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A Global Perspective: Current Trends and Issues in ICT for 21st Century Education

Lynne Schrum
West Virginia University

Niki Davis
Canterbury University (New Zealand)

Michele Jacobsen
University of Calgary (Canada)

Andreas Lund
ProTed, Center for Excellence in Teacher Education, University of Oslo (Norway)

H. Ferhan Odabasi
Anadolu University (Turkey)

Joke Voogt
University of Amsterdam & Windesheim University (The Netherlands)

Jennifer Way
University of Sydney (Australia)

Abstract: Around the world educators, policy makers, and others share a universal goal to ensure that all learners reach their full potential; we seek best practices to prepare educators and leaders to improve student learning, prepare learners for their futures, maintain current educators' knowledge and skills, increase student engagement, and integrate learning technologies into their curriculum. Questions have been raised regarding the role of practicum, appropriate curriculum, and use of technology in this preparation and for ongoing professional development. The discovery and sharing of a purposeful and systemic plan will require many educators to work together, share lessons learned, and invest energy in promoting policies to bring about changes. This paper brings together updates from experts from around the globe; each contributor has extensive experience and knowledge to share from his/her country's perspective. The purpose of this paper is to share what these individuals know from their experience, and to generate a discussion within our educational community on questions of future research, learning from each other, and identifying opportunities for collaboration.

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A Global Perspective: Current Trends and Issues in ICT for 21st Century Education

Around the world educators, policy makers, and others are seeking best practices to prepare educators and leaders to improve student learning, prepare learners for their futures, increase student engagement, and integrate learning technologies into their curriculum; a universal goal is to ensure that all learners reach their full potential. Questions have been raised regarding the value of practicum, appropriate curriculum, and role of technology in this preparation. And yet, Fullan (2013) stated, "It is now time for technology to join the fray in a more purposeful way in order to transform learning for educators and learners in the 21st century" (p. 3). The discovery and sharing of this "purposeful" way will require many educators to work together, share lessons learned, and invest energy in promoting policies to bring about changes (Schrum & Levin, 2015). The challenges are well known and it appears they are universal. Perhaps one of the most difficult tasks is to understand the nature of teacher beliefs and organizational culture, as they impact the goals for improving educational outcomes (Ermer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Kim, Kim, Lee, Spector, & DeMeester, 2013; Melitski, Gavin, & Gavin, 2010).

Educators are faced with an ever-changing landscape that demands they remain knowledgeable, update their pedagogy to take advantage of new characteristics, and collaborate for improved student outcomes (Ainsa, 2013; Karchmer, 2001; Eyyan & Yaratan, 2014). Fullan and Langworthy (2014) suggest these "new pedagogies… require students not only to create new knowledge, but also to connect it to the world, using the power of digital tools to do things that value in our knowledge-based, technology-driven societies" (p. 1). New conceptions of formal and informal learning, especially in the maker movement (Martin, Bowden, & Merrill, 2014; Martinez & Stager, 2013; Peppler & Bender, 2013), require continuous professional development and revisions of teacher candidate preparation. Professional development now takes many forms from traditional workshops to online collaboration (Cifuentes, Maxwell, & Bulu, 2011; Ertmer, Bai, Dong, Khalil, Park, & Wang, 2002; Hartsell, Herron, Fang, & Rahtod, 2010). In addition, several studies have suggested that administrative support is an important factor in technology implementation and that without it other variables will be negatively affected (Ertmer, Bai, Dong, Khalil, Park, & Wang, 2002; Gerard, Bowyer, & Linn, 2008; Hilliard & Jackson, 2011).

This paper brings together teacher educators' perspectives from several countries; each contributor is familiar with the current and future plans for educator preparation and professional development, as well as the questions each country is addressing. What do teachers need to know and be able to do today and tomorrow to support all learners? What are the best ways to prepare them? How are digital technologies integrated into the entire preparation program seamlessly? What is the status, for example, of MakerSpaces or Bring Your Own Device (BYOD) throughout the world? How are countries preparing for the educational environment needed in the next several decades?

Aotearoa New Zealand

Niki Davis, University of Canterbury, New Zealand

The trends and issues in ICT for 21st century in Aotearoa New Zealand may provide a particularly contrast with other parts of the world at this time for reasons of culture, history and geography including economy. An earlier overview of ICT policies and practices in education in New Zealand was provided by Brown and Chamberlin (2009). The recent global economic downturn has not impacted the Asia Pacific region to the same extent as North America and Europe and to some extent it has benefited from the stimulus of natural disasters such as the Christchurch earthquakes of 2010-2011 (Abei-Arthur & Davis, 2014; Dabner 2015). The challenge for nationwide ICT access in a largely rural geography including remote coast and island locations for schooling has delayed equitable access until now. Most relevant is the status of the indigenous people.

