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ICT in Teaching and Learning
Report from the Working groups on ICT and the teacher/learner perspective
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Introduction

The following paper summarizes the outcomes of the Teacher and Learner working group meetings during the EDUsummIT – the international summit on ICT in Education. The paper is based on findings derived from the chapters of the International Handbook of Information Technology in Primary and Secondary Education, as well as from studies performed by the participants of the working-group and by others known to members of the working group.

We begin with research-based claims, divided into three sections: claims on ICT and pedagogy, claims regarding teachers' perspectives on ICT, and claims concentrating on students' perspectives on ICT. We further define actionable goals and objectives for the future of ICT in teaching and learning, based on the claims; then, we suggest strategies for attaining these goals and objectives.

Claims

ICT and Pedagogy

1. Pedagogical perspectives

1.1. A complex relationship exists between technology and pedagogy, which can be illustrated by the pendulum metaphor. The emphases shift from one to the other: while technology facilitates novel pedagogies, new forms of pedagogy enable the implementation of even more novel technologies developing constantly and vice versa (Ching, 2009; Kozma, 2003; Wozney, Venkatesh and Abrami, 2006).

1.2. The use of ICT must be underpinned by the dynamic interplay of learning theories and pedagogical principles. Technology should not be used alone to drive pedagogy (Lai, 2008).

1.3. ICT should be embedded in the learning environment and integrated into the classroom culture (Lai, 2008).

1.4. Collaborative environments would help with technology integration particularly when teachers understand the underlying philosophy (Webb, 2009; Johnson, Johnson and Stanne, 2000; Stevens and Palacio-Cayetano, 2003; Eickelmann and Schulz-Zander, 2008) because a hallmark of the new technology is that it empowers a "participatory culture" (Jenkins, Purushotma, Clinton, Weigel, and Robison, n.d.; Squire and Jenkins, 2003)

2. *IT and the Curriculum*

   2.1. ICT changes the body of knowledge expertise, facilitating a diversity of resources, team teaching, new mix of expert personnel (learning facilitators, information professionals, subject experts, technicians) (Gibson, 2003, 2006).

Teacher

3. *Teacher Beliefs, Attitudes and Practices:*

   3.1. Research highlights the role of teachers beliefs and attitudes in ICT implementation (Bai and Ertmer, 2008; Koster, Brekelmans, Korthagen and Wubbels, 2005) as well as social and cultural contexts (Knezek and Christensen, 2008; Park and Ertmer, 2007; Pearson and Somekh, 2006).

   3.2. Teachers' beliefs are deeply seated and control their approach to new practice so there is a need to develop different pathways or a synergy between beliefs, attitudes and practices (Cox, 2008; Cox and Webb, 2004).

   3.3. Teachers embody new practice, adopting for themselves new technologies which they expect learners to benefit from (Kozma, 2003; Law, Pelgrum, and Plomp, 2008). The more benefits are perceived by teachers the more likely they adopt the new technologies (Owston, 2003).

   3.4. Teachers do not use IT in innovative ways automatically; more often they integrate the technologies in their routines (Müller, Blömeke, and Eichler, 2006). In general this does not change teaching (Tubin, Mioduser, Nachmias and Forkosh-Baruch, 2003) as studies indicate using a triangulation approach including different observational measures (Schulz-Zander, Pfeifer and Voss, 2008).

4. *Professional Development*

   4.1. Professional Development of teachers for ICT implementation must emphasize quality, be embedded in teaching and learning, and be holistic in nature (Lawless and Pellegrino, 2007; Penuel, Fishman, Yamaguchi and Gallagher, 2007).

   4.2. Teacher professional development is crucial for ICT implementation (Knezek, Christensen, Mayes and Morales, 2005), teachers state a lack of pedagogical and didactical measures (Law and Chaw, 2008; Eickelmann, 2009).

   4.3. There is growing recognition of the importance in using online communities of practice as a model for teacher professional development (Kirschner and Lai, 2007). Furthermore intra-school offers and informal learning within the teacher community plays an important role and should be considered in school concepts and policy plans (Dexter, 2008; Eickelmann and Schulz-Zander, 2008)

Learner

1. *New Generation*

   1.1. Research indicates there is a new generation learner being created as a result of ICT penetrating our lives (Beck and Wade, 2004; Prensky, 2001a, 2001b)

   1.2. There is a need for multiple new literacies in the Digital Age (Mioduser, Nachmias and Forkosh-Baruch, 2008; Jenkins et al., n.d.), especially those preparing for life long learning (Voogt, 2008) and work force needs of the 21st Century (P2CS, 2008).

