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Journal of Computer Assisted Learning

Moving education into the digital age: the contribution of teachers' professional development

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Abstract

This article introduces the main outcomes of discussions at EDUsummIT 2011 by the specific Technical Working Group on Teacher Professional Development (TWG3). The focus was to explore how professional development of teachers may ensure that teachers are better prepared to use information and communication technology (ICT) to promote 21st century learning. The article is organized into three main sections: a review of key literature on professional development of teachers (TPD), in general and with specific reference to ICT; a summary of the key points emerging from TWG3's discussions; and recommendations for action.

On the basis of discussions held within the TWG3, the authors concluded that effective TPD requires changes at several levels of educational systems (political, institutional and individual), and that ICTs should be seen as an opportunity for introducing new goals, structures and roles that support these changes. It is significant that while many of the issues highlighted by the group are well established, addressing them continues to be problematic globally.

Keywords

digital age, ICT, IT, policy recommendations, practitioner research, teacher professional development, transformation.

Introduction

At EDUsummIT 2011 the working group on Teacher Professional Development (TWG3) set out to explore how professional development of teachers may ensure that teachers are better prepared to use information and communication technology (ICT) to promote 21st century learning. The discussions were informed by previous work that begun at EDUsummIT 2009 and an article summarizing recent research in the field

(Albion, Knezek, & Adubra, 2011). TWG3 generated grounded recommendations, to be disseminated through United Nations Educational, Scientific and Cultural Organization (UNESCO), and enacted by group members on return to their own contexts.

This article extends those discussions, linking them explicitly to relevant research, in order to elucidate the evidence base and enhance the weight of TWG3's recommendations. Section 1 provides an update of key literature on Teacher Professional Development (TPD) in general and with specific reference to ICT; Section 2 expands on key points emerging from TWG3's discussions; and Section 3 discusses TWG3's recommendations for action.

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From the literature

Teacher professional development

TPD, as the body of systematic activities designed to prepare teachers to do their job at several stages of their professional life, has become a major issue within educational research (Darling-Hammond, 1999; Darling-Hammond & Bransford, 2005), because the preparation of quality teachers is considered the most important factor affecting student performance (Rivkin, Hanushek, & Kain, 2005). Hence, TPD is rooted in a performance-oriented perspective on the literature that emphasizes professional development for quality of education (Scheerens, 2010).

Some issues associated with TPD approaches deal with the important question of continuous professional development in schools on the basis of cooperation within school teams, peer review, professional learning communities (PLCs) and human resources development models (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). In fact, recent research (e.g., Walsh, Bradshaw, & Twining, 2011) points towards the importance of informal elements, such as collegiality, for encouraging reciprocal learning between beginning and experienced teachers (Patrick, Elliot, Hulme, & McPhee, 2010) and to the value of informal practice-based learning networks for sustained professional development of teachers (Bradshaw, Twining, & Walsh, 2011; Hanraets, Hulsebosch, & de Laat, 2011). Other research has confirmed the value of teacher cooperation for professional development while highlighting the importance of support at all levels within a school (Schulz-Zander & Eickelmann, 2010).

Designing effective professional development

There is a consensus in much of the literature on a number of features of effective TPD. For example, the UK Government Department for Education (DfE, 2010) reported (*emphasis added*) that:

A systematic review of research on professional development found that there are some key features of professional development which are linked to better achievement by children:

- Observation of teaching;
- Feedback to teachers;
- The use of *external expertise linked to school-based activities*;

- Scope for teachers to *identify their own CPD focus*;
- An emphasis on *peer support*;
- Processes to encourage, extend and structure *professional dialogue*; and
- Processes for *sustaining CPD over time* to enable teachers to embed practice in their classrooms.