Aotearoa New Zealand is the only nation in the world where the indigenous population have fought and won recognition in law of their place within our 21st century multicultural society (Note, the author's use of the Māori word for New Zealand, Aotearoa, is an example of this increasingly common cultural practice of blending Māori language and English with the placement of Māori first). While the nation is English speaking with only Māori the national language (plus NZ sign language), it is also 'super diverse' in spoken languages. Māori language and culture is an essential part of the school curriculum with increasing opportunities for Māori and others to experience success as Māori. Thus one of the trends is increasing ICT for such equitable purposes that include other disadvantaged groups, particularly Pacifika cultures. This is probably best described in the Ministry of Education's term priority learners, which also includes children with English as a second language and those with special needs. Evidence for this trend can be found in:

- The school curriculum and Ministry of Education's bilingual website for schools web site Te Kete Ipurangi (TKI). (e.g. overview of ICT initiatives in schools is provided on this page http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/Initiatives/ICTInSchools.aspx)
- The adoption of ICT by Māori for language revitalisation (e.g. Ti Aika's description in Greenwood, Ti Aika & Davis, 2011)
- Initial teacher education, including immersion teaching (e.g. Greenwood's description in Greenwood et al, 2011, and the exemplary programme in Davis & Fickel, 2014)

There are major initiatives that are currently improving the ICT infrastructure for education. This ICT infrastructure trend is contrasted with others in guidance on ICT infrastructure provided by UNESCO Institute of Statistics (Twining & Davis, In Press 2015). The Government is on target to have broadband Internet service in 98% of all schools by 2016, using optic fibre complemented with satellite for remote area including high country and offshore islands. This initiative by the Ministries responsible for education and economy also includes support to rewire schools (LAN and wireless) and provide and educational portal to a nationwide Network for Learning (N4L) for secure web browsing and an increasing range of ministry, public and commercial services (21st Century Learning Reference Group, 2014). The N4L web portal called POND is designed for social

networking among educators and this would best include school leaders, including principals (Stuart, 2014). An additional issue is the challenge to develop such leadership expertise.

Following negotiation to educate policy makers on the extent of education beyond the school premises, access to POND includes teacher educators and preservice teachers (Davis, 2014). The inclusion of initial teacher education aims to increase the quality of resources while also enabling student teachers to contribute while mentored within their programmes. One important aspect is the development of Digital Citizenship (Dabner, 2015), while modelling practice to develop the 'adaptive expertise' necessary in the 21st century.

The trend to improve access to educational services through ICT includes development of the largest school in the country, Te Aho o Te Kura Pounamu, The Correspondence School (TCS), which was established in 1922 to provide access to a full curriculum range for all students. Although TCS has applied ICT for a number of years, its correspondence school legacy and lack of infrastructure for students in rural and other challenging locations has restricted widespread adoption. This changed in 2014 as noted on its web site that all high school examination course materials have been placed onto the learning management system and new online courses will replace the existing courses for years 9 and 10 from 2015. Additional provision of online and distance education across ICT networked schools also continues to evolve slowly (e.g. see Barbour, Wenmoth & Davis, 2011).

Finally, give the planned discussion of research on this topic, it is useful to note that a national research initiative is planning research in this area. National Science Challenge 2, E Tipu e Rea: A Better Start, includes the theme "growing up in the digital world" as part of the ten-year interdisciplinary programme that is currently under construction. Perhaps the most relevant project (led by McNaughton) has already been funded to investigate and improve the culturally-sensitive deployment of ICT with students aged 5-19. There is also likely to be an investigation of literacy, bilingualism and the potential negative impacts of ICT on education and health. Planned participants include the Computers in Homes initiative that works via schools to help families in greatest need to use the ICT in their everyday lives including school with training for parents to encourage digital citizenship.

A Canadian Perspective:
Design-Based Research - Sponsoring Innovation In Canadian Education

Michele Jacobsen, Werklund School of Education, University of Calgary

In Canada, K-12 Education is funded publicly and education policies are developed and implemented by departments or ministries of education in each province or territory. There are 13 different education systems in 10 provinces and 3 territories that oversee curriculum and develop and administer provincial or territorial assessments. Nationally, there can be a great deal of variation in curriculum and assessment, including how and whether digital media and technology is used to enhance student and teacher learning.

Four key themes have emerged across Canada with regard to technology-enabled learning: 1) computer and information literacy, 2) student engagement, 3) inquiry and

knowledge building approaches to learning with technology, and 4) design based research approaches to sponsoring and studying innovation in education.

