

## 21<sup>st</sup> century learning, technology and the professional development of teachers

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### Abstract

There are two imperatives for transforming K-12 teaching and learning.

The *educational imperative*. The World Economic Forum concludes that at a time of fast-paced digital change, countries need innovative places of learning that can provide the next generation with the skills of the future (Kruchoski, 2016).

The *technology imperative*. The information technology revolution presents technology-rich innovative learning environments for improving and extending teaching and learning and the affordance of customisation of learning to individual learner needs, a concept which is highly supported by the learning sciences (Groff, 2013).

The first part of this paper examines the competencies learners need for tomorrow's world and the innovative technology-based methods of learning needed for the regeneration of education systems. The later parts of the paper focus on the teachers' pre-service and in-service training needs in regard to information and communications technology (ICT) integration in the classroom and how ICT can be used to provide professional development for teachers and principals.

**Keywords:** informative and communications technology (ICT); ICT integration in the classroom; pedagogy; pre-service training; in-service training.

## Обучение в 21 веке, новые технологии и профессиональное развитие учителей

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### Аннотация

Изменения в сфере школьного образования невозможны без двух императивов.

Первый – это образовательный императив. Всемирный экономический форум пришёл к выводу о том, что во время стремительных цифровых изменений странам необходимо создать инновационную среду обучения, которая сможет обеспечить у следующих поколений развитие навыков, которые будут востребованы в будущем (Kruchoski, 2016).

Второй – технологический императив. Информационная революция повлекла за собой возникновение и распространение технологий, необходимых для создания инновационной среды обучения, которая призвана способствовать совершенствованию процессов преподавания и обучения, а также делать обучение более доступным, персонализированным и адаптируемым к индивидуальным потребностям учеников, что считается чрезвычайно важным в образовании (Groff, 2013).

В первой части этой статьи рассматриваются навыки, которые будут особенно необходимы в будущем, и инновационные методы обучения, реализуемые с помощью информационных технологий и необходимые для регенерации системы образования. Далее в статье уделяется внимание обучению учителей и повышению их квалификации без отрыва от работы, рассматриваются вопросы интеграции информационно-коммуникационных технологий (ИКТ) в классную деятельность учителей.

**Ключевые слова:** информационно-коммуникативные технологии (ИКТ), интеграция ИКТ в деятельность класса, педагогика, подготовка учителей, повышение квалификации учителей.

### **The educational imperative**

In the traditional educational systems which the educational reformer John Dewey (1938) described as "imposed from above and from outside" (p18), the teacher's role was to communicate knowledge and enforce standards while the students' role was to sit quietly in their rows of desks, writing down and memorising what was taught. Knowledge was compartmentalised into subjects, all students learned the same thing at the same time, and the only other main source of knowledge other than the teacher was the sometimes dog-eared and outdated textbook.

We now have a much better idea of how learning occurs. We understand that quality in-depth learning includes personalised learning, socially-constructed learning and learning through interaction with a wide range of resources and the physical world. Hanley et al (1970, p5) argue that the aims of pedagogy should be:

1. To initiate and develop in learners a process of question-posing.
2. To teach a research methodology wherein learners can search for information to answer questions they have raised and apply it to new areas.
3. To help learners develop the ability to use first-hand sources as evidence from which to develop hypotheses and draw conclusions.
4. To conduct classroom discussions in which learners learn to listen to others as well as express their own views.
5. To give sanction and support to open-ended discussions where definitive answers to many questions are not to be found.
6. To encourage learners to reflect on their own experiences.
7. To create a new role for the teacher as a resource rather than an authority.

Stenhouse (1975, p80) argues that education as we know it essentially comprises four elements:

1. Training (the acquisition of essential skills).
2. Instruction (the learning and retention of essential information).
3. Initiation (familiarisation with social values and norms and the capacity to interpret and react to the social environment).
4. Induction (introduction into thought systems and how to make for oneself relationships and judgements).