... There is also convincing evidence that *collaborative professional development* is more strongly associated with improvements in teaching and learning ...
(DfE, 2010, p. 10)

This analysis resonates with the need for TPD to be collaborative, experimental and reflective (Baumfield, Hall, & Wall, 2008; Coolahan, 2002; Fraser, Kennedy, Reid, & Mckinney, 2007; Hall, 2009; Murchan, Loxley, & Johnston, 2009; Williamson & Morgan, 2009). Consistent with that, in the broader context of both UNESCO (Villegas-Reimers, 2003), and the European Union, the school is seen as a learning organization where TPD has a place in the sense of *an active and constructive process that is problem oriented, grounded in social settings and circumstances, and (. . .) throughout teachers' lives* (Scheerens, 2010, p. 32). What is perhaps missing from the above analysis is the need for TPD to be evaluated in relation to its intended impact (McCormick *et al.*, 2008).

Problematically, the conventional structure of schools results in teachers mostly working in isolation from each other in their classrooms (Dodor, Sira, & Hausafus, 2010; Heider, 2005; Lortie, 1975). In reflecting on the legacy of Lortie, Hargreaves (2010) describes decades of research that has confirmed the difficulties of building genuine collaboration among teachers whether in the same school or more widely using new network technologies. Having their professional expertise recognized and valued by colleagues is a consistent challenge for teachers, even within the same school, and many countries lack infrastructure to support teachers in collaborating beyond the school boundaries (OECD, 2009).

All of these factors from 'generic TPD research' are relevant when thinking about ICT TPD. In the next section, issues specific to ICT TPD are examined.

Critical issues in TPD for integrating ICT

Some challenges confronting those responsible for teacher professional development related to ICT were

explored in the *International Handbook of Information Technology in Primary and Secondary Education* (Voogt & Knezek, 2008) and in the work of the first EDUsummIT in 2009. The broad topics considered there were teacher learning for pedagogical innovation, benchmarks for teacher education relative to pedagogical use of ICT, factors affecting teachers' use of ICT, models for teacher education related to ICT, multimedia cases in teacher education, communities of practice (CoPs) for teacher professional development, and teacher learning for educational renewal with ICT. Research published since that time has enhanced our understanding of these topics and some significant findings are summarized in this section.

If teachers are to engage in pedagogical innovation then they need to be prepared with knowledge beyond what is essential for operating in classrooms, as they are currently constituted (Law, 2008). However, research continues to find that, even in teacher preparation programmes that promote use of ICT for active student learning, ICT is used mostly for productivity and information presentation (Graham, Tripp, & Wentworth, 2009). Other research that directly addressed the question of innovation with pre-service teachers found that their understandings of pedagogical innovation and capacity to deal with it varied (Davis, Hartshorne, & Ring, 2010) with the implication that programme designers need to consider readiness for change when promoting unfamiliar pedagogical approaches. In this endeavour, there is a need for benchmarks in relation to policy development and assessment using ICT as well as for pedagogical use (Kirschner, Wubbels, & Brekelmans, 2008), as for example the ones proposed by Kirschner *et al.* (2008).

Although these steps should result in programmes that are designed to prepare teachers who can apply ICT for pedagogical innovation there are other factors that will influence the adoption of ICT by teachers. Somekh (2008) argued that, although there is substantial research that has identified teachers' beliefs as critical factors in the adoption of ICT (Ertmer, 2005), those beliefs are necessarily connected to broader socio-cultural factors that affect teachers' adoption of ICT. Moreover, a strong case can be made that changes in teacher beliefs follow, rather than precede and cause, changes in behaviour (Guskey, 2002). More recently, Belland (2009) used the sociological concept of *habitus* as an alternative basis for explaining teachers'

apparent reluctance to adopt ICT. In that view, 12 years of primary and secondary schooling, in which ICT was either not present or not integral, leaves prospective teachers with understandings of how education is practised that are difficult to change in the short period of an initial teacher preparation programme, especially if that programme also fails to make ICT integral.