Computer and Information Literacy and Student Engagement

Two national organizations that work to influence policy and practice with regards to information literacy and student engagement in a digital age will be highlighted. One, the Canadian Ministers of Education Council (CMEC), provides educational leadership at the pan-Canadian and international levels and contributes to the provincial and territory jurisdiction over education through research projects and knowledge mobilization initiatives. The CMEC profiled recent international research on computer and information literacy and how Canadian students compare on several indicators (Labrecque & Dionne, 2014). In almost all Canadian jurisdictions, there are plans and policies in place to support the development of computer and information literacy across K-12 education. Provincial ICT plans and policies tend to refer to improving student learning with specific mention of developing information literacy and ICT-based skills in critical thinking, collaboration, and communication. Labrecque and Dionne (2014) describe priorities for learning with ICT that are similar across jurisdictions, such as: 1) supporting educators and leaders through professional development in the use of ICT for learning; 2) creating effective learning environments using technology in education; 3) increasing available resources for ICT use in education; 4) decreasing inequalities in ICT use; and 5) increasing access to on-line systems and tools.

Two, the Canadian Educational Association (CEA), created in 1891, is a network of passionate educators advancing ideas for greater student and teacher engagement in public education. The CEA convenes divergent stakeholders from across Canada and from international contexts to advance ideas and to mobilize a pan-Canadian movement for change in education (http://www.cea-ace.ca/). In response to national trends, and as part of their vision to transform education in Canada, the CEA produces and disseminates research that can impact teaching and leadership practice and enhance student engagement. Building upon Willms, Milton & Friesen's (2009) study, *What did you do in school today?,* the CEA has carried out longitudinal, pan-Canadian research on the relationship between student engagement and adolescent learning, student achievement, and effective teaching. Since 2007, the CEA's initiative on student engagement has gathered results from over 60,000 students to better understand academic outcomes, instructional challenge, and intellectual engagement of students across Canada. A key finding is that levels of student engagement tend to decrease as students move from elementary, to middle and to high school.

Inquiry and Knowledge Building

Across Canada, several provincial jurisdictions are promoting a shift from curriculum and assessment practices focused on information acquisition to effective teaching practices that support inquiry and knowledge building approaches to greater student engagement (Jacobsen, Lock and Friesen, 2013). Within schools, the challenge is to design new curriculum, teaching and leadership approaches that expect students and teachers to work collaboratively in networked environments to generate ideas, to continuously improve knowledge through inquiry, and to connect and communicate with global communities.

Two related initiatives in Alberta highlight this shift from acquisition of content to inquiry and knowledge creation: 1) Inspiring Education (Alberta Education, 2014) and 2) the Learning and Technology Policy Framework (Alberta Education, 2013). Educators in Alberta work with the bold provincial vision "Inspiring Education" that articulates a changed K-12 education system. The expectation is that teachers and leaders will sponsor the following qualities and abilities in youth: 1) Engaged Thinker: learners who think critically and make discoveries, use technology to learn, innovate, communicate, and discover, work with multiple perspectives and disciplines to identify problems and find the best solutions, communicate ideas to others; and, adapt to change with an attitude of optimism and hope for the future; 2) Ethical Citizen: learners who build relationships based on humility, fairness and open-mindedness, demonstrates respect, empathy and compassion, and through teamwork, collaboration and communication contribute fully to the community and the world; and 3) Entrepreneurial Spirit: learners who create opportunities and achieves goals through hard work, perseverance and discipline, strive for excellence and earn success, explore ideas and challenge the status quo, who are competitive, adaptable and resilient; and who have the confidence to take risks and make bold decisions in the face of adversity.

Alberta Education's (2013) Learning and Technology Policy Framework is designed to enact one of the four policy shifts identified by Alberta's Inspiring Education. Policy Shift 4: *Technology to Support the Creation and Sharing of Knowledge* is critical to achieving the vision of supporting students to become engaged thinkers and ethical citizens, with an entrepreneurial spirit. When digital technology first emerged as a classroom resource, it was primarily a tool for teachers to present information and to communicate with students and parents. Policy Shift 4 describes the need to move towards classrooms in which students, themselves, are using technology to support active learning and knowledge building. Alberta Education's (2013) Learning and Technology Policy Framework re-enforces *Inspiring Education*'s emphasis on putting the student at the center of decision-making. Some classrooms have already made great strides in adopting a student-centered learning philosophy, while others require more assistance. The updated policy framework provides guidance and rationale for making decisions that support this shift.

Design Based Research to Sponsoring Innovation

As the issues and problems that define 21st century education become increasingly complex, our collective need for new knowledge and innovative solutions for technology enhanced learning experiences in diverse educational contexts increases. Yet classroom teachers and school leaders often struggle to see any meaningful connection between educational theory and research conducted in universities and their real-world, complex and contextually rich experiences of teaching, learning and leading in schools. Design-based research (DBR) is a response to the gap between basic and applied research practices, to the call for change and innovation in education systems, and to the need for teachers to develop principled practical knowledge in using technology for engaged learning (Jacobsen, 2014).

