one knows and what one actually believes, both the labels and the definitions of teacher beliefs used in the literature are diverse and difficult to define. However, specific ideas from a substantive body of knowledge about teacher beliefs are evident to help us to understand and deal effectively with the complexity of beliefs. Firstly, Calderhead (1996) distinguishes between what would constitute as knowledge and what would be considered a belief. Beliefs are generally referred to as "suppositions, commitments and ideologies" whereas knowledge is referred to as "factual propositions and understandings" (p.715). In the case of teacher beliefs about ICT, for example, knowledge of a blog and how to blog, and even knowing other teachers who use blogs in their practice, does not mean that a teacher will believe that blogs are a beneficial tool for use in their classroom. Knowledge is external to the self, in the sense that it requires evaluation or judgement to reach a consensus. Whereas, beliefs are formed by non-consensus, they stem from affective feelings and emotive evaluations as well as personal experiences, which are not open to outside appraisal or critique (Pajares, 1992). Consequently, as suggested by Nespor (1987) beliefs are far more influential than knowledge in influencing

behaviour. The important question now becomes “how to change a belief?”

Rokeach (1976) talks about the strength or stability of a belief by its positioning in the belief system. The more central a belief is within what he calls the ‘central-peripheral dimension’ (p.13) as well as the more connections it has with other beliefs indicates the less this belief is likely to change. This idea suggests that beliefs are established during earlier experiences and become stronger over time as they are used to process subsequent experiences (Pajares, 1992). Nepsor (1987) suggests beliefs gain their strength from their ‘unboundedness’, meaning that the connection a belief has with another is highly variable, unpredictable, unstable and uncertain, indicating that there is no clear logical rule for the connection. On top of this illogical formation, the linkages are bounded up with emotional and personal experiences. This premise suggests that teachers’ beliefs vary in strength and kind, and the ease with which teachers change their beliefs is related to the strength of the belief under challenge.

Pedagogical beliefs are formed over many years of experiences, from life as a pupil in the classroom (Keys, 2007; Richardson, 2003) to the variety of professional context teachers encounter. Because of this, beliefs can be resistant to change. Long-standing beliefs are supported by strong authority and broad consensus (Albion & Ertmer, 2002). However, even though beliefs are not easily changed, it does not mean that they cannot be changed. According to Nespor (1987) when beliefs change, it is more likely a conversion or a Gestalt shift, rather than as a result of a marshalling of evidence. Like the visual experience of seeing one-way and then another, the shift is instant but may shift back unwillingly. In the context of teacher change, successful professional development promotes making conscious teachers’ pre-existing pedagogical beliefs for interrogation and reformation though out the program. A focus on the second order barriers of teacher beliefs is evident in literature associated with professional development including that related to the integration of ICT (Ehman & Bonk, 2002; Eib & Cox, 2003; Kagan, 1992; Prestridge, 2009; Shriner, Schlee, Hamil & Libler, 2009; Windschitl & Sahl, 2002; Wideen, Mayer-Smith & Moon 1996). Further discussion of the relationship between beliefs and practices specifically related to ICT is now required.

2.2 Teacher beliefs and the link with ICT practices

Teacher beliefs about learning and teaching are critical factors in how ICT is actualised in the classroom (Becker, 2000; Cox, Webb, Abbott, Blankely, Beauchamp, Rhodes, 2004; Orlando, 2009; Wozney, VenKatherinesh, & Abrami, 2006). The relationship between teachers’ beliefs and the integration of ICT has been explored in the literature. Loveless (2003, p. 323) in her research of primary teachers’ perceptions of ICT and their pedagogy, found that teachers’ perceptions of ICT are fashioned by their ‘identity and participation in wider cultural and social spheres which influence the professional arenas and settings in which they practice’. She grouped teachers’ perceptions of ICT into three categories: ICT in society: teachers talked about the ‘Information Society’ and its impact on children’s future working lives; ICT capability: teachers talked about the ICT skills or ‘information literacies’ children require as a subject and as a cross curricular tool; and ICT in schools: teachers talked about ‘new’ technology in schools and how the lack of resources influenced its integration. Loveless suggests that these perceptions reflect ongoing negotiations of the meanings of ICT in teachers’ work and that seeing them as sources of tension rather than as sources of anxiety is more constructive for continued meaning-making.

Veen (1993) found that teachers’ beliefs about the nature of a given subject, such as History or Science, and the associated pedagogical practices greatly influenced their use of ICT. This aligns with the concept of Technological Pedagogical Content Knowledge (TPCK) provided by Mishra and Koehler (2006, 2009), who highlight the way ICT applications change content knowledge. Jacobs and Clements (1999) found two distinct epistemologies that were either conducive or obstructive to the implementation of ICT. A constructivist epistemology

'believing that students learn best when they are given projects and guidance to help them construct mathematical concepts for themselves' (p.243) was found to be conducive, whereas a reductionist epistemology, 'where concepts are viewed to be passed along one at a time to students' (p. 244) was found to be obstructive. Howard, McGee, Schwartz, and Purcell (2000) developed a scheme to represent the underlying beliefs of objectivist/constructivist learning models, indicating that a sophisticated epistemology engenders principles of constructivism. The relationship between constructivist approaches and the use of ICT is presented as highly effective in the literature (Becker, 2000; Ertmer et al., 2007; Gibson 2001; Jonassen, 2006; Scrimshaw, 2004).