The importance of models of good practice in teacher preparation, including in the use of ICT, has been recognized and it appears that success requires adopting a mindset that teaching is not effective without ICT (Ertmer & Ottenbreit-Leftwich, 2010) and embracing associated practices. McDougall (2008) argued that even effective programmes for teacher preparation require ongoing re-development. She noted that there were few published evaluations of such programmes and that more research was needed to document the effects of teacher development efforts on classroom practices. Between 1999 and 2006, the US Department of Education's Preparing Tomorrow's Teachers to use Technology (PT3) program awarded more than 400 grants totalling almost \$340 million to teacher education programmes (US Department of Education, 2006). Researchers have reported that the PT3 initiative achieved gains in pre-service teachers' ICT knowledge and frequency of use during field experiences through approaches such as mentoring and creating ICT-rich instructional materials (Polly, Mims, Shepherd, & Inan, 2010). TPD approaches such as video clubs in which teachers collaboratively review video of their own teaching (Gamoran Sherin & van Es, 2009) and immersion in technology-rich classrooms (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010) have resulted in increased use of ICT by teachers.

Lastly, research targeted on TPD and ICT integration highlights the importance of institutional and group professional learning environments as models to overcome the problem of teaching as an isolated profession (Hargreaves, 2010; Lortie, 1975). CoPs and PLCs have been proposed as approaches to reducing isolation and encouraging professional growth. The handbook chapter addressing this topic (Looi, Lim, & Chen, 2008) describes work with CoPs in traditional and online modes, arguing that new technologies offer new opportunities for professional growth and identity formation for teachers but that there is need for further study of how such communities can be built and

Category	Definition
IT	Using computers in a way that helps children to develop their IT skills, knowledge and understanding
Learning tool	Using computers in a way that supports any aspect of children's learning other than <i>IT</i> itself
Other	Using the computer in a way that is not covered by IT or learning tool

IT = information technology.

Table 1. The Focus Dimension Within the Computer Practice Framework (Based on Twining, 2008, p. 566)

sustained. Hur and Brush (2009) investigated self-generated online communities of teachers and reported that reasons for participation were most often related to experience of personal support. In a more structured approach with a focus on technology integration, teachers progressed through mentoring to a teacher-led CoP that supported more student-centred use of technology (Kopcha, 2010). Other researchers have argued, on the basis of experience with teacher communities, that making practice public using new media and social networking approaches can transform teachers' practice (Lieberman & Pointer Mace, 2010).

EDUsumMIT: TPD to move education into the digital age

The TWG3 comprised 21 participants representing 14 different nationalities from around the globe. Their discussion is summarized in Twining, Albion, and Knezek (2011). This section extends specific aspects of that discussion.

Clarifying goals of TPD for ICT integration

Working from their original remit to address TPD for 'technology use in schools and classrooms', TWG3 was challenged to concentrate on TPD which would be most relevant for *moving education into the digital age*. In their view, that should go beyond preparing teachers to *adopt* technologies for common tasks and should focus on improved learning and teaching through effective use of information technology (IT). This refinement clarifies the focus on the integration of new technologies within all disciplines and across pedagogical practices rather than being limited to IT/Computing as subjects. Moreover, it was in line with what Twining (2008) described as using IT as a

'Learning Tool' on the Focus Dimension of the Computer Practice Framework (See Table 1).

The overarching question debated by TWG3 was whether the focus of TPD should be on transforming educational practice or supporting and extending existing practice. The notion that IT can be applied to education in qualitatively different ways can be traced back at least as far as the Type I (facilitating teaching the same things in the same ways as before) and Type II (making available new and better ways of teaching) distinction drawn by Maddux, Johnson, and Willis (1992). The Mode Dimension of the Computer Practice Framework (Twining, 2008) extends this typology, building upon the Focus Dimension with three categories of impact that using IT as a 'Learning Tool' might have. Table 2 provides definitions of the three categories within the Mode Dimension, which focus on the extent to which using IT as a 'Learning Tool' changes what is taught (the curriculum) and/or how it is taught (pedagogy), and whether or not these changes could have been achieved without IT.