Principled practical knowledge goes beyond connecting theory with practice, and can be described as teacher "know-how" or experience combined with "know-why" and a scholarship of teaching (Bereiter, 2013). Alberta Education is leading innovation in practice

by initial efforts to fund participatory and design based research projects that purposefully engage university researchers with classroom teachers and school leaders in collaborative cycles of design, implementation and evaluation of innovative practices that result in enhanced principled practical knowledge to do with student engagement in technology enabled learning environments.

One principle that sets DBR apart from other forms of educational research is the commitment of researchers to develop solutions to educational problems *in collaboration* with practitioners (Bereiter, 2013; Brown, 1992; McKenney & Reeves, 2012). Researchers and teachers collaboratively design research-informed, technology enabled learning experiences for students and then study the impact of these designs on learning (Jacobsen, 2014). DBR is intentionally interventionist and researchers work closely with educators on understanding complex problems of practice, and on the collaborative design, development, implementation and evaluation of research-informed innovations in authentic learning contexts (McKenney & Reeves, 2012). Design-based research is informed by theory and aims to contribute to theory (as well as to educational innovation), and so goes beyond merely developing and testing particular interventions (Jacobsen, 2014). Rather than professional learning initiatives that focus on short term gains in teacher competency, design based research is an approach to bringing researchers and practitioners together to design and enact innovative learning solutions and share their learning beyond local contexts.

Drawing upon contemporary learning theory, design-based researchers and classroom teachers acknowledge that learning, cognition, and knowing are irreducibly co-constructed and cannot be treated as isolated entities or processes. Learning is understood to be a collective endeavor distributed across the knower, the environment and the activity in which the learner participates, rather than an entity located only within the individual thinker (Barab & Squire, 2004; Jacobsen, 2014).

Design based research arises out of a need for educational research to better meet the needs of educators, to impact practice, to be intentionally interventionist, and to focus on interactions and their effect in real-world contexts (Jacobsen, 2014). In contrast to case study research that focuses on "what is" in education, the best DBR is driven by a vision of "what can be." Guided by a vision of yet-to-be-realized possibilities, DBR is characterized by emergent goals for learning and teaching – goals that arise and evolve in the iterative cycle of design and research that focuses on the continual improvement of learning with technology in today's classrooms, with real learners and with real teachers. Canadian provinces and territories that emphasize participatory and design based research approaches to sponsoring innovation in schools are leading both research and innovation in professional learning for ICT and student engagement as well.

A Norwegian perspective

Andreas Lund, ProTed, Center for Excellence in Teacher Education, University of Oslo, Norway

In 2006, Norway became the first European country to develop a national curriculum that established what is today referred to as "digital skills" as a fundamental competence on par with

oral skills, reading, writing, and doing arithmetic. Also, the curriculum linked digital skills to making use of digital tools across all subjects and at all levels. The European Survey of Schools (EUN, 2013) found that "Norway comes top in Europe with regard to ICT infrastructure and use" (Søby, 2013, p.4). For example, in Norway we have statistics to show that, on an average day in 2012, 76% of children between the ages of 9 and 12, and 91% of adolescents between the ages of 13 and 19, used the Internet (Egeberg et al., 2012). Also, all senior high and nearly all junior high schools have integrated learning management systems in their practices, and as from 2012, the Norwegian Directorate for Education and Training has increasingly opened up for learners' access to the Internet during national exams.

In sum, this should ideally amount to a point of departure for innovative educational practices. However, we know surprisingly little about exactly how ICT is used in education. One survey shows that teachers use ICT for administrative purposes more than teaching purposes (Hatlevik, Egeberg, Guðmundsdóttir, Loftsgarden, & Loi, 2013), and the many studies that examine teaching practices and classroom activities in technology-rich learning environments show that development is incremental (which may turn out to be important at an aggregated level) and that there is a multi-faceted picture of how ICT is put to use (Hauge & Lund, 2012). There is no indication that in-service courses have had much impact.

Consequently, integration – or lack of integration – of ICT in teacher education has attracted a lot of interest recently. Several reports convey a picture of ICT competence in teacher education as being haphazardly offered, mostly by committed individuals, there is little institutional commitment, weak links to subject matter taught, and newly qualified teachers find that they are not prepared for technology enhanced practices in schools (Tømte, Kårstein & Olsen, 2013; Gudmundsdottir, Loftsgarden, & Ottestad, 2014). These alarming findings correspond with an increased interest in (political as well as from the research field) and intensified focus on teacher education programs. Especially, the recent political decision that the main model for Norwegian teacher education should be a R&D based, five-year master's program has transformed the context for what is now referred to as teachers' professional digital competence (PDC). Currently, there is a national debate on what PDC entails and how it can be operationalized in teacher education. In the following, I briefly outline how our Center for Excellence in Teacher Education, ProTed, approaches such issues. We draw on sociocultural perspectives and Cultural-Historical Activity Theory (CHAT) in order to theoretically validate this framework for PDC. It is a framework that has developed over time (see e.g. Hauge, Lund & Vestøl, 2007; Lund & Rasmussen, 2008; Lund & Hauge, 2011a; 2011b) and is currently making an impact on Norwegian teacher education (Lund et al., 2014).