The first two of these four elements involve inculcating knowledge content and skills sets and achieving pre-determined outcomes and mastery. The second two are concerned with teaching and learning processes that focus on developing the generic attributes required for study, social situations and employment.

Cisco, Intel and Microsoft commissioned 60 education experts in five countries to research and define these qualities, skills and abilities. After extensive research, they concluded that most education systems have failed to keep pace with the dramatic changes in the global economy and develop the skill sets students need to succeed in the 21<sup>st</sup> century, which they identified as:

#### ***Ways of thinking***

1. Creativity and innovation.
2. Critical thinking, problem solving and decision-making.
3. Learning to learn and metacognition.

#### ***Ways of working***

4. Communication.
5. Collaboration (teamwork).

*Tools for working*

6. Information literacy (finding, evaluating and applying information sources and resources).

7. ICT literacy (using digital tools, networks and communications).

*Living in the world*

8. Citizenship – global and local.

9. Life and career.

10. Personal and social responsibility (including cultural awareness and competence).

(Griffin, McGaw, and Care, 2012)

**The technology imperative**

In a world experiencing what Christensen (1997) describes as “disruptive innovation”, small start-ups using new or innovative technologies can create new markets and disrupt and displace established systems, products, processes and occupations. In my country, Australia, uncertainty, innovation and risk are all tightly linked and demand intervention (Williamson et al, 2015). According to McCrindle (2017), that today’s Australian school leavers will live longer and work later in life than previous generations, will average 1.8 years per job early in their careers and about 3 years per job over their working lives and will hold 17 different jobs and follow 5 careers during their lifetimes. Some of the jobs they will hold do not currently exist, just as such jobs as app developer or medical nanotechnologist did not exist when they started school. In such volatile and fracturing times, it will not be so much their initial formal qualifications that count but their capacity to adapt to the changing demands of the workplace.

Technology is great for automating systems and replacing repetitive functions, but is less effective in adapting to complex change and engaging with people. So to help pupils “future-proof” their careers and adapt to a constantly changing workplace, schools must take steps to equip them with the generic competencies outlined above.

There is a widely held belief by such agencies as the OECD that there is a nexus between introducing ICT into the classroom and reforming teaching and learning (Venezky and Davis, 2002) . The arguments may be summarised as follows. ICT provides access to all knowledge. Given the infrastructure and access, it can provide any child anywhere with captivating knowledge appropriate to his or her needs. With learning objects and open courseware, high quality content can be accessed and used in multiple applications by various age groups in different locations and cultures. ICT can support homework and out-of-school hours’ tuition, open schooling for remote and socially disadvantaged children, and education for children with special needs. It can also provide continuity of schooling at times of natural or human-made disasters. It can revolutionise classroom teaching and learning by supporting moves from rote learning and shallow coverage of content to mastering higher order learning skills such as problem-setting, questioning, organising, evaluating and generating knowledge. It can enable pupils to quickly access and investigate facts and ideas, and use games, simulations and role plays to solve problems and reach conclusions in stimulating and meaningful ways. The technology also allows pupils to create in multimedia, publish on the web, and communicate and collaborate with children in other schools, cultures and countries. It also benefits teachers by enabling them to create motivating and informative textual, graphic and audio-visual presentations, delegate laborious and time-consuming drilling and testing to the computer and focus on counselling and support for the pupils. There can never be enough outstanding teachers, and the sheer volume and complexity of modern knowledge mean that even the most committed and talented teacher cannot be expected to be the source of all knowledge (Latchem, 2010).

### **Mixed success in achieving ICT integration in the classroom**

Currently, the integration of ICT in the classroom is meeting with mixed success. The Government of Canada (2012) concluded that its national Computers for Schools Program had achieved its expected outcomes, operated more efficiently and equitably than any of the available alternatives, provided a model for similar initiatives in other countries and helped youth to gain work-related social skills.

The findings in some other countries are less encouraging.