Of course, transformation of practice goes beyond changes to curriculum content and processes. The SITES-M2 study (Kozma, 2003a, 2003b) collected 174 case studies of innovative pedagogy with ICT from 28 countries. The data suggested that pedagogical transformation occurs when teachers move beyond simple applications of ICT to use it for planning instruction and collaborating beyond the classroom, supporting learning by creating structure, providing advice and monitoring progress. Students are enabled to use ICT to research projects, analyse data, design products, and share their work within and beyond the classroom. In these circumstances, the nature of the teacher-learner relationship shifts and the roles of teacher and learner are shared and sometimes reversed. Subsequent analysis of the SITES-M2 data identified six dimensions on

Table 2. The Mode Dimension Within the Computer Practice Framework (Based on Twining, 2008, p. 567)

Category	Definition
Support	Learning objectives (excluding those relating specifically to <i>IT</i>) remain the same but the process is automated in some way. <i>Support</i> is thus about improving efficiency and effectiveness without changing curriculum content.
Extend	Curriculum content and/or process are different, but these changes <i>could</i> take place in a classroom context <i>without</i> a computer or related information and communication technology.
Transform	Curriculum content and/or process are different, and these changes <i>could not</i> have taken place in a classroom context <i>without</i> a computer or related information and communication technology.

which pedagogical innovations could be compared (Law, Yuen, & Fox, 2011). These were learning objectives, teacher's role, learner's role, sophistication of the technology, connectedness between classroom and the wider world, and the multiplicity of the learning outcomes. The Schome Park Programme (http://www.schome.ac.uk/wiki/The_Schome_Park_Programme) similarly identified nine dimensions of practice that need to be considered when thinking about educational transformation, which they labelled: roles, relationships, curriculum, discipline, theoretical stance, motivation, focus, perspective and stance (Twining, 2010). As ICT becomes integral to the work of teachers and learners in classrooms, transformation can occur along one or more of these dimensions and TPD can be designed to support those changes.

Obstacles to success

TWG3 identified a number of issues that were seen to constitute obstacles to effective TPD. These included a lack of consistent vision for what might constitute success; poor match between needs and provision; exclusion of significant voices from decision making; potential misalignment among government policy statements, institutional cultures and individual professional responsibility; and failure to successfully harmonize context, policy, practice and research.

The importance of shared visions in education is well documented in the literature (DfES, 2004; Fullan, 1992; National College of School Leadership [NCSL], 2003, 2004), as is the lack of agreement underpinning IT use in education (dICTatEd, 2007; Twining, 2007; Van de Brande, Carlberg, & Good, 2009). TPD

intended to promote 21st century learning often arises from visions for success that are inconsistent. When some leaders and participants aim to *transform learning* through the professional development effort and others aim to use the effort to *improve performance of learners in the current system* of schooling and accountability, success is unlikely. Shared vision has been recognized as the first of several necessary conditions for leveraging technology to enhance and transform learning (International Society for Technology in Education, 2008; Van de Brande *et al.*, 2009). UNESCO's (2008) ICT competency standards are an example of an initiative designed to facilitate shared understandings across countries and between policy-makers and practitioners.

Another important point raised in TWG3's discussions was that teachers (and learning) are often treated so generically that resulting TPD is not experienced as relevant. Socio-economic context, age-level assignment, subject or content specialization, and prior experience are all critical characteristics of teachers to consider when designing TPD. Typically, elementary teachers are 'in the business' for a whole different reason than are secondary teachers, and motivation impacts the kind of TPD that a teacher finds engaging. As a result, TWG3 concluded that skills to be developed must match content, technology and pedagogy with the desired learning to ensure an effective professional learning experience.

Moving the focus beyond pedagogical practices, and toward the school as learning organization, TWG3 considered that teachers, school and system administrators, students, parents and community leaders all have legitimate stakes in the success of our

education systems, but too often many of these voices are missing from discussion that might influence the direction of professional development. Successful TPD should acknowledge and embrace principles drawn from knowledge of the context of teachers' practice, policy imperatives, emerging pedagogical practice and current research (Cochran-Smith & Lytle, 1999; Scheerens, 2010). Failure to attend to any of these multiple sources of information may result in TPD efforts being less relevant and effective.