We do this in the following five steps (dramatically condensed for this abstract):

1. **PDC in the teaching profession.** How is PDC in teacher education different from similar competences in other professional fields of study, such as psychology, pharmacy, law, or engineering? One obvious difference is that, in teacher education, the aim is not solely to educate student teachers as to how to understand and use various emerging technologies that are relevant to the execution of a particular craft or profession. It involves being able to make their *learners* capable of using technology and learning resources in productive ways. This represents a dual challenge.
2. **A principled view of ICT.** Technologies are powerful mediating and transformative artifacts. Learning is woven into the use of artifacts, to the extent where we cannot only

assess results or documentation of learning but must also include how we arrive at knowledge through relevant, informed selection and use of available cultural tools or artifacts, what Säljö refers to as the "performative" nature of learning (Säljö, 2010). If we do not do this, both learning activities and the assessment of them lose their ecological validity; they do not correspond with how we in practice and in everyday situations organize ourselves to learn, solve problems, and develop new insights.

3. **Epistemic implications.** Researchers have observed how ICT impacts on our conceptualization of what knowledge is (ontology), as well as our assumptions of how knowledge can be acquired or constructed (epistemology) (Crook, 2001; Lankshear, Peters, & Knobel, 2002). Such generic implications impact on how we perceive pedagogy in the networked society.
4. **Subject specific implications.** Diverse types of ICT is appropriated and put to use in very different ways depending on the knowledge domain. Thus, PDC entails that student teachers can make informed judgments about ICT enhanced practices based on generic as well as subject specific qualities that are embedded in the artifacts.
5. **Designs for teaching and learning.** Finally, we make a normative turn, and invoke the notion of "design" as a model for student teachers to create learning environments and trajectories. This involves:
    - Defining a learning object and discussing how learners and teachers could approach such an object.
    - Selecting and employing cultural resources (material as well as human) conducive to working toward the learning object and producing results. At the core of this process is building the inner consistency of task type, choice of artifacts and activities, and assessment.
    - Addressing the conditions under which the activities unfold: institutional rules and regulations; the total learning community (individual, class, and beyond); division of labor between those involved and the duration of the activity.
    - Testing the intended design as developed by student teachers in actual practice to see how it is picked up and enacted by learners in schools.
    - Sharing experiences that show how the intended designs related to the enacted designs in order to foster collaborative approaches to the teaching profession.

When we earlier emphasized the need for theoretical validation of PDC it is because of the need to theorize the relationship between tool and agent in order to unpack this relationship's inherent potential and what is at stake when it is integrated into learning and teaching activities. The relationship between agents and tools has attracted significant attention from various theoretical perspectives, especially from Actor Network Theory (ANT), Distributed Cognition (DC), Phenomenology, and Cultural Historical Activity Theory (CHAT) (see for instance Shaffer & Clinton, 2006 for an extended discussion). In drawing here on CHAT, it is because, more than ANT or DT, CHAT clearly distinguishes human agency from agency and inscriptions embedded in tools, and more than Phenomenology, it connects cognition to institutional affordances. Our position is that human agency and institutional affordances are fundamental when developing teacher education.

Emerging technologies may not lead to a substantial change in educational practices, as technology integration is only one component of educational reforms (Burbules & Callister, 2000). However, Turkey has focused on getting new versions of computers -whether it may be desktops, laptops or tablets- and considered it as an effective educational reform. Turkey started to invest in computers for educational use in 1984 (Odabaşı, 1998). Besides, subsequent projects emphasized the role of technology, particularly computers. The first of these projects was the Project for Improving National Education, which aimed to catch up with contemporary educational practices worldwide. The project led to the establishment of schools called Curricula Laboratory Schools and Computer Experimental Schools. The second project was the Basic Education Project, launched by the Turkish Ministry of Education in 1998. This project sheltered three main goals which were improving the physical infrastructure, improving the educational quality through establishing computer labs and improving the teacher quality in terms of computer literacy. That is, equipping schools with computers and relevant emerging technologies or equipping individuals with relevant literacy skills were the primary purposes.

The current trend regarding computers in Turkey is the FATİH project. FATİH is an acronym for the Movement of Enhancing Opportunities and Improving Technology, and proposes a smart class for all schools in Turkey. A total of 42.000 schools and 570.000 classes are supposed to be equipped with the latest IT tools. The project has already delivered 8500 tablet PCs to schools, and an additional 49000 are to be distributed. Other components of the project involve providing equipment, e-content and teacher training regarding conscious ICT use. However, until now the prominent part of the project has been the distribution of smart boards and tablet PCs. None of the other components has raised an issue or presented a change in the education system so far.