Assessing government-led ICT initiatives in primary and secondary schools across England, Ofsted (2011) found that while the majority of primary school principals felt that ICT was contributing to their schools' development and were providing training and support for their teachers and support staff, the management and use of ICT in 50% of the secondary schools was no better than satisfactory. And in both primary and secondary schools there was a lack of support for staff teaching the more demanding topics and little attempt to assess the impact of ICT on pupils' learning.

In its 2011-2012 survey of the uptake of technology in classrooms and use, competence and attitudes of students in schools in 27 EU Member States plus Croatia, Iceland, Norway and Turkey, the European Commission (2013) found that many schools were still inadequately equipped with ICT, some students never, or almost never, used a computer during their lessons and only a third of the pupils were being taught by teachers for whom ICT training had been compulsory.

Examining the impact of school technology on international test results such as Pisa and tests measuring digital skills in over 70 countries, the OECD found that the impact of ICT use on student performance was mixed and concluded that ensuring that every child reached baseline proficiency in reading and mathematics would achieve more in creating equal opportunities than solely expanding access to high-tech devices and services (Schleicher, 2015).

In 2014 in Australia, 10,500 students were assessed on their ICT knowledge, understanding and skills. Despite a 2009 A\$2.4 billion Digital Education Revolution promise to put computers in the hands of all secondary school students and prepare them for work in a digital world, nearly half of the secondary school students were failing to meet minimum digital literacy standards and only 52% of Year 10 students were competent in such tasks as creating tables and charts, sorting data in a spreadsheet and editing graphics and text. Worse still, it was found that basic digital skills appeared to be decreasing (Fraillon et al., 2015). Further research by Phillips' (2015) showed that the new digital technologies curriculum would take several years to become fully embedded in Australian schools, teachers in schools were not being given sufficient training and professional support and the resources provided often become rapidly outdated as the focus of curriculums changes.

Such findings show that ICT integration is a complex and multi-dimensional task. As infoDev (undated) observes, an enduring problem is that educational planners and technology advocates typically think of the technology first rather than the specific educational aims and applications and what can support or stand in the way of achieving these. So government policymakers, administrators and school heads as well as classroom teachers need on-going training, support and advice in providing and managing the infrastructure and technology in schools and classrooms and developing appropriate policies and procedures for ICT-based teaching and learning.

### **Pre-service teacher training (PREST)**

In pre-service teacher training (PRESET), trainee teachers need to master the core technical knowledge and skills. The International Computer Driving Licence<sup>1</sup> suggests such knowledge and skills are needed at three levels:

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<sup>1</sup> <http://ecdl.org/about-ecdl>

### **Base Level**

- Computer essentials
- Online essentials
- Word processing
- Spreadsheets
- Theory

### **Intermediate Level**

- Presentation
- Using databases
- IT security
- Online collaboration
- Image editing
- Web editing
- Project planning
- 2D computer aided design
- Health information systems usage
- ICT in education
- Digital marketing

### **Advanced Level**

- Advanced word processing
- Advanced spreadsheets
- Advanced database
- Advanced presentation

Even if teachers in training do gain all these competencies, it does not necessarily follow that when they graduate they will be capable of exploiting all the newer forms of technology in the classroom. Steketee (2005) suggests that there are four possible approaches to training teachers in the uses of ICT:

1. *The ICT skills development approach.* By training teachers in using the tools, it is hoped that they will develop competence and confidence in applying these in the classroom.

2. *The ICT pedagogy approach.* By showing teachers how ICT-based teaching and learning tools can be applied across the curriculum and involving them in lesson and courseware design, it is hoped that they will appreciate what is involved in ICT integration in the classroom.

3. *The subject-specific approach.* By embedding ICT training in specific areas of the curriculum, it is hoped that teachers will develop useful insights and skills in applying ICT in teaching, learning and assessment in their subject specialisms.

4. *The practice-driven approach.* By providing practicums and follow-up activities, it is hoped that the teachers will be exposed to the problems, means and possibilities of ICT integration.