Cox et al (2004) moved away from the instructionist/constructivist framework to analyse ICT practices shaped by pedagogical beliefs. They did this by focusing on teachers' perception of ICT in the teaching process, that is, as a 'servant' to reinforce existing practices or as a 'partner' to change the way the teacher and the children interact with one another and the given task. In this way, trying new approaches to a task is perceived as necessary to utilise the ICT. Loveless, Burton, and Turvey (2006, p. 10) captured student teachers' reflections on their conceptualization of their teaching practices that supported development of children's creativity through the integration of ICT. Student teachers' pedagogical beliefs were described as 'play as a starting point', 'giv[ing] permission to try things out', 'compromise and improvisation in responding to the children's ideas' and 'not wish[ing] to provide too much guidance which might 'stifle''. These student teachers were learning *with* the children in their groups, as facilitators of creative thinking, rather than as instructors of ICT functions.

Evident in this literature are the influences on teacher beliefs about ICT. Influences include technology in society and working life, teacher competency, access in classrooms, the nature of the subject or task and associated pedagogies, how children learn, and the learning outcomes to be achieved. There is a link between teacher beliefs associated with constructivist approaches and using ICT as a partner to facilitate creative thinking and learner-centred activities. These beliefs align with what has been described previously in this paper as digital pedagogies. Teacher beliefs that expose digital pedagogies will be explored further in this paper.

3. Research Context

This paper reports on one aspect of a research project concerned with ICT professional development that enables teachers to engage with digital pedagogies. The project is supported by funding from Griffith University, Queensland, Australia and four Catholic Schools in the Brisbane Archdiocese.

The schools and their communities provide the research context. The schools are within the greater metropolitan region and are all Preparatory to grade 7 (Primary school children ages 5- 12 years) and educate from 200 to 520 children. All teachers and community members were informed of the research directions and ethical protocols.

4. Methodology

This paper is concerned with examining teacher ICT beliefs and practices to gain conceptual understanding of the requirements for ICT professional development. A mixed methods approach was adopted for this stage of the project in such a way that quantitative data informs qualitative data collection. To ascertain teachers existing pedagogical beliefs and practices with ICT a survey was distributed to all teachers within the four catholic schools (n=48). Questions asked participants for background and demographic information, ICT beliefs, ICT practices in general, current ICT usage and ICT competency as well as future ICT directions. The survey also included questions regarding the types of professional development that teachers had attended, and teachers' perceptions of effective elements of ICT professional development. Participant teachers responded on a 7-point Likert scale (Agree to Disagree).

Three items in the scale were recoded to ensure all items were reporting a positive orientation to the integration of ICT.

Survey data was analysed using the Statistical Package for the Social Sciences (SPSS). An initial assessment of the reliability of the scale was undertaken. An initial reliability analysis was undertaken to assess the suitability of the questionnaire items as a single scale. A Factor Analysis was then used to identify dimensions underlying the set of questions – using an Oblimin Rotation, with Principal Components Extraction with Factors identified where eigenvalues were greater than 1. Factor scores were calculated through the analysis (regression method) and respondents were identified by the factor they most strongly aligned with.

For the purpose of this paper, data relating only to teacher ICT practices was analysed. The survey questions pertaining to ICT practices are provided below in Table 1. The ‘teacher practices’ data set was analysed for Factors (See Table 3). These results informed the qualitative data collection in a ‘ground truthing’ process to explicate teacher beliefs behind ICT practices. The participants chosen for interview and document analysis were those who loaded a relatively high score on the Factor analysis (see Table 4). Two teachers from each of the Factor categories were interviewed and curriculum documents collected.

Table 1 Survey questions for Teachers’ ICT practices.

Question 1	I don’t know how to use ICT to enhance children’s learning in my classroom
Question 2	As I plan the next unit of work I think about how I will integrate ICT
Question 3	Students need to be competent at basic computing skills before they engage in a broad range of higher level ICT activities
Question 4	Teaching critical analysis is an important part of ICT activities
Question 5	ICT activities should relate to student’s everyday out-of-school experiences
Question 6	ICT lessons should focus on ICT skill development
Question 7	ICT should be taught as a separate subject area
Question 8	An ICT specialist should be employed to teach ICT to all students
Question 9	ICT activities should enable students to draw on and engage with problems encountered in real-life contexts
Question 10	ICT activities are part of larger on-going tasks rather than explicit ICT focused lessons
Question 11	Students are more self-directed during ICT activities which changes my role as a teacher

A semi-structured interview schedule was designed and implemented. Specific questions that related to the survey questions were included in the schedule. All interviews were audio-recorded and transcribed. Following this, each participant teacher was ask to provide documentation of planning and assessment they had implemented that demonstrated their use of ICT. Qualitative data was analysed using ground theory methods. The NUD*IST computer program was used to mechanise this thematic analysis process (Richards and Richards 1991). Through the constant comparative method of analysis (Glaser and Strauss 1967) questions were asked about data, comparisons were made for similarities and differences, strengths and weaknesses were identified, and further properties and dimensions were explored. Finally, an ICT framework was employed to analyse the curriculum documentation. The ‘Digital Age Learning Matrix’ developed by Starkey (2010) was used to examine learning activities that integrate digital technologies. The matrix (Figure 1) combines levels of learning with the categories of digital technology use.

Figure 1 Digital Age Learning Matrix.

		Levels of learning					
Digital Technology use		Doing	Thinking about connections	Thinking about concepts	Critiquing and evaluating	Creating Knowledge	Sharing Knowledge
	Accessing Information						
	Presenting						
	Processing Information						
	Gaming						
	Communicating						

The basic level Doing is where students do something such as post a comment on a blog, upload a photo to a wiki, search for information on the internet. When students make connections, they are working in the second level, such as compare/share activities. The third level indicates that students are able to demonstrate their conceptual understanding whereas in the fourth level students are working with procedural knowledge such as exploring the limitations and potential of the information and source. At the fifth level students are creating new knowledge. The final level brings together the ideas of connectedness, critique and creativity; students are sharing new knowledge and gaining feedback to initiate further knowledge creation. The Digital Age Learning Matrix provided a framework for the analysis of interview and documents to identify the ICT practices that the teachers used in their classrooms. All names used in the data reported in this paper have been replaced with pseudonyms.