Another current trend in Turkey is the establishment of distance education centers within the universities. Anadolu University had long been the only distance education university since 1982. Known as a mega university (Daniel, 1996) it is still the biggest one with regard to student population and the number of programs offered. On the other hand, almost 50% of Turkish universities have begun to initiate distance education courses, since recent developments in Internet technology helped them to produce and benefit from a large variety of open education resources. However, most of these universities realize their distance education practices on local levels. One of the common applications is delivering the common courses of the university online such as history, foreign language, Turkish language and grammar. Another practice is delivering certificate course on regional levels. The universities in different regions of Turkey carry different certificate programs via distance education. The universities in the same region share the programs which are rich in range from nursing to civil aviation. So the borders are quite clear for the moment, and so far, so good.

The Netherlands Perspective

Joke Voogt, University of Amsterdam/ Windesheim University

Introduction

The Dutch education system is based on a delicate balance of centralized and decentralized control. Core objectives describe in general terms what is to be learned. A school's performance on these core objectives is being controlled by the inspectorate and through national exams at the end of primary and secondary education. Within this framework, teachers and schools are relatively autonomous in the way they organize the school's curriculum. This autonomy, however, is utilized to a limited extent, because teachers, traditionally, mainly use pre-cooked textbooks in their teaching (Kuiper, Nieveen & Berkvens, 2013; Nieveen & Kuiper, 2012).

Yet, recent developments in Dutch educational policy, in particularly related to the position of technology in education, require schools and teachers to better use their autonomous position in organizing the curriculum at school level. Three advisory boards to the government questioned whether the Dutch education system is future-oriented and adequately prepares young people for a digital society. The Scientific Council for Government Policy (WRR, 2013) argued that for leveraging the economy we to need to become a learning economy, implying a central role for education. In their view education needs to better address the talents of students and they see an important role for technology to achieve a more flexible curriculum. The Education Council (Onderwijsraad, 2014) calls for an evaluation of the current curriculum with a view to the future, and the need to pay attention to 21st century skills in particular. And finally, the Royal Dutch Academy of Sciences (KNAW, 2013) questions the lack of proper attention for digital literacy in the secondary education curriculum. As a response to these advisory reports specific actions at the policy and practice level have been undertaken. These will be discussed in the next section.

21st century skills

The call for paying attention to 21st century skills (Onderwijsraad, 2014) resulted in a discussion about what these skills encompass, and if and how they are being taught in the current primary and secondary school curriculum. Voogt and Pareja Roblin (2010; 2012) compared several (international) 21st century frameworks, and found that in (almost) all frameworks communication, collaboration, digital literacy, social and cultural skills, problem solving, critical thinking, creativity and self-regulation were mentioned as important competencies for living and working in a digital society. This skills set was adopted in a study about the presence of 21st century skills in the primary and secondary school curriculum (Thijs, Fisser & Van der Hoeven, 2014). The findings of this study showed that it depends on individual teachers if students are given the opportunity to develop 21st century skills. Core objectives and commonly used textbooks and digital teaching materials pay little attention to these skills. Concerning digital literacy it was concluded that the core objectives for primary and secondary education do not explicitly address digital literacy (Thijs et al, 2014). Further, although Computer and Information Science is currently an optional course in the upper secondary education curriculum, it needs to be updated by paying more attention to computational thinking (Tolboom, Krüger, & Grgurina, 2014).

Personalized learning

Personalized learning involves the creation of learning environments that cater for diversity between students with the intention to optimally develop students' talents. Ideally personalization in education concerns what students learn, how they learn, when they learn and where they learn. Ultimately personalization may result in the creation of learning environments, in which students have their own personal curriculum (Marquenie, Opsteen, ten Brummelhuis & van der Waals, 2014). Personalization requires the curriculum to be flexible. Currently, the idea of personalization, when implemented in educations practice, is less ambitious and refers to a curriculum that differs in pace, level and/or sequence of learning. Because of its adaptive and interactive possibilities technology is considered an essential tool in realizing personalized learning in schools. Hence, to implement personalized learning schools need to have the disposition of excellent technology (software and hardware) and curricular space to experiment with a flexible curriculum (VO-raad, 2014). In addition, competent teachers need to be prepared, who are able to integrate such technology in a pedagogically sound and responsible way (Voogt, 2014).

Conclusion and discussion

In order to prepare students for living in a digital society it is acknowledged that in the current primary and secondary education curriculum, it is important to more systematically pay attention to 21st century skills and personalization. To implement these issues in their own school, schools and teachers can use the autonomy offered to them by the system. It is well understood that schools and teachers need support to realize the implications of these changes in their own school. In particular support the following support is identified as essential for successful implementation:

- The elaboration of 21st skills in curriculum frameworks and exemplary teaching materials to offer teachers an operationalization of the 21st century skills in practice (Thijs et al., 2014).
- Assessment frameworks to help teachers monitor and assess the development of 21st century skills in students (Voogt & Pareja Roblin, 2010; Thijs et al., 2014).
- Effective professional development trajectories to prepare pre-service and in-service teachers to teach with technology (e.g. ten Brummelhuis, Wijngaards, Swager, & van Goozen, 2010; Heitink, Verplanken, Fisser, van Braak, J. & Voogt, 2014).
- Digital learning platforms suitable to implement personalized learning (VO-raad, 2014).
- Expanding boundaries of current legislation in order to experiment with different forms of a flexible curriculum (VO-raad, 2014).

