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Critical reflections on the benefits of ICT in education

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In both schools and homes, information and communication technologies (ICT) are widely seen as enhancing learning, this hope fuelling their rapid diffusion and adoption throughout developed societies. But they are not yet so embedded in the social practices of everyday life as to be taken for granted, with schools proving slower to change their lesson plans than they were to fit computers in the classroom. This article examines two possible explanations – first, that convincing evidence of improved learning outcomes remains surprisingly elusive, and second, the unresolved debate over whether ICT should be conceived of as supporting delivery of a traditional or a radically different vision of pedagogy based on soft skills and new digital literacies. The difficulty in establishing traditional benefits, and the uncertainty over pursuing alternative benefits, raises fundamental questions over whether society really desires a transformed, technologically-mediated relation between teacher and learner.

Keywords: *ICT; learning outcomes; digital technology; evidence base*

Challenges of ICT provision in learning environments at school and home

> ICT can improve the quality of teaching, learning and management in schools and so help raise standards. That's why ICT is at the heart of the DCSF's commitment to improving learning for all children. (ICT in Schools website, Department for Children, Schools and Families, 2010)
>
> It's our ambition to create a more exciting, rewarding and successful experience for learners of all ages and abilities enabling them to achieve their potential. (BECTA website, 2008)

There is little doubt that society's main ambition for children's use of digital technologies centres on their potential benefits for education. Information and communication technologies (ICT) bring together traditionally separated educational

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technologies—books, writing, telephone, television, photography, databases, games and more. In consequence, they bridge forms of knowledge and literacy, and they intersect places of learning—home, school, work and community. But these changes pose both opportunities and challenges to schools, for to embed ICT in the educational infrastructure, teacher training, curriculum structures and materials, classroom practices and modes of assessment must be redesigned at all levels. This article first notes the present state of ICT provision, with the focus on British schools although American and European data are reviewed where available. This sets the scene for a critical analysis of whether the results have been as beneficial as hoped for by educators and public policy.

In Britain (Becta, 2009a, b), Europe (Korte & Husing, 2006), the USA (Office of Educational Technology, 2004) and elsewhere, recent years have seen a steady embedding of digital and networked technologies in the classroom, with widespread use of interactive whiteboards, virtual learning environments, educational computer games, and increasing reliance on internet applications including email and e-learning for both classroom and independent study (Sheard & Ahmed, 2007). A pan-European 2006 survey of teachers of children in the fourth year of primary education (Eurydice, 2009, p. 207) observes that,

> In comparison with the situation in 2001 … the use of new technologies to teach reading at school has increased…. This increase is expected to speed up in subsequent years, with the growth of specialised software and on-line materials intended specifically for teaching reading in primary education.

In 2008/9, UK schools spent some £880 million (or 3.2% of overall spend) on ICT, nearly one third of this from the 'Harnessing Technology Grant' from the Government (Becta, 2009a). Digital resources of one kind or another are used by almost half of all primary pupils at least weekly (43% in English, 46% in maths and 30% in science) though by less than one in ten secondary pupils (8% English, 7% maths and 10% science; Becta, 2009b). So, with government policies in recent years to provide internet access for every children and every school, with industry supporting diverse digital education initiatives, and with families gaining internet access at home, much rides on the claim that digital technologies will be as important in the 21st century as was the book in the 19th.

However, accompanying every step of these policy developments, critics have doubted that more or better ICT means more and better education. Some are anti-technology, harking back to an ideal of 'innocent childhood'. Some question investment in technology at the expense of other areas of provision (Oppenheimer, 1997). Thus, although the once-outlandish notion of 'ICT skills as a third skill for life alongside literacy and numeracy' (Office of the e-Envoy, 2004) is becoming accepted (notably in the 2009 government review of the primary curriculum; Rose, 2009, p. 54), scoping this conceptually and evaluating it empirically remain major challenges. This paper examines these two issues, asking, first, does the evidence support the claim that ICT enhances learning and, second, what is meant by learning and how are expectations of learning changing?