   1.3. ICT has an impact on identity and self belief, interests, strengths and aspirations, confidence in ability to learn, and personal, informal use of ICT (research on partial anonymity – successes and problems) (Gibson, 2008; Schrier and Gibson, in press)

1.4. Online environments affect learning processes: gamers for example, are literate users of technology who acquire a large scope of skills and have a need to connect with outside groups (Gibson, Aldrich and Prensky, 2007; Sorenson and Meyer, 2007)

2. *Skills*

2.1. Diverse learners' aptitudes, information skills and judgement with ICT can be overestimated (Bennett, 2007; Laurillard, 2007).

2.2. Do students use technology well? Literature review states that exposure to ICT is not high and not innovative (Cox and Marshal, 2007; Cox, 2008). Informal use of computers for entertainment purposes does not necessarily increase relevant competencies for school, whereas program and communication-related uses do (Wittwer and Senkbeil, 2008).

2.3. Expert Internet usage among youth is an overstatement, since they fail to evaluate and criticize information and can fail to handle high loads of information (Zheng, 2008)

2.4. New feedback of data from ICT tools used by learners permits new action research, regarding meta-cognition skills (Laurillard, Oliver, Wasson, and Hoppe, 2009)

3. *Motivation*

3.1. Delight leading to productive engagement can be facilitated through ICT tools (Foreman et al., 2004; Gee, 2004; Squire and Jenkins, 2003), although this can be challenged by ICT unreliability (Millwood, 2000).

3.2. ICT facilitates co-design of learning by learners, ownership of their curriculum ICT competences and intrinsic motivation (Shroff and Vogel, 2009).

3.3. High levels of motivation are gained from mobile student-owned devices (Dede, Nelson, Ketelhut, Clarke, and Bowman, 2004) and the use of ICT within a new learning culture (Bull et al., 2008). Follow-up SITES-M2 study – motivation of students 4th-12th graders – motivation for using technology decreases slightly in schools by age when it is not combined with a new learning culture (Eickelmann and Schulz-Zander, 2008).

4. *Attitudes*

4.1. In places where IT implementation is widespread, 20% of the students do not want to use IT in their learning; this complies with a general population figure of people who are not motivated to engage in learning with IT. Overall students' attitudes and the perceived value of its use are positive and they would like to use it more often (Eickelmann and Schulz-Zander, 2008).

4.2. Willingness to risk mistakes can be supported through ICT approaches (provisionality etc.) and is increasingly an expectation of the digital native generation (Beck and Wade, 2004; Prensky, 2001b)

5. *Outcomes*

5.1. German and international studies show a positive effect of ICT use on reading and writing competencies whereas for other domains results are inconsistent, The time frame of several studies are meant to be even longer for further results. Best effects on school effectiveness are connected with mobile device (Eickelmann and Schulz-Zander, 2008)

5.2. PISA and PIRLS 2006 show: Students from with higher socio economic background profit from better access to ICT and parental support to use ICT for educational tasks to which the school has to counterbalance in terms of equal opportunities for all students (Senkbeil and Wittwer, 2008; Schulz-Zander, Eickelmann and Goy, in press).

5.3. In a follow-up study of the School of the Future (IL) – achievements were higher for this IT enriched school in traditional measurements (Chen, 2006).

5.4. SITES-M2 secondary analysis (IL) – research framework according to which students' roles change as a result of innovative IT implementation (Mioduser et al., 2006).

5.5. Technology is effective if teachers use it to engage students in the learning tasks, scaffold them to inquire, discover, critique, create, and apply new understanding and knowledge, within a community of learners (Law, 2008).

5.6. Some uses of simulations improved understanding of science beyond that achieved by other pedagogical approaches particularly where its use is planned and supported by teachers and the simulations address difficult science concepts (Webb, 2008).

Goals and actions for the future of ICT in teaching and learning

The review of the evidence base for ICT in teaching and learning can be summarized in claims relating to four main themes:

1. Learners' needs, expectations, knowledge and skills are changing, as a result of digital technology, in complex and diverse ways that we are only beginning to understand.
2. Relationships between technology, pedagogy and the curriculum are complex.
3. Teachers need time and professional development opportunities in order to adapt.
4. Evidence for benefits of using technology for learning is growing but the evidence base inevitably lags behind the rapid technological developments.

Major actionable goals for the future of ICT in teaching and learning are identified in Table 1. Specific objectives are presented in relation to each of the goals. While the strategies for achieving the goals, as shown in Table 1, align approximately to the main goals that they support, most of the strategies relate to more than one goal. The seven major goals focus on research frameworks, researching learners' communication, collaboration, teacher development, organisation of knowledge expertise, as well as a broader review of the general goals of education.