An Australian Perspective
Jennifer Way, University of Sydney

This overview does not attempt to provide an account of the wide variety of current Australian research in this area; rather it provides some background information on the major shifts in the national education-technology context, and focuses on the developments

and research in which I have had direct involvement. The overview concludes with some research directions that have arisen from my own work and that of my colleagues.

The Australian context

Although, legally and constitutionally, education remains the remit of each state government, the funding for education comes from the Federal (Australian national) government. The last ten years has seen an unprecedented level of centralized education policy that has directly impacted ICT in education, with the state ministers of education participating in significant national initiatives.

Schools

In 2002 the typical Australian primary (elementary) school had mid-level ICT infrastructure and was motivated to develop skills in using computers and digital media for the purpose of better achieving the curriculum (Way & Webb, 2007). Just three years later, 21% of schools were pursuing ICT-mediated learning environments and transformative pedagogies (Way, 2009). The integration of technologies into school education received a boost with the introduction of the national government's *Digital Education Revolution* strategic plan in 2008. The plan recognized that information and communication technologies "are enabling the transformation of the curriculum and changing the way learners and educators operate, learn and interact" and was shaped by the vision that "Australia will have technology enriched learning environments that enable students to achieve high quality learning outcomes and productively contribute to our society and economy". *(Joint Ministerial Statement on ICT in Australian education and training: 2008-2011* – see AGDET document website*).* Four aspects of change were targeted: leadership, infrastructure, learning resources and teacher capability.

Affordable laptops promoted the distribution of resources across classrooms (rather than in computer labs), which was supportive of constructivist approaches to learning and teaching (Way, 2009). A government-based national initiative to produce 'digital learning objects' provided teachers with easy access to online resources targeting specific learning outcomes (*The Le@rning Federation Initiative*, 2001-2009, see ESA website). Supported by the government DER initiative, the influx of Interactive Whiteboards (IWBs) into all schools (and the majority of classrooms) was a catalyst for increased integration of ICT by even the technology-resistant teachers, though high quality pedagogy is, of course, not automatic (Way, Johns, Lilley, Mauric, Ochs & Ruster, 2009). Now that handheld tablets have become readily available, most schools are ready to embrace digital technologies in a significant way.

Curriculum

The introduction of Australia's first national curriculum began in 2012, and includes a set of general capabilities imbedded in each subject-area syllabus, one of which is the *Information and Communication Technology capability* (ACARA, Australian Curriculum). The 'learning continuum' for ICT is organized around five themes: Applying social and ethical protocols and practices; Investigating; Creating; Communicating; Managing and operating ICT. The curriculum documents also include an emphasis on the development of

domain-specific inquiry processes with students, though the current capacity of teachers to achieve this is uncertain.

Teacher education

With the widespread integration of digital technologies into classrooms at last a reality, the inclusion of technology-based pedagogies in the teacher preparation curriculum is no longer considered to be 'preparing for the future', but an immediate imperative to 'keep up' with current practice. Attention therefore turned to Faculties of Education in the universities. Government funded national projects such as *ICT in Everyday Learning* and *Teaching Teachers for the Future* developed resources to support ICT knowledge and effective pedagogy in teacher educators, teacher graduates and practicing teachers (ESA, 2011 – see ESA website). Unfortunately, funding for ICT resources in universities was not part of the project and most faculties struggle to provide the equivalent levels of technologies to those found in many schools. Although some research was incorporated in these projects there is great potential for further research into the efficacy of the material and its implementation.

Along side the Australian Curriculum, came the introduction the *Australian Professional Standards for Teachers* (AITSL) and new accreditation standards for initial teacher education programs (AITSL, 2011). These standards include ICT, in terms of resources for engaging students, effective teaching strategies and responsible use. The result has been increased attention by pre-service educators to productive uses of digital technologies in their own pedagogy.

Research directions

Engagement

During the 1990's it was very common to see reported amongst the outcomes of classroom studies of computer use, the statement, 'the students were more engaged'. However the nature of this engagement and its connection to technology was rarely explained. In recent years we have come to realize the complexity, individuality and importance of actively promoting student engagement in learning (Martin, Way, Bobis & Anderson, 2015). At the very least, researchers of learning technologies should attend to three aspects of engagement – behavioral, emotional and cognitive (Fredericks, Blumenfeld & Paris, 2003). Of particular interest are the higher levels of cognitive engagement, such as meta-cognition and critical thinking, for which teacher scaffolding becomes critical. Engagement is not only considered as an immediate outcome but as a contributor to disposition and motivation for continued participation and study – not just at the student level but also at teacher level.