5. Results

The results will be discussed in the order of data collection. The survey results will be discussed first as these informed the proceeding interview and document collection. Results of analysis of interviews and documents will follow.

5.1 Survey

The data set in the survey comprised of Agree/Disagree scaled responses to 11 questions regarding teachers' current ICT practices.

The scale (Items 1-11) had a moderate reliability, given the relatively small sample size, with a Cronbach's $\alpha = .678$. Analysis of the scale indicated that Question 3 was poorly correlated to the overall scale, with an $\alpha = .727$ for the 10 remaining items. This suggests that while a reduced version of the questionnaire (ie 10 statements) could be used to provide a single assessment with a moderate level of reliability, consideration of the presence of several factors may be useful.

A Factor Analysis was thus undertaken on all 11 questions (presented in Table 1). The Factor loadings (from the Pattern Matrix) are presented in Table 2 along with the level of variance explained by the identified factors. No significant correlations were found between the four Factors.

Table 2 Identified factors with weightings reported in Pattern Matrix (% explained variance)

Item	Factor1 (28.579%)	Factor 2 (16.215%)	Factor 3 (11.608%)	Factor 4 (10.139%)
Question 1	.773	.248	-.184	.222
Question 2	.371	.145	.263	.307

Question 3	.063	.264	.872	-.047
Question 4	-.108	.649	-.440	-.116
Question 5	.181	.846	.128	.043
Question 6	-.077	.706	.217	-.096
Question 7	.824	-.239	.228	-.136
Question 8	.501	.104	-.353	-.219
Question 9	.099	.207	.212	-.721
Question 10	.366	-.108	.057	-.680
Question 11	-.237	.014	-.137	-.811

This analysis suggests that teachers were responding to four Factors, as defined by associated questions in Table 3. Question 3, an item identified by the reliability analysis as less related to other items, was included in the Factor Analysis and interestingly, was identified as a distinct Factor (ie the only item loading strongly on that factor), consistent with the assessment from the reliability analysis. Question 2 (on Factor 1) did not load strongly on any factor (ie in this case all others loaded at the above 0.5), but has been included under Factor 1 – its strongest loading. As previously mentioned questions 1, 7 and 8 were reworded so that all questions were reporting a positive orientation to the integration of ICT.

Table 3 Associated questions relating to each Factor

Factor 1	Factor 2	Factor 3	Factor 4
Q1: I do know how to use ICT to enhance children's learning in my classroom	Q4: Teaching critical analysis is an important part of ICT activities	Q3: Students need to be competent at basic computing skills before they engage in a broader range of higher level ICT activities	Q9: ICT activities should enable students to draw on and engage with problems encountered in real-life
Q2: As I plan the next unit of work I think about how I will integrate ICT	Q5: ICT activities should relate to student's everyday out-of-school experiences		Q11: Students are more self directed during ICT activities which changes my role as a teacher
Q7: ICT shouldn't be taught as a separate subject area	Q6: ICT lessons should focus on skill development		Q10: ICT activities are part of larger on-going tasks than explicit ICT focused lessons
Q8: An ICT specialist shouldn't be employed to teach ICT to all students			

Drawing upon the Literature for Digital Pedagogies the Factors are presenting different ICT practices:

Factor 1—teachers' practices are represented in this Factor as Foundational ICT Practices. The statements expressed in Factor 1 are in the affirmative and indicate that teachers were responding to foundational ICT practices such as beginning to think (as this did not load strongly) about ICT in the planning phase, understanding that ICT should be integrated into all Learning Areas/ subjects and is the responsibility of the classroom teacher. ICT was also identified as a tool to enhance children's learning. These practices could be considered as 'general' or 'basic' in this form as there is no development of 'how' ICT enhances learning and the statements depict general understandings represented in curriculum documentation for

the use of ICT in learning.

Factor 2- teachers' practices are represented in this Factor as Developing ICT Practices. The statements expressed in Factor 2 indicate that teachers are thinking about curriculum implications of ICT such as ICT activities encompassing critical thinking, skill components and relevancy to life experiences. These elements demonstrate a development towards what has been described as digital pedagogies.

Factor 3- teachers' practices are represented in this Factor as Skill-based ICT Practices. One statement was expressed in this Factor indicating the focus on ICT skills. The idea represented in this statement, that basic ICT skills precede student engagement in complex ICT tasks, aligns with the aggregation of skills similar to an ICT skills continuum, which reduces ICT to a competency approach rather than a tool for thinking and creating. In other words, it suggests that students must do Word processing before Web design or Robotics and that ICT skills are in focus rather than an enhancement of learning. The skills directive aligns with traditional knowledge competency, sometimes called an 'Industrial' narrative (Whitby, 2006), whereas utilising ICT as a thinking or mindtool (Jonassen, 2006) enabling complex ICT applications at any given point, orientates with constructivist approaches that are more likely to be associated with digital pedagogies.

Factor 4- teachers' practices are represented in this Factor as Digital Pedagogical Practices. The statements expressed in Factor 4 indicate that teachers are identifying characteristics of ICT application that represent digital approaches such as enabling students to engage with authentic problem-oriented activities, the beliefs that ICT is a tool within the task, not a focus of the lesson, and the beliefs that the teacher's role is changing to facilitate self-directed learning.

The Factor scores for each factor from the analysis were used to link teachers to the Factor with which they were most strongly identified – these are presented in Table 4 with the greater the Factor score the greater the teacher's affiliation with that Factor. Teachers are represented in descending order based on their Factor scores.