Table 1   Goals, objectives and strategies for the future of ICT in teaching and learning

Goals for the future of ICT in teaching and learning	Objectives for ICT in teaching and learning	Strategies for ICT in teaching and learning
Research frameworks 1 Understand better the complexity of pedagogy, learning theory & technology and their interrelationship, by proposing clearer conceptual analysis based on a systems approach (using ecology, cybernetics, inter-disciplinary thinking etc.).	Develop a new theory base that integrates learning theory, pedagogy and technological affordances within an understanding of emergent phenomena in complex systems.	Understand change as a process rather than an event Use a systems approach and combine bottom up and top down research strategies Establish inter-disciplinary research teams Develop complex models e.g. by using ecological approaches or complexity theories Use multilevel analysis techniques

Research on learners 2 Discover how the characteristics of learners affect how ICTs impact and have interaction effects on the learner and on classroom culture.	Understand 21st century learners in relation to their use of ICT Understand how to develop 21st century learners in relation to their use of lCTs Understand the impact of ICTs on learners Understand the impact of ICTs on classroom culture.	Encourage practitioner research
Communication 3 Through better design & communication, explain findings and analysis of complex systems to public, policy makers and practitioners.	Policy makers and stakeholders understand the nature of technology use in learning and its benefits and limitations Policy makers and stakeholders understand 21st century learners	Publish and share results via traditional and new platforms e.g. on YouTube Connect research and practice through evidence-based research
Goals for the future of ICT in teaching and learning	Objectives for ICT in teaching and learning	Strategies for ICT in teaching and learning
Collaboration 4 Develop a community of practice in order to advance organisational growth in the profession	Establish mechanisms for joint knowledge creation by teachers, learners and policy makers Develop shared understanding of ICT and learning	Develop / describe scenarios for learning with ICT
Teacher development 5 Inform and develop teachers' understanding, strategies, planning and practice by clarifying what levels of responsibility / skill / capacity / multi-tasking are available to what age / developmental stage of learner to engage in a participatory, creative, online culture of knowledge acquisition & sharing when ICT tools are widely available.	Enhance motivation, attitudes and beliefs of teachers Develop shared understanding of 21st century learners' needs, IT literacies and extent and range of competencies Develop shared understanding of characteristics of the 21st century teacher e.g. – flexibility, open-minded, adaptability Develop teachers' understanding of how to use ICT Embed ICT in the curriculum Empower teachers that debate knowledge as a normal process Create rich learning environments Enable teachers to participate in learning communities incorporating teachers, learners	Change teachers' views on education by enabling envisioning and scenario building Focus on both pedagogy and technology Implement ICT in pre-service education > change teacher education Teacher curriculum for pre-service education Integrate IT competencies in school programs: for teachers and students Develop strategies for understanding the nature of new technologies as they become available Facilitate collaboration through learning communities

		Consistency in teacher development; financing
		Embed ICT in all teacher professional development
Organisation of knowledge expertise	Enable teachers to be effective in classrooms	In-service professional development through sharing good practice
6 Change the organisation of knowledge expertise towards a diversity of resources, team teaching, new mix of expert personnel (learning facilitators, information professionals, subject experts, technicians).	Cope with media to evaluation of information	Envision how to create the 21st century learner?
	Educate learners about ICT	Assuming new technologies are better than older ones: create imbalance. Then strive for new balance by introducing disruptive technology
	Develop awareness of disruptive innovation in classrooms and schools	
	Develop understanding of ddisruptive innovation theory	Integrate IT on the input level – facilitate sustainability

Goals for the future of ICT in teaching and learning	Objectives for ICT in teaching and learning	Strategies for ICT in teaching and learning
Overall goals of education 7 Review the **goals of education** in the light of affordances of ICT-based approaches to learning and teaching (including lifelong-learning, cultural, social, citizenship and workplace issues).	Understand the needs of the future citizen Re-define educational goals Ethical and proper use of technology – teachers and students Create a framework for alternative assessment Create learning communities – collaboration and sharing Equity in IT implementation	Create a learning environment for the whole school community (teachers and students) Promote authentic usable learning situations Consider: ▪ should life be dominated by technology? ▪ how to live in a digital world ▪ outcomes from research and development in ICT and learning

Epilogue

The conceptual frameworks underpinning the relationship between teaching, learning and information and communication technologies are manifold and complex. In fact, the relations between them are associated with several concepts related to several components of the school milieu, including curricular issues, policy issues and leadership within the school. As features on this complex landscape, this working-paper sheds light on two of the core and vital aspects of education - teaching and learning.

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