He argues that while the first three approaches are important, without the fourth—gaining first-hand experience of putting the ideas into practice—there will never be significant change in classroom practice. Mumtaz (2000) concludes that even with training in the most up-to-date technology, without practical experience and mentoring in ICT integration in teaching practicums, recently qualified teachers are unlikely to venture into using technology innovatively in the classroom. And Dagiene (2003) suggests that once teachers are enabled to recognise the ways in which ICT can improve pupils' learning, they will be far more motivated to gain the necessary technical knowledge and skills. A strong case can therefore be made for compulsory training in and application of ICT-based pedagogical methods during practicums and the inclusion of higher-order ICT competencies in the requirements for national teacher certification.

### **In-service teacher education and training**

In-service teacher education and training (INSET) can take many forms: courses and workshops on subject matter or methods; education conferences or seminars at which teachers can discuss educational issues and present their findings; observation visits to other schools; peer observation and mentoring; participation in networks of teachers; and collaborative reflection, research and development.

Whatever the means of INSET used, the elearning ecosystem is changing so rapidly that while ensuring that the best of their individual practices are not lost it is important that serving teachers are not only kept up to date with the technology but with:

- The teaching and instructional design skills that will enable them to help their pupils engage in constructivist thinking, experimentation, problem-solving and learning linked to real life situations.
- The ever-growing and changing range of computer- and Internet-based sources they can use in teaching and learning.
- How to exploit collaboration tools such as weblogs, wikis, podcasts, Flickr and YouTube so that pupils can create, adapt and share content, discuss issues and support one another's learning.
- E-assessment—not only using ICT for true/false, multiple choice or fill-in-the-blank testing, but assessing pupils' abilities in self-directed study, information retrieval, analysis, synthesis, problem-solving and creativity;
- E-portfolios—creating multimedia records of pupils' efforts, achievements and reflections on learning for the purposes of conducting formative and summative assessment and showcasing the pupils' best work (Latchem, 2010).

All of these activities present new challenges in classroom management. Teachers therefore also need training in how to schedule and organise individualised and collaborative ICT-based learning, develop and co-develop courses and courseware, team teach, and become teacher-researchers, seeking to learn from what happens in the classroom, and becoming innovators and agents of change.

The integration of ICT in the classroom may not fit easily into existing school cultures. As a result, teachers may only use the new tools in ways that conform to current teaching practices, rather than taking advantage of their innovative affordances. Shulman (1986) argued that teachers need to acquire an amalgam of content and pedagogical knowledge or PCK. Koehler and Mishra (2009) advanced this argument, suggesting that to effectively integrate ICT in instructional practices, teachers needed an amalgam of technological, pedagogical and content knowledge or TPACK.

A deep knowledge of the hardware and software resources, the features of these resources, and how to use them effectively in specific subject domains for specific learners in specific classroom contexts cannot be developed through occasional short, one-off presentations or demonstrations. A multi-strategy, ongoing approach is needed for teachers to experiment with the technology and instructional design methods involved in applying such concepts as scaffolding (Vigotsky, 1978) and constructionism (Papert, 1980).

INSET in ICT integration also needs to take account of the affective as well as the cognitive and skills dimensions of change. So communities of practice are needed in which teachers can call upon each other for information, advice and support, brainstorm ideas, share resources and collaborate in innovations at the district, school, department or subject level.

Learning in the home or community by means of ICT is another integral and important aspect of the children's learning. There can be vigorous debates between parents and schools regarding the pros and cons of using ICT, the amount of screen time

and traditional and progressive schooling. So it is also important for to schools inform the parents about the changes and the reasons for these, take account of the parents' views and enlist their support.

### Online PREST and INSET

In most countries, the provision of face-to-face PRESET and INSET is limited by a lack of time, money and qualified and experienced trainers. A lack of access to up-to-date training, ideas and resources can be de-motivating and lead to a brain drain of teachers from more remote and otherwise disadvantaged school districts. The Internet offers teachers the opportunity to benefit from continuing professional development in the theory, research and practice of ICT-based teaching and learning and whenever and wherever it is needed. And with its interactivity, it can help teachers interact and share knowledge, skills and findings. Online PRESET and INSET is less expensive than face-to-face provision and it allows all teachers, regardless of location and personal circumstances, to access the same quality of expertise, case studies and examples of best practice. However, many teachers may prefer a blended learning approach in which they are periodically able to engage in face-to-face presentations, discussions and practice sessions in schools, teachers' centres, education offices and so on.