Table 4 Teachers and their Factor score

F1: Foundational		F2: Developing		F3: Skill based		F4: Digital	
4	2.2018	42	2.50905	17	2.34457	11	1.41201
25	1.73344	26	2.22911	44	1.93888	16	1.11574
18	1.53039	22	2.09439	3	1.78852	20	1.10814
2	1.36374	31	1.12016	15	1.74653	12	0.78007
1	1.35452	34	1.10696	5	1.41288	48	0.73697
49	1.34115	29	1.0974	45	1.30856	46	0.69815
35	1.33282	6	1.07809	30	1.18596	41	0.61472
47	1.29458	32	1.03018	33	0.96685	27	0.31932
38	1.18229	9	0.32983	43	0.5842	28	0.30368
37	1.12293						
13	1.06253						
23	0.89081						

40	0.79959						
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Most teachers identified with Foundational ICT practices (Factor 1). Of the 49 teachers surveyed 9 teachers (7, 8, 10, 14, 19, 21, 24, 36, 39) did not have a marked preference on any of these Factors. These teachers are not represented in Table 4. There is stronger alignment for teachers with Developing ICT practices (Factor 2) where scores are greater than 2 compared with teachers indicating Digital Pedagogies scoring in the range of 0.3- 1.4, identifying it as the weakest Factor.

As explained in the Methodology section above, two teachers from each of these categories were interviewed and curriculum documents were analysed to provide further insight into beliefs behind practices. This data will now be discussed.

5.2 Interview and document analysis

The four Factors relating to ICT practices will now be investigated further through teachers' ICT beliefs that inform those practices using data obtained in interviews and document analysis. The four Factors will each be explored respectively: Foundational ICT Practices; Developing ICT practices; Skill-based ICT practices and Digital Pedagogical Practices.

5.2.1 Foundational ICT Practices

Brontie and Debbie are both middle primary school teachers. They perceive themselves as low in ICT competency and know that they are not using ICT to its greatest potential. Brontie states *"I don't know how to incorporate it into my teaching so that everything is enhanced"* while Debbie has gone from *"total fear of breaking the machine to becoming more confident"*. She describes her competency as a challenge and she is getting used to exploring things, even though in her generation *"you were told to be careful and not break things"*. The main themes that can be drawn out of the interviews and analysis of curriculum documentation is that both teachers have low levels of competency impacting on their confidence with using ICT in their classrooms. There is a belief that ICT can enhance learning but they do not know how. Debbie scores weakly on the foundational level while Brontie score is strong. The following account of beliefs and classroom practices with ICT provides an insight into this categorisation and teacher thinking.

Debbie talks less about the curriculum use of ICT and more about personal competency. She states that *"I really want to learn. I think if I get a bit of tuition I think I can be quite competent"*. She annoys her sons *"constantly"* about her mobile phone, she has tried reading manuals for the digital camera, she learns when her class is being taught (by the Librarian), and she is eager to learn *"all the other stuff"*. This enthusiasm for the development of her own personal competency suggests valuing of ICT as a curriculum tool and as she proposes, a driver of her conception of a good teacher. She explains that:

But there was a time with teaching that if you weren't IT literate you felt that your teaching wasn't as good as the people who were. And that climate was existing – it was very subtle, it was never a big deal, but you did feel it. And I made a conscious decision at that point that I would grab every bit of professional development and was going to beat it.

However, Debbie does little with ICT in her classroom. She has a data projector with a screen that she uses to show images, for example, various bridges to examine different styles of construction. This is done as a whole class. When asked how this is different or better than children looking at a picture or a photo in a book she explains *"It pulls the kids back to something interesting, its communal and it generates classroom discussion"*. This can be

described as guided inquiry but could be done without the ICT. She does not build on this activity by enabling children to photograph bridges and deconstruct them themselves, making learning relevant. In her school there is a computer lab in the library in which they do ICT lessons: “*We do it in the library, research. But that is mainly set up by the TL*” (Teacher Librarian). Debbie thinks ICT “*should be a separate subject with an expert doing it*”, which supports her ICT practices and indicates a weak factor score on the Foundational level. Debbie sees the use of ICT for research as valuable: “*it’s not as boring as go and find an encyclopedia and research it*” [emphasis is on ICT to motivate rather than as a curriculum tool] but she worries that kids “*don’t go to the books as much cos it’s so easy to Google and we have the huge problem with making sure they do take notes correctly*”. In Debbie’s Library time ICT enables learning at the Doing level as indicated on the Digital Age Learning Matrix (in Table 5). She has requested that the Librarian teach her class “*Word and Keyboarding skills*”. Debbie places importance on her personal competency but worries that if ICT is incorporated into her curriculum her students may miss important basic skills in Literacy and Numeracy. Debbie focuses mainly on developing ICT competency and adds ICT to established curriculum.

Whereas, Brontie who has a stronger factor score on the Foundational Level is designing ICT tasks that support outcomes of the existing curriculum. These tasks could be described as rudimentary uses of ICT and represent learning at the Doing level on the Digital Age Learning Matrix (in Table 5). Brontie uses spreadsheets to find out the class’s ‘favourite music’ or most common ‘eye colour’ and gives children topics to research on the internet. ICT is used as a tool to investigate content matter at a basic level demonstrating an ‘Adoption’ of ICT where practices are content driven (Dwyer, Ringstaff, Sandholtz, 1991; Prestridge, 2007; Rakes, Fields & Cox, 2006). Brontie’s use of ICT can be aligned to Schibeci, MacCullum, Cumming-Potvin, Durrant, Kissane, & Miller (2010) ‘Where’s the on button’ stage as teachers main focus is on developing technical competency with a little curriculum experimentation.