In Australia, much attention is currently being given to raising teaching quality and student engagement with Science, Technology, Engineering and Mathematics (STEM), this being the mission of the country's Chief Scientist (STEM: Australia's Future, 2014). The relationship between faculties in universities, teachers and their schools is an area in need of practical research.

Differences in disciplines

It has been observed that teachers develop different pedagogies for subject areas, and use technologies in different ways and frequencies. For example, in English and Literature studies a teacher may use student-created movies extensively, yet in Mathematics only use drill and practice software. Surprisingly this phenomenon remains under-researched.

The education of pre-service teachers presents a complex context for research, with its iterated layers of teaching and learning, from the university educator, through the pre-service teachers, into the classroom with young students. Little is known about how educators support pre-service teachers in coming to understand the nature of knowledge in their discipline, and about ways of working within the discipline. For example, being able to teach science requires more than scientific knowledge, it also requires an understanding of 'being a scientist' and the scientific enquiry process. Even less is known about how pre-service teachers deal with the differences between the disciplines. For example, understanding the creative and technical processes of a writer is very different to understanding what it means to be a scientist. This becomes quite intriguing in the case of primary teachers who teach across six different disciplines.

A nexus of Engagement, Discipline Knowledge And Practice, & Technology

The EDKAPT Nexus project is an embryonic initiative by a multi-disciplinary group of teacher educators at the University of Sydney.

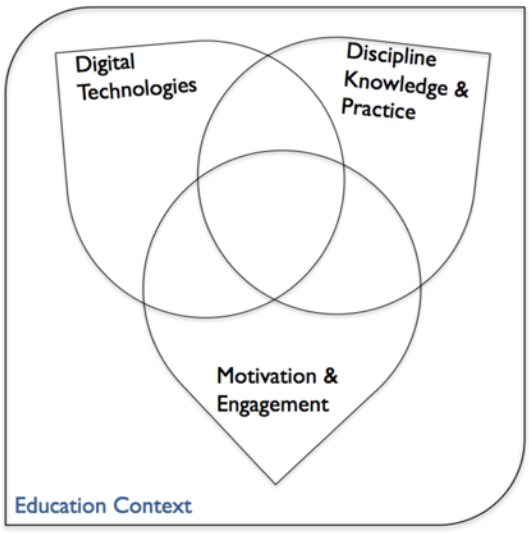

Diagram representing the scope of the EDKAPT Nexus

Research into preparing teachers for the effective use of digital technologies to facilitate an understanding of disciplinary practices in their students is very rare. In Australia the application of the TPACK framework (Mishra & Koehler, 2006; Harris, Mishra & Koehler, 2009), that views technology as another form of teacher knowledge connecting with pedagogy and content knowledge, has been a popular component of classroom research and professional development. However, our project seeks to conceptualize the selection and uses of digital technologies as a component of the knowledge and understanding that reflect *authentic discipline practices*. We intend to investigate the

cognitive, behavioral and emotional engagement of learners within discipline specific technology-rich learning experiences that are shown to be transformative.

Our work begins with developing case studies within the disciplines of History, Mathematics, Science and English, in the context of pre-service teacher education. Case studies from teacher education contexts outside Australia would make a valuable contribution to progressing the thinking in EDKAPT Nexus project.

Conclusion

This paper has demonstrated the broad variety of initiatives that a few countries are implementing in an effort to prepare educators and leaders to meet the needs of the learners who are entering our schools daily. We know they are not the same learners with whom we worked fifty or even ten years ago. What is essential is that we continue to learn from each other, share ideas, and try to collaborate whenever possible.

It is also essential that we realize the common themes seen in these countries' efforts to improve teaching and learning. They share recognition of the importance of student engagement and authentic curricula, as well as the significant role of teachers' experience and knowledge in integrating digital technologies. Although not always specifically mentioned by all, there is a clear understanding that pedagogical content knowledge and technological pedagogical content knowledge are important in implementing new models of integrating ICTs. There appears to be a growing acknowledgement that design based research might assist in understanding more deeply the processes, impact, and outcomes of ICT. Finally, it is essential that education policy help drive realignment of learner goals and achievement, through expanding expectations, providing support, and recognition of the changing landscape and culture of "schooling" in today's global society.

In these reports, we have seen perspectives based on a theory of implementation, efforts to research this rapidly changing landscape, and specific projects that seek to provide proof of concepts. What we also must remember is that context and content matter deeply, and yet, all countries and institutions face similar challenges. This paper is only the first step in a global effort to improve student learning, support educators' efforts, and take advantage of the pedagogical affordances of current technologies; now it is hoped that researchers around the world will work together to understand the complexity and possibility available.

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