Inertia resulting from extended exposure to traditional educational approaches is a significant inhibitor of change (Belland, 2009). TPD must model the transformed approaches to learning and teaching that it promotes. This is reflected, for example, in the envisioned model of the European Commission 'Creative Classroom', which promotes cycles of discussion, development and sharing of educational practices, and connected resources across teachers' professional networks in Europe, considering the learned lessons collected from these last as part of the evidence for policymaking in a bottom-up approach (Van de Brande, 2011).

TWG3 concluded that, because community leaders, school and system administrators, teachers, parents and students all have legitimate stakes in the success of education systems, TPD that is aligned to a shared vision and encouraged from the top, bottom and middle is most likely to be successful in moving education into the digital age (Twining *et al.*, 2011). To this end, TPD could be afforded through three important nested levels of support (as illustrated in Figure 1), namely:

- Policy/Government – vision, influence of assessment, essential conditions, sustainability.
- Organization/Institution – shared vision, coaching, adaptive professional development, culture of a learning organization, sustainability.
- Individual professional responsibility – shared vision, new teaching strategies, career-long learning, PLCs, mentoring.

This categorization of support according to three broad levels reflects Kozma's (2003a) three levels of influence on IT use in education, as reported in Hinostroza, Labbé, López, and Iost (2008, p. 86):

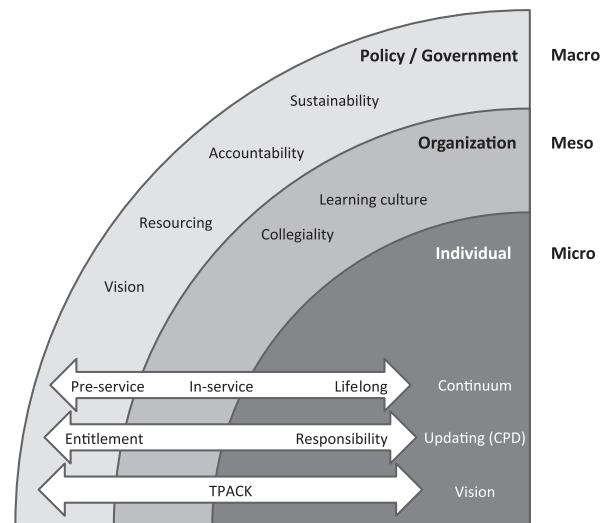


Figure 1 Three Nested Levels of TPD

- Macro-level or system factors such as cultural norms, social context, educational policy, curriculum standards, etc.
- Meso-level or school factors such as availability of IT infrastructure, IT integration plans, school leadership, innovation history, parental expectations, etc.
- Micro-level or individual factors for teachers, such as pedagogical practice, innovation history, educational background, experience with technology, etc.; and for pupils, such as experience with technology, social and cultural background, etc.

Specific elements at each level within Figure 1 are explored below.

Imperatives for action

A substantial part of the discussion in the TWG3 was devoted to identifying strategic areas for intervention. While the discussion may appear rather unexceptional, it reflects the state of play globally, as it emerged from this international group of experts. It is significant that, while many of the issues are well understood (and have been in some cases for many years), they still remain unresolved: this motivated the focus on *putting into practice* well-established principles rather than more innovative approaches.

Regarding *individual professional responsibility and opportunities*, it was noted that IT introduces a new vision of disciplines, of their epistemological and methodological tools. For example, the nature of

history today has been changed; the sorts of questions historians can ask, the ways in which they can access and manipulate data, the techniques they have for analysing artefacts, and the methods for communicating and representing their understandings have all been changed by new technologies. The same is true for all disciplines. It is widely acknowledged that in order to teach effectively one needs to have the relevant discipline expertise, and IT capability appropriate to the discipline needs to be understood as part of that corpus of knowledge. Thus, specialist subject teachers in schools need to understand how IT has changed the nature of their disciplines. The group considered specifically the *Technological Pedagogical Content Knowledge* (TPACK) framework for teacher knowledge (Mishra & Koehler, 2006) as one way of viewing the knowledge required for teaching that better grasps the importance of the knowledge that exists at the intersection of knowledge of discipline content and knowledge of IT application. Achieving and maintaining currency in this important element of Technological Content Knowledge presents a challenge for teachers at a time when both discipline knowledge and IT are advancing rapidly.