Table 5 Debbie’s (D) and Brontie (B) use of ICT

		Levels of learning					
		Doing	Thinking about connections	Thinking about concepts	Critiquing and evaluating	Creating Knowledge	Sharing Knowledge
Digital Technology use	Accessing Information	D B					
	Presenting	B					
	Processing Information	B					
	Gaming						
	Communicating						

The combination of using ICT in rudimentary ways and not knowing how ICT can enhance learning or how ICT relates to real life practices provides some insights into beliefs that inform Foundational ICT practices. These beliefs do not indicate a negative disposition towards ICT, rather it seems that teachers want further ICT possibilities to be explored. Also as indicated in the difference between Debbie and Brontie’s personal competency and curriculum practices, it can be suggested that as a teacher builds personal competency their confidence with using ICT in the classroom increases and leads to experimentation.

5.2.2 Developing ICT Practices

Items relating to this factor indicate that the use of ICT should relate to critical thinking, ICT skills and real life experiences. This category had the strongest factor scores. Angela and Gabrielle are representative of this category.

Angela has taught in the lower school for 10 years in England and in a range of Australian schools, which she describes as having good access to technology. In England, Angela said that “*everything was web based, the lessons were already there and it was really interactive for the kids. They would have to come out and write on it and the word would change to the correct word because it was on those big whiteboards*”. This account of best practice could be described as a teacher-directed instructional approach where all the class is doing the same activity with the use of an electronic textbook. The activities are prescribed and Angela, in this instance, did not design the learning task or the integration of the ICT. Gabrielle teaches two days a week. Similarly her main use of ICT is through whole class lessons using the data projector looking at websites, maths tutorial video segments and electronic worksheets. Gabrielle, like Angela is using ICT to achieve existing curriculum outcomes, much like using a text book or the old Black Line Master (Schibeci et al, 2010). Similarly to ICT practices in the Foundational level, ICT practices are rudimentary and indicate that learning is at the Doing level with some indication that ICT is used to make connects between information/concepts (Table 6).

Table 6 Angela (A) and Gabrielle (G) use of ICT

		Levels of learning					
Digital Technology use		Doing	Thinking about connections	Thinking about concepts	Critiquing and evaluating	Creating Knowledge	Sharing Knowledge
	Accessing Information	A G	A G				
	Presenting						
	Processing Information	A G					
	Gaming						
	Communicating						

Theses tasks are teacher-centred through use of explicit instructions, however, when Gabrielle was asked how she would implement a multimedia project she explains a community network orientation:

[I: Interviewer; G: Gabrielle]

G: Well I suppose one of the things they could do is tap into what other people are doing, other community groups. They might be able to link into their web sites, have a look and see. They might be able to have podcasts for between schools, perhaps. You know, if they’ve set up a community of schools who are doing it, they might be able to share a blog perhaps.

I: So what’s the good bit about that? Why would you bother doing that?

G: I think to get more ideas. And to let the kids know that they’re not the only people doing it, that this is an area of concern over a wider community. It’s not just something that we dreamed up here.

I: So it’s that notion of a greater learning community.

G: Yeah. And also I always value other peoples’ ideas. I think when you’re sharing ideas, when you’re looking at how someone else is doing it, you can take those ideas and come up with something even richer then, in your own community.

In this excerpt, Gabrielle describes how ICT enhances the learning process, how it enables children to share ideas and generate new knowledge. These tasks where ICT is a tool to

enable communication are more open-ended and require facilitation rather than explicit instruction. The interesting point here is why these types of complex practices are not the usual ICT practices these teachers enable. This gives rise to the idea that teachers' beliefs about ICT do not always inform practices (Albion & Ertmer, 2002).

Both Angela and Gabrielle expressed the idea that when looking at websites children process 'all' the information. This provides an insight into the beliefs that inform Developing ICT practices. Planning learning experiences that relate to real problems and experiences is not what Angela believes is as important as ensuring her children are able to deal with the information brought on by the internet. However, as indicated in the insight given by Gabrielle, beliefs about open-ended tasks that enable collaboration and communication are valued by teachers in this category but not realised. Teachers practicing at this level could be described as believing in the use of ICT as a tool to achieve established curriculum outcomes with teacher-directed practices. A view towards facilitating use of ICT as an embedded part of multidisciplinary learner-inquiry is evident but not actualised.

5.2.3 Skill-based ICT Practices

Teachers responding to this factor indicate a focus on skill development for ICT integration. Darren and Katherine are representative of this category.

Darren an upper school experienced teacher who is close to retirement age and Katherine a lower primary school teacher who has been teaching for over 10 years, present themselves as both competent with ICT and interested in using ICT in their classrooms. The main theme that generates from this category is a disposition to developing students' ICT skills as a response to the use of technology in society.

Darren's use of ICT in learning is driven by the need to ensure his students are computer literate, in both their technical and critical literacy skills. Darren states that:

And the jobs, that many of the children that are in school at the moment haven't been invented yet. And it's that question of, what skills do I need to give my kids to prepare them for that type of working or living future? And I just don't know what the answer is. And I don't know – and this is the biggest concern – I don't know if what I'm doing now is valuable or not.

The need to equip his students for future study and working life requirements influences the way Darren uses powerpoint, as an example, throughout a unit of work. Powerpoint becomes the medium through which children build their research reports. Within a study on an environmental issue students add continually to their powerpoints, which are presented to the class, at any given time for group feedback on text and image layout, presentation, font selection, styles. He explains that he says to his students "we're not critising you, but I would like to think that you'll go away with 10 things to consider about changing [your powerpoint]". The purpose is not to develop a deeper understanding of the concepts under study, more the presentation of concepts. The focus is on the presentation of the content. Darren encourages his students to be critical of each other's work, to justify their own presentation styles. Teaching children to be critical, to question and analyse is extended to other ICT activities such as facts on websites, You Tube videos, digital images, which Darren believes is getting them ready for high school. Darren comments on the validity of this approach, "I don't know if what I'm doing now is valuable or not". This indicates that he realises skills in powerpoint will become redundant but he may not understand that building a competency level will enable his children to appropriate with new technologies in the future.