Enhancing traditional learning outcomes

> The evidence seems to point to an impact on attainment where ICT is an integral part of the day-to-day learning experiences of pupils, although the weight of evidence is insufficient to draw firm conclusions. (Condie & Munro, 2007, p. 24)

> It does help you with school with subjects, depending on what the information you want, some subjects like geography and things that you can look around the world. Geography's a good example of the internet. You can do some research about other cultures and other communities …. And mostly like things like English, Maths, it's not. (Boy, 15, talking of the internet)[1]

Educational policy regarding ICT hardware and software in schools has not primarily aimed to teach children how to use technologies, valuable though such skills are (Hobbs, 2007). Rather, the ambition is that ICT use will improve educational outcomes across the curriculum, as revealed in examination grades and other standardised measures of assessment. Achieving this aim would indeed justify the considerable expenditure and transformation of infrastructure witnessed in classrooms in the past decade. Yet, despite considerable evidence that teachers, along with parents, pupils and other stakeholders *believe* ICT to improve outcomes,[2] few independent evaluations comparing educational settings with versus without an ICT intervention have been conducted, and those that exist are rather equivocal in their conclusions. An early longitudinal British study, ImpaCT2 (Harrison *et al.*, 2003), designed to evaluate the government's 'ICT in Schools Programme', reported that:

> The outcomes of the initiatives are more evident in improvements in pupils' achievements in ICT capability than in their application of this learning in other subjects. (Ofsted, 2004, p. 4)

Behind the positive press release, the researchers were rather cautious, noting that:

> In some subjects the effects were not statistically significant and they were not spread evenly across all subjects. (Harrison *et al.*, 2003, p. 1)

A few years on, a US report to Congress found that test scores in classrooms using reading and mathematics software for a year were little different from those obtained using traditional teaching methods. However, there were some indications that ICT use improved results for reading, though not mathematics, among nine-year-olds (Dynarski *et al.*, 2007). An analysis of the international PISA survey found that those who sometimes use computers or the internet at school perform better than those who never use them but that those who use them often may perform worse. The authors note:

> a positive correlation between student achievement and the availability of computers both at home and at schools. However, once we control extensively for family background and school characteristics, the relationship gets negative for home computers and insignificant for school computers. Thus, the mere availability of computers at home seems to distract students from effective learning. (Fuchs & Woessmann, 2004, p. 1)

It seems that a simple increase in ICT provision does not guarantee enhanced educational performance. In a 2007 study of learning outcomes for 12–13 year-olds in an

American middle school, improved grade point averages were only associated with subject-related technology uses—i.e. those dedicated software resources or games produced to support particular curricula elements of science, mathematics or history (Lei & Zhao, 2007). But unfortunately, these tended to be the least popular activities, seen as 'hard work' by pupils. Hence Cox and Marshall (2007, p. 63) observe that 'the contribution of ICT to students' learning was very dependent upon the type of ICT resource and the subject in which it was being used'—a far from generic or transferable effect and one that contradicts the easy assumption that because children like using technology, this in and of itself gives them the confidence and motivation that enhances learning.

Complex and qualified conclusions emerged also from a systematic meta-analysis of findings from over one thousand studies of online learning by the US Department of Education (Means *et al.*, 2009). Focusing on the few studies that rigorously contrasted learning via an online versus a face-to-face condition, the meta-analysis did find a positive benefit for online over face-to-face instruction, though the effect was larger for blended learning (modes of instruction that combine online and face-to-face). However, generally the comparisons did not control for curriculum content, aspects of pedagogy or learning time, and 'studies in which analysts judged the curriculum and instruction to be identical or almost identical in online and face-to-face conditions had smaller effects than those studies where the two conditions varied' (p. xvi). Nor did including digital or interactive elements such as videos or online quizzes add to the amount that students learned. On the other hand, digital 'manipulations that trigger learning activity or learner reflection and self-monitoring of understanding are effective' (p. xvi). Thus Means *et al.* concluded that:

> In many of the studies showing an advantage for online learning, *the online and classroom conditions differed in terms of time spent, curriculum and pedagogy*. It was the *combination* of elements in the treatment condition (which was likely to have included additional learning time and materials as well as additional opportunities for collaboration) that produced the observed learning advantages. (p. xvii, italics in the original)

However, most of these studies concerned adults (e.g. from medical training or higher education programmes), and 'when learners' age groups are considered separately, the mean effect size is significantly positive for undergraduate and older learners but not for K-12 students' (p. xvii), thus revealing little benefit for school pupils.

Equivocal findings such as these led a pan-European literature review to conclude that ICT impacts positively on educational performance in primary schools, particularly in English and less so in science and not in mathematics (Balanskat *et al.*, 2006, p. 3). As that review also showed, in OECD countries there is a positive association between the length of time of ICT use and students' performance in PISA mathematics tests. Particularly, broadband access in classrooms results in significant improvement in pupils' performance in national tests taken at age 16. A different technology, interactive whiteboards, is associated with an improvement in pupils' performance in national tests in English (particularly for low-achieving pupils and for writing), mathematics and science.