Furthermore, ICT offers new approaches to supporting learning and changes pedagogy in ways that often align better with new understandings of how children learn through constructivist and socio-cultural approaches. These changes increase the potential to *transform*, rather than simply *support* and *extend*, educational practice. Preparing teachers to integrate ICT into their pedagogical practice is made more challenging by the instability associated with the rapid development of technology (Borko, Whitcomb, & Liston, 2009).

This new appreciation of the complexity of teachers' knowledge must be recognized in approaches to teachers' initial preparation and continuing professional development. It is not sufficient to design TPD that treats the discipline, pedagogy and technology separately, without regard to the intersections. For example, the TPACK framework is being applied as the basis for an Australian national project to enhance graduating teachers' capacity for working with IT (Education Services Australia, 2011). Thus, TPD for transformative learning has to itself model transformative learning (e.g., see Bradshaw *et al.*, 2011; Condie & Livingston, 2007; Walsh *et al.*, 2011).

Finally, TWG3 agreed that practitioner research and related approaches, of which action research (e.g., Selwood & Twining, 2005), design-based research (e.g., Barab & Squire, 2004) and action learning (Boshyk & Dilworth, 2010) are examples, map well onto the key features of effective professional development. There was also agreement that the above-mentioned professional learning requirements for the teacher are fundamentally achieved through shared *reflective practice* (Brown, Parsons, & Parsons, 2001; Schön, 1987).

Regarding the *organization/institution* level, there was general agreement within TWG3 that TPD should be seen as forming a continuum from pre-service to in-service and lifelong professional development. Moreover, it will be contextualized in different formal/informal staff development environments. Informal practice-based networks for sustained professional development can be enhanced through encouraging increased collegiality in support of reciprocal learning and creative collaboration among experienced and beginning teachers. Informal professional learning acquired through interactions, participation in school projects and travel should also be recognized. Furthermore, this networked professional learning should be based on the adoption of technologies such as Web 2.0, mobile devices, augmented reality, and so on, because IT changes the nature of relations, knowledge production and knowledge re-production or sharing.

These discussions raised a question about what the aims of TPD should be – a question about our educational vision, moving the focus to the level of *policy/government*.

There was general agreement that TPD aimed to develop teachers' capability to use IT in ways that *transform* practice while preparing them to work effectively within the current system (e.g., using IT to *support* and *extend* practice) needs to include a focus on underpinning principles and theories of education relating to the philosophy of education, learning theory and change management. There was concern that in some countries these elements had been weakened or removed from both pre- and in-service professional development in order to allow more time to focus on developing particular 'skills' (such as teaching synthetic phonics). This has reduced the ability of teachers to make informed decisions about educational practices.

Other characteristics of professions were also felt to be absent in some countries. These included:

- A requirement for regular updating and re-accreditation.
- Engagement with cutting edge knowledge and practice within the field, as both consumers and producers of research.
- An independent professional body, which ensured that appropriate standards of competence and practice were adhered to.

Indeed, it was argued that in some countries (e.g., England) where teachers' underpinning theoretical understanding had been eroded, there was no independent professional body and there was no requirement for regular staff development or re-accreditation; it was hard to continue to justify calling teaching a profession.

Discussion

TWG3 proposed a set of recommendations related to policy, practice and research divided by areas illustrated in Figure 1. A key challenge for TWG3 in formulating recommendations was to ensure that they were relevant across international contexts, where differing practices and beliefs exist. Inevitably, this meant working towards a minimum level of provision, which might already be in place in some contexts but not in others. As illustrated in Figure 1, some of the recommendations apply at all three levels: government, organization and individual.

Starting at the bottom of Figure 1, a general underpinning principle is that effective practice (using IT to enhance learning and teaching) requires an integration of discipline expertise, pedagogical expertise and IT competence, which includes technical skills (TPACK). One of the challenges teachers face in achieving this blend is to know what good performance looks like and that challenge is compounded when other stakeholders, such as parents and policymakers hold different views of what constitutes good performance. Hence, it is critically important to engage all stakeholders in developing a shared vision for education and the role of IT.