Table 7 Darren (D) and Katherine (K) use of ICT

		Levels of learning					
Digital Technology use		Doing	Thinking about connections	Thinking about concepts	Critiquing and evaluating	Creating Knowledge	Sharing Knowledge
	Accessing Information	K D			D		
	Presenting	K D			D		
	Processing Information	K D			D		
	Gaming	K					
	Communicating						

Katherine, like Darren, emphasises the need to develop her students ICT skills. She focuses on keyboarding skills, saving and retrieving documents, looking at websites and wordprocessing. She would like to get every child access to ‘Matheletics’ an online drill and practice maths tutorial, which she believes is good practice with ICT. These activities indicate a Doing Level of learning with ICT in Table 7. Katherine values these types of ICT activities because “*they’re more engaged as a learner if you’re doing things with technology*”. She believes that ICT should be used in the curriculum because children are “*bombarded with all sorts of technology at home*” and “*it is going to be their reality as adults. You want children to be able to edit, say, in literacy as that sort of thing where the technology just lends itself to them being about to do that*”. Katherine demonstrates a limited understanding of the use of ICT to enhance learning as she focuses on basic skills, rote learning and the comprehension of information. However, she values the use of ICT in her classroom and is personally competent with ICT.

Darren and Katherine are both competent with ICT. The underlying belief that drives their use of ICT is the relevancy it has for use in work and social lives. They acknowledge the proliferation of technology in society and are trying to ensure that their students have the ICT skills to function effectively in their future. They are focused more on the functionality of ICT than the use of ICT as a tool to enhance learning.

5.2.4 Digital Pedagogical Practices

Teachers responding to this factor indicate a focus on using ICT to support open-ended problem orientated tasks that require teacher facilitation and enable different learning pathways. This category has the weakest scores indicating that teachers are evidencing some beliefs and practices that are indicators for this category rather than being representative of this category. Lucy and Elizabeth fell into this category.

Lucy and Elizabeth present themselves as competent users of ICT, with an interest and confidence for using it in their classrooms. The main beliefs that distinguishes them from the other categories is in their discussion of the role of ICT in the process of learning and their role as a teacher facilitating learning. Both teachers place high importance on teaching the fundamentals of grammar, punctuation and times-tables, and realise that children can retrieve ‘any information’ they need to because of the internet, such that, learning needs to be more than a recount of facts.

Lucy, presents a sound competency level with ICT, however, she wants to move on from what she is doing with ICT in her classroom. Lucy mainly uses ICT as a publishing medium. In her composite class of Grade five/six/seven children have their own wiki where they “*put their work up*” such as their research projects. The class also has a blog where children will post a recount, “*that is why I would love to learn more and it seems that everything we are using [ICT] for is just publishing*” as Lucy explained. Lucy enables children to access,

present and process information from different data sources to think about connections between ideas as indicated in Table 8. ICT is used as a publishing medium and therefore does not involve conceptual development. Lucy is using digital ICT tools as publishing mediums rather than as knowledge construction tools. Rather than using her class wiki as a website to publish work, she need to engage children is collaborative construction of concepts under study. This would move her to what would be considered as digital pedagogy. Lucy believes that *“children are using this technology and nowadays there is hardly anyone who hasn’t seen a You Tube video or who doesn’t have some technology at home, and all that like chat rooms and My Space or whatever”*. This motivates Lucy to use ICT in her classroom as *“their interest level go high, and they really- but I don’t know if I am too narrow minded and it is just another way of publishing. I don’t want it to be all about the publishing side”*. She lacks the pedagogical knowledge to move from adapting her existing curriculum to integrate ICT to appropriating and inventing with ICT enabling curriculum and pedagogical reform.

Table 8 Lucy (L) and Elizabeth’s (E) use of ICT

		Levels of learning:						
Digital Technology use		Doing	Thinking about connections	Thinking about concepts	Critiquing and evaluating	Creating Knowledge	Sharing Knowledge	
	Accessing Information	L E	L E	E	E	E		
	Presenting	L E	L E	E	E	E		
	Processing Information	L E	L E	E	E	E		
	Gaming							
	Communicating							

Elizabeth, having taught in London with an extensive range of ICT applications describes her return to the Australian classroom as like *“having my head chopped off as I didn’t have my whiteboard and my [techno] toys”*. She describes a range of ways ICT is used in learning within her Grade 6 class. These include Inspiration concept maps, clay-animation, internet research, powerpoints and use of the digital camera. Elizabeth enables ICT to be used as thinking and construction tool as indicated in Table 8. She believes that *“we operate in an 1800’s classroom”* and we need to *“smash doors open and give children a big wide area and have moveable tables and chairs”*, teach in different ways but she states teachers are *“scared of the possibilities”* and there is no *“one solution”*.

Elizabeth describes her beliefs about teaching:

I’m not a believer in direct teaching anyway. I’m more about cooperative teaching, learning together. More like a journey I suppose. It sounds a bit cheesy but more like saying here’s the open-ended question, I want you to help me get to it. Let’s work through it together.

These ideas about changes in teaching and learning indicate new paradigms like digital pedagogies (Ertmer, Ottenbreit-Leftwich, and York, 2007; Gibson, 2001; Prestridge, 2010). Digital pedagogies can not be considered as teaching with web 2.0 tools in teacher directed approaches. Digital pedagogies could be considered practices where ICT are fused with learning as engagers and facilitators of thinking and construction, where the student is viewed as an active creator and user of information within learning dynamic supporting collaborative investigation of real life happenings within multidisciplinary global contexts.