Evaluations, it seems, have thrown up apparently *ad hoc* patterns of significant and insignificant findings which defy researchers' ability to explain, although some are more optimistic in drawing conclusions than others. Underwood (2009, p. 5) states that 'despite these caveats, there is growing evidence that learning benefits arise from the use of digital technologies'; however, she cites little evidence to support this claim (mainly the Means *et al.*, 2009 report discussed above, the author's prior literature reviews and a 1999 article that predates much educational technology use). It would be overly pessimistic to conclude that ICT has no benefit for education, for some positive findings exist, especially as regards improvements in children's motivation to learn rather than their learning outcomes (Passey *et al.*, 2004). Nonetheless, it remains difficult to explain why only some learning outcomes are improved for some children using some technologies and in some subjects.

Impediments to establishing the benefits of ICT in education

> Most schools in most countries, however, are in the early phase of ICT adoption, characterised by patchy uncoordinated provision and use, some enhancement of the learning process, some development of e-learning, but no profound improvements in learning and teaching. (Balanskat *et al.*, 2006, p. 2)

> Yeah, it's IT, that's what it's called, and you go, you have about ten computers in a big computer room and you work in groups to do like stuff on the computer. They let you go on the internet but it has to be educational stuff you look up and all that. That's boring but we don't listen to that and we look up what we want when the teacher's not looking. (Angie, 9)

A long line of critical reviews echoes Wellington's (2004, p. 33) eloquent claim that there are 'inherent difficulties in evaluating the effect of any learning intervention and attributing cause-effect relationships in education. These difficulties are here to stay.' Without here rehearsing familiar limitations of the experimental method, three problems are worthy of note.

One problem with the literature is conceptual and methodological—the conflation of diverse forms of educational technology under the umbrella term 'ICT'.[3] This term can include one-to-many technologies (usually used by the teacher at the front of the classroom) and peer-to-peer technologies, professionally produced and user-generated contents. It may include technologies specific to the school (e.g. interactive whiteboards) or those used across formal/informal boundaries (e.g. edugames) and, last, it includes both stand alone and online, networked technologies. Thus it is difficult to distinguish which aspects of technologically-mediated learning, if any, are effective in any particular situation.

A second problem is policy-related and practical—the failure to recognise that, although getting technology into classrooms has been resource-intensive, this pales by comparison with the far greater demands of ensuring its effective use. Changing schools is, in short, a lengthy and demanding process and, as yet, much of the investment in hardware has yet to show a noticeable benefit in educational practices and outcomes. For example, a qualitative strand of the ImpaCT2 research, having noted

that pupils experience computers and the internet more positively at home than at school, recommended that teachers:

> need to consider how to build on their pupils' experience, developing skills and enthusiasm in relation to networked ICT … [if] they are able to achieve the necessary changes in school culture and teaching practices to reap the benefits of the Government's investment. (Somekh *et al.*, 2002)

Nonetheless, in its schools' inspections conducted between 2005 and 2008, Ofsted (2009) qualified its broadly positive portrait of 'the importance of ICT' in education by observing that primary school pupils are generally better at using ICT to communicate than to manipulate data and that 'teachers tended to give more attention to those aspects of ICT where they themselves felt confident' (p. 4), while in secondary schools, similarly pupils were better able to use ICT for presentational purposes than for spreadsheets, databases or programming. Further, 'teachers gave too much emphasis to teaching students to use particular software applications rather than helping them to acquire genuinely transferable skills' (p. 4).

After watching teachers struggle in classrooms with technology, Seiter (2008, p. 36) notes that 'the hours of trial-and-error that many digital skills require and the freedom to develop a deep understanding of software that includes programming are nearly impossible to practise in a public school computer lab.' Indeed, although one benefit of ICT is that it supposedly enables self-paced learning, it is precisely in uses of ICT to support independent study that Selwyn *et al.* (2008) find most variation in implementation across schools, suggesting that social and economic dimensions of classroom practice moderate educational benefits. Similarly, when examining the educational potential of mobile technologies, Attewell *et al.* (2009) argue that while technologies can make learning more convenient, it requires considerable input of teacher training, preparation and production of appropriate materials for such learning also to become more effective. Problematically, teacher surveys find that 'teachers mainly focus on the development of technical ICT skills' notwithstanding that 'the ICT curriculum centres on the integrated use of ICT within the learning and teaching process' (Tondeur *et al.*, 2007, p. 962). More positively, LeBaron and McDonough (2009) turn common problems into policy recommendations, listing as priorities the provision of effective and continuing leadership training for school managers, integration of ICT into all levels of teacher education, establishing communities of practice among practitioners, integrated planning at all levels from local to national, coordination of leadership and, unsurprisingly, provision of adequate resources.