The shared vision should recognize that education will continue to evolve from traditional models, roles

and practices to new and emerging ones that integrate new technologies. Accordingly, TPD must be seen as forming a career-long continuum (pre-service, in-service and lifelong) and policy should provide for minimum entitlements and requirements for professional development. So important is the continuing development of teachers for the success of new educational initiatives that policy should ensure that dedicated funding is set aside for related TPD. While there is little robust research evidence about the level of TPD funding required, members of TWG3 argued that at least 30% of funding for new educational initiatives should be ring-fenced for TPD based on experience of implementing national initiatives, such as the UK Building Schools for the Future Programme.

The complexity of teachers' work, blending knowledge of discipline, pedagogy and IT makes it imperative that programs for TPD should be developed using multidisciplinary teams that not only include these separate elements but also ensure they are effectively integrated. Developing teacher educators so that they can model effective integration of IT will assist teachers at all stages to appreciate the vision for effective integration and build their own performance accordingly.

Although teachers need to be well versed in their disciplines and skilled practitioners, they should not be mere technicians. They need to be solidly grounded in relevant education theory, including philosophy of education, learning theory and management of educational change, so that they understand their craft and are able to apply theory to evolve their practice in response to changing conditions. This mixture of theoretical and practical preparation should extend throughout their careers.

The apparent disconnect between educational research and the practice of teachers in classrooms has been noted previously. There is a need for educational research that is more closely connected to, and informs, the practice of teachers and vice versa. Thus, research funding should be focused on supporting practitioner research, particularly relating to IT and subject integration. Practitioners should be engaged in research about IT in learning and teaching at both pre-service and in-service stages of their careers and better routes should be developed for sharing of expertise, effective practice and research findings between practitioners.

Conclusions

Early during TWG3 discussions, consensus developed that research-based and experience-based knowledge for effective teaching – including effective professional development – is not adequately disseminated in a manner that impacts policy or practice. A major portion of this article is devoted to models for professional learning, standards and expectations for professional practice, and imperatives for action to ensure that these well-established criteria are recognized and respected as important. Ways should be created for EDUsummIT sponsoring organizations such as UNESCO, IFIP, ISTE, Kennisnet and SITE to become conduits for channelling the best professional development practices into policy and practice.

Rapid developments in IT continue to affect both discipline knowledge and pedagogical possibilities in ways that must influence teachers' professional learning for employing IT as a constituent part of learning experiences rather than as a specific topic. The resultant changes in pedagogy often align better with new understandings of how education could *move into the digital age*. As such, they represent what Cuban (1988), drawing on Watzlawick, Weakland, and Fisch (1974), defines as second-order change:

Second-order changes seek to alter the fundamental ways in which organizations are put together. . . . Second-order changes introduce new goals, structures, and roles that transform familiar ways of doing things into new ways of solving persistent problems. (Cuban, 1988, p. 342)

However, one of the most significant 'findings' from the TWG3 discussions was that while many of the issues relating to effective TPD are not new, much TPD across the world continues to ignore them, resulting in the overall pattern of TPD being a not very effective activity (e.g., Opfer, Pedder, & Lavicza, 2008). Thus, the gauntlet that EDUsummIT 2011 has thrown down, to move education into the digital age, is a challenging one, which will require significant political will. However, any countries that fail to rise to this challenge are likely to limit the possibilities of their people for access to knowledge as well as full participation and expression in a global society. TPD is critical to the success of education, particularly during a period such as this one in which education faces such radical challenges. TWG3's recommenda-

tions are intended to be realistic and achievable, but will only succeed in moving education into the digital age if implemented in tandem with the recommendations of other working groups. In fact, the Learning Society (Carneiro, 2007) has to meet challenges that require a complex and global vision of education. This has been also the strategy within TWG3: to build on the many facets of local educational practices towards shared values to expand and *transform* educational culture.

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