Underwriting both Lucy's and Elizabeth's ICT practices is strong beliefs about both the value of ICT as a learning tool and its relevancy to working and social life. Both teachers expressed a high level of ICT competence and confidence to try new software and approaches to teaching and learning. Both of the teachers in this category emphasised ICT to enhance the learning process not the ICT product and the changes in the learner and pedagogy required.

6. Conclusion

In this paper teachers' beliefs about ICT and their practices in the classroom have been presented based on survey and interview data as well as document analysis. Reflecting on the current educational reform agenda in Australia, teachers are being asked to employ contemporary learning resources and activities that will ensure a digitised curriculum through digital pedagogies. Enabling this meaningful change to teaching and learning suggests that teachers would be better positioned to engage with this if they possessed ICT beliefs and practices representative of those teachers who were responding to factor 4 Digital Pedagogies. As evident in both the ICT beliefs and ICT practices, these teachers are acknowledging the role of ICT as a knowledge construction tool through collaborative activity, the relevancy of ICT to society and future employability, and the orientation towards authentic problem-based approaches to teaching and learning.

Evidenced in this data is that the majority of teachers in this study represented ICT practices that were Foundational, with the strongest loading for teachers in the category of Developing ICT practices. In Foundational ICT practices teachers focus on personal and student competency and in Developing ICT practices teachers were 'adding' ICT to existing curriculum. Teachers in both of these categories responded to the ICT beliefs statements in ways that suggested their emerging levels of personal ICT competence, confidence and engagement with ICT. Their beliefs can be aligned to those held by teachers in Factor 4 Digital Pedagogies, in that, they believe ICT is a learning tool to enhance curriculum and that its use relates to real life practices. This supports a developmental ICT competency framework as evident in the literature (Dwyer, et al., 1991; DEST, 2002; Schibeci et al, 2010). What distinguishes the levels is an appropriation of ICT to learning, moving from adding ICT to existing practices to reforming teaching with invisible blends of ICT for creating and constructing knowledge (Prestridge, 2007). However, a framework moving from Foundational, Developing to Digital does not take into account teachers who focus on Skill-based ICT practices and who are competent and confident with ICT.

Emerging from the data is a relationship between ICT competence, confidence and practice. As teachers expressed a greater personal competency with ICT they were more confident to use ICT in the classroom. However, the level of competence or confidence did not shape the types of ICT practices. As found in factor 3 Skill-based ICT practices, teachers expressed a level of ICT competence and confidence however, their ICT practices could be considered as operating within a traditional teacher-centred approach where developing ICT skills and functionality are in focus. The ICT competency-confidence relationship is important to the use of ICT in classroom. It can be inferred here from the available data that teachers do not have to possess high levels of competency with ICT before they have the confidence to use it in the classroom. Exploring this relationship between competency and confidence will impact the required balance between training and pedagogically focused approaches in ICT professional development.

This paper has theorised ICT practices and provided further clarity to the current understanding of the term digital pedagogies. It has also provided an insight into the beliefs that teachers hold that inform their ICT practices in their classrooms. Beliefs, as explained in the Literature, can be idealistic and desirable. When the reality of the classroom is encountered, beliefs may not inform practice Albion & Ertmer (2002). Further research is needed to examine actualised practices that stem from stated beliefs and at what point in practice do beliefs transform.

7. Acknowledgement

8. References

- Albion, P., & Ertmer, P. (2002). Beyond the foundations: The role of vision and beliefs in teachers' preparation for integration of technology. *TechTrends* 46(5), 34-38.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs: Prentice-Hall.
- Becker, H. (2000). Who's wired and who's not: Children's access to and use of computer technology. *The Future of Children*, 10(2), 486-499.
- Calderhead, J. (1996). Teachers: Beliefs and knowledge. In D. Berliner and R. Calfee (Eds), *Handbook of Educational Psychology: 709- 725*. New York: Teachers College Press.
- Clark, C., & Peterson, P. (1986). Teachers' thought processes. In M. Wittrick (Ed.), *Handbook of research on teaching* (3rd ed.: 255 - 296). New York: Macmillan.
- Cox, M., Webb, M., Abbott, C., Blankely, B., Beauchamp, T., & Rhodes, V. (2004). *ICT and pedagogy*. Becta Report. Retrieved September 20, 2009, from <http://publications.becta.org.uk/display.cfm?resID=25813>
- DCSF. (2009). Every child matters. Retrieved February 2, 2009, from Department of Children Schools and Families website <http://www.dcsf.gov.uk/everychildmatters/>
- DEEWR. (2009). *The digital education revolution*. Retrieved September 2, 2009, from <http://www.deewr.gov.au/SCHOOLING/DIGITALEUCATIONREVOLUTION/Pages/default.aspx>
- DEEWR. (2008). *Success through partnership. Achieving a national vision for ICT in schools* (p. 3). Retrieved September 2, 2009 from <http://www.deewr.gov.au/SCHOOLING/DIGITALEUCATIONREVOLUTION/Pages/default.aspx>
- DEST (Department of Education, Science and Training). (2002). Raising the standards: A proposal for the development of an ICT competency framework for teachers. Canberra: DEST. Accessed December 2010.: http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/raising_standards_ict_competency_framework.htm
- Drenoyianni, H., & Selwood, I. (1998). Conceptions or misconceptions? Primary teachers' perceptions and use of computers in the classroom. *Education and Information Technologies*, 3(2), 87-99.
- Dwyer, D., Ringstaff, C., & Sandholtz, J. (1991). Changes in Teachers' Beliefs and Practices in Technology-Rich Classrooms. *Educational Leadership*, 48(8), 45-52.
- Eib, B. J., & Cox, S. (2003). Integrating technology with teacher inquiry. *Principal Leadership*, 3(5), 54-58.
- Ehman, L., & Bonk, C. (2002). *A model of teacher professional development to support technology integration*. Paper presented at the Annual meeting of the American Educational Research Association, New Orleans, LA, April 1-5, 2002.
- Ertmer, P. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology, Research and Development*, 53(4), 25-40.
- Ertmer, P., Ottenbreit-Leftwich, A., & York, C. (2007). Exemplary technology use: Teachers' perceptions of critical factors. *Journal of Computing in Teacher Education*, 23(2), 55-61.
- Gibson, I. (2001). At the intersection of technology and pedagogy: Considering styles of