There are also ample opportunities for self-study. The many e-books and online journal articles from which teachers can learn more about classroom uses of ICT. A number of international organisations provide non-formal English-language online training in ICT. The ICT CFT framework<sup>1</sup>, developed by UNESCO, CISCO, COL, INTEL, ISTE and Microsoft specifies the competencies that teachers need to integrate ICT into their professional practice. More than 14 million people have taken the International Computer Driving Licence (ICDL)<sup>2</sup> in 24,000 accredited test centres in over 150 countries, including Russia<sup>3</sup>. The ICT in Education Erasmus+Course can be taken by teachers of all subjects keen to increase their proficiency in using technology in the classroom. There are also ever-increasing numbers of free online courses in ICT and digital literacy<sup>4</sup>, massive open online courses (MOOCs) in teacher education<sup>5</sup> and for those interested in more advanced formal study international online postgraduate programmes in instructional design and technology. Study by such means will also broaden teachers' understanding of what is entailed in taking greater responsibility for their learning in a digital world.

Online SchoolNets are another means of promoting the effective use of ICT in schools. They can be national, like SchoolNet South Africa<sup>6</sup>, or international, like the European SchoolNet<sup>7</sup>. The 20 year-old SchoolNet South Africa partners in providing training in ICT integration with South African universities and two world-wide teacher development programmes supported by Intel (Intel® Teach)<sup>8</sup> and Microsoft (Learning Partners)<sup>9</sup>, and collaborates with schools in research and development projects. Through the European SchoolNet, 34 European ministries of education are helping to transform learning and teaching by providing professional development for teachers and school

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<sup>1</sup> <http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/unesco-ict-competency-framework-for-teachers/what-is-the-ict-cft/>

<sup>2</sup> <https://icdl.org/about-icdl>

<sup>3</sup> [www.ecdlrussia.org](http://www.ecdlrussia.org)

<sup>4</sup> <http://www.ictliteracy.info/ICT-Training.htm>

<sup>5</sup> <https://www.mooc-list.com/tags/teacher-education>

<sup>6</sup> <https://www.schoolnet.org.za/>

<sup>7</sup> <http://www.eun.org/>

<sup>8</sup> <https://www.intel.com/content/www/us/en/education/k12/teach-elements.html>

<sup>9</sup> <https://www.microsoft.com/en-au/learning/partners.aspx>

heads, supporting collaborative initiatives and sharing evidence and data on innovative models for schooling upon which to base new policies.

### Conclusion

This paper has argued that in addition to academic knowledge and technical skills, today's learners need to develop the generic attributes and ICT skills needed for life and work in the 21<sup>st</sup> century. It has described the ways in which online and blended forms of PRESET and INSET can be used to train teachers in the new pedagogical and ICT-based methods equitably and cost-effectively. It has cautioned that schools are social systems and that a critical mass of teachers will only adopt the new teaching methods and applications of ICT when links are forged between theory and practice, the benefits are clearly demonstrated and attention is paid to the affective as well as the cognitive and skills dimensions of change. It has also shown that there is need to widen the professional knowledge base of ICT adoption in ministries of education, local education authorities, teacher educators, school heads, teachers, parents and the wider community.

ICT can bring many educational benefits. But badly managed, it can also have negative effects on children's health and development. So large-scale research involving multiple teachers or schools is needed to verify the validity of the claims made for ICT-based teaching and learning. And self-reflection, evaluation and action research into classroom practices is needed by individual teachers and groups of teachers to ensure that the promises of these new forms of teaching and learning are fulfilled, time and money are not wasted, false hopes are not raised and learning is truly made more motivating and meaningful by combining technology-based, face-to-face, self-directed and collaborative learning.

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