- learning and teaching. *Journal of Information Technology for Teacher Education*, 10 (1/2), 37-61.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.
- Higgins, S. and Moseley, D. (2001). Teachers' thinking about ICT and learning: beliefs and outcomes. *Teacher Development*, 5(2), 191-210.
- Howard, B., McGee, S., Schwartz, N., & Purcell, S. (2000). The experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education*, 32(4), 455-462.
- Jacobs, J., & Clements, D. (1999). Challenges for teachers attempting to integrate a mathematical innovation. *Journal of Research on Computing in Education*, 31(3), 240-251.
- Jonassen, D. (2006). *Modeling with technology: Mindtools for conceptual change*. Upper Saddle River, N.J. : Pearson Merrill Prentice Hall.
- Kagan, D. (1992). Implications for research on teacher beliefs. *Educational Psychologist*, 27(1), 65-90.
- Keys, P. (2007). A knowledge filter model for observing and facilitating change in teachers' beliefs. *Journal of Educational Change*, 8(1), 41-60.
- Lankshear, C., & Bigum, C. (1998). *Literacies and technologies in school settings: Findings from the field*. Paper presented at the Australian Association for the Teaching of English and the Australian Literacy Educators' Association Conference, Canberra, Australia.
- Loveless, A. (2003). The interaction between primary teachers' perceptions of ICT and their pedagogy. *Education and Information Technologies*, 8(4), 313-326.
- Loveless, A., Burton, J., & Turvey, K. (2006). Developing conceptual frameworks for creativity, ICT and teacher education. *Thinking Skills and Creativity*, 1: 3-13.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.
- Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.
- Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, 19(4), 317-328.
- Orlando, J. (2009). Understanding changes in teachers' ICT practices: A longitudinal perspective. *Technology, Pedagogy and Education*, 18(1), 33-44.
- Pajares, M. (1992). Teachers' beliefs and educational research. Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307-332.
- Prestridge, S. (2010). ICT professional development for teachers in online forums: Analysing the role of discussion. *Teaching and Teacher Education*, 26(2), 252-258.
- Prestridge, S. (2007). Engaging with the transforming possibilities of ICT. *Australian Educational Computing*, 22(2), 3-9.
- Richardson, V. (2003). Pre-service Teachers' Beliefs. In J. Raths & A. McAninch (Eds) *Teacher beliefs and classroom performance: The impact of teacher education*. Greenwich Connecticut: Information Age Publishing.
- Rakes, G., Fields, V., & Cox, K. (2006). The Influence of Teachers' Technology Use on Instructional Practices. *Journal of Research on Technology in Education*, 38(4), 409-424.

- Rokeach, M. (1976). *Beliefs, attitudes, and values. A theory of organization and change*. San Francisco, CA: Jossey-Bass.
- Schibeci, R., MacCullum, J., Cumming-Potvin, W., Durrant, C., Kissane, B. & Miller, E. (2008). Teachers' journeys towards critical use of ICT. *Learning, Media and Technology, 33*(4), 313-327.
- Scrimshaw, P. (2004). *Enabling teachers to make successful use of ICT*. Report for Becta Retrieved September 10, 2009, from <http://partners.becta.org.uk/>
- Shriner, M., Schlee, B., Hamil, M. & Libler, R. (2009). Creating teachers' perceptual, behavioral, and attitudinal change using professional development workshops, *Teacher Development, 13*(2), 125-134.
- Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers & Education, 44*(3), 343-355.
- Starkey, L. (2010). Teachers' pedagogical reasoning and action in the digital age, *Teachers and Teaching, 16*(2), 233-244.
- Tondeur, J., van Braak, J., & Valcke, M. (2006). Curricula and the use of ICT in education: Two worlds apart? *British Journal of Educational Technology, 38*(6), 962-976.
- Veen, W. (1993). How teachers use computers in instructional practice: Four case studies in a Dutch secondary school. *Computers and Education, 21*(1/2), 1-8.
- Watson, D. (2006). Understanding the relationship between ICT and education means exploring innovation and change. *Education and Information Technologies, 11*(3-4), 199-216.
- Whitby, G. (2006). *A time to be bold. New Challenges in Learning and Teaching*. Retrieved November 10, 2009, from <http://www.gbwhitby.parra.catholic.edu.au/resources/vicprins-070806-timetobebold.pdf>.
- Wideen, M., Mayer-Smith, J., & Moon, B. (1996). Knowledge, Teacher Development and Change. In I. Goodson & A. Hargreaves (Eds.), *Teachers' Professional Lives*: 187-204. London: Farmer Press.
- Windschitl, M. & Shal, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics and institutional culture. *American Educational Research Journal, 39*(1), 165-205.
- Wozney, L., VenKatherinesh. V., & Abrami, P. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and Teacher Education, 14*(1), 173-207.
- U.S Department of Education (2006 July). The national technology plan. Retrieved February 2, 2009, from <http://www.ed.gov/about/offices/list/os/technology/plan/2004/site/edlite-default.htm>