A third problem is intriguing—not only schools must change but so too must the home. Visions of learning 'anywhere, anytime', schools without boundaries, peer-based learning, the home–school link and building 'whole school communities' all depend not only on state policy and provision regarding schools but also on individual decisions by parents to provide internet access for their children at home. Parental resourcing of the home has traditionally been regarded as a private matter, not subject to public policy. In the early days of ICT adoption, the home posed less of a problem than an opportunity: since children's use of domestic technologies was more flexible,

experimental, playful and enthusiastic than at school, the challenge was for teachers to build on home use within the structured context of the school (Grant, 2009). Now the opposite problem is on the agenda: since some children lack ICT access at home this impedes visions of a seamless learning environment spanning home, school and community. Most recently, it has become problematic for educational policy as well as for social equality that domestic internet access is uneven: although many parents do invest in domestic internet access, to keep their child 'ahead' or at least stop them 'falling behind', many struggle just as much as teachers with the practical difficulties of going online, often lacking the necessary financial, social or technical resources (Livingstone, 2009). Announcing a policy of financial support for the Home Access Programme (which provides a computer and a year's broadband access for the poorest fifth of UK families), then Schools Minister Jim Knight said, at the 2008 BETT conference:

> We have to find a way to make access universal, or else it's not fair. More than a million children—and their families—have no access to a computer in the home. I want a home computer to be as important as having a calculator or pencil case is …. The so-called 'digital divide' cannot be allowed to reinforce social and academic divisions. (DCSF, 2008)

The promise of the internet is that it enables most or all technologies previously said to enhance learning—information sources, educational software and edugames, collaborative learning resources, and so forth. But it is as hard to establish that home internet access raises educational attainment as it was, above, to establish that school ICTs are beneficial. In one early study, HomeNet Too, low-income, mainly ethnic minority children in the USA were provided with a home computer and internet connection, along with technical backup. 'Mere connection' improved school achievement over 16 months as a direct function of frequency of internet use (Jackson *et al.*, 2006). Specifically, this intervention found that increased internet use raised subsequent achievement in reading, though not in mathematics (rather than finding the opposite, namely that already high-achieving children get more from gaining internet access than do low-achieving children; see also Barron *et al.*, 2010). The difference between findings for reading and for mathematics, also found in the above-cited study for Congress, seems to reflect the fact that online resources often place heavy demands on reading ability. Consequently, while the internet appears to motivate (some) children to read in a manner that books do not (see also Passey & Rogers, 2004), this hardly capitalises on the intrinsic properties of this convergent, interactive, online technology.

In the UK, Chowdry *et al.* (2009) analysed the *Longitudinal study of young people in England*, which assessed the educational attainment of 15,000 teenagers at Key Stage 3 (KS3, aged 14 years) and Key Stage 4 (KS4, aged 16 years). Controlling for socio-economic status, parental education, family background, parental school characteristics and neighbourhood characteristics, they found that home access to a computer and/or the internet is positively associated with levels of educational attainment at both KS3 and KS4. Further analysis by these researchers showed that internet access plays a greater role than computer access although, as the researchers also caution,

the analysis remains correlational rather than causal (e.g. it may be that parents provide internet access for higher achieving children) (Goodman & Gregg, 2010). Furthermore, the study does not report findings by subject (mathematics, English, science), although previous findings noted earlier would suggest differences to occur here also. Nonetheless, the findings do suggest that the lesser likelihood of home access to a computer or, especially, the internet among teenagers from poorer families may contribute to the explanation of why they tend to make less progress from KS3 to KS4.

The fourth and last problem is more fundamental. Although ICT has been promoted as a means of improving basic skills of reading, writing, mathematics and science, both enhancing exam results and reducing disadvantage in traditional assessment processes, critics have rejected the lack of imagination in this agenda. They see it as wedded to a 20th, even a 19th century conception of drill-and-skill education, with scholastic aptitude testing as the only legitimate outcome measure (e.g. Smith & Curtin, 1998). The alternative proposition is that digital technologies can support a more flexible, learner-centred notion of education that facilitates the soft skills vital for the new demands of the 21st-century global service and information economy. This conception of learning capitalises on the evident enthusiasm with which children use digital technologies for exploration, creativity and fun when at home, encompassing not just ICT-mediated formal educational and information resources but also, indeed especially, the use of instant messaging, online gaming and social networking to foster constructive learning practices, peer collaboration and learner motivation.

Broadening expectations—enhancing soft skills

> [Children are] the first generations to live in an all-encompassing electronic habitat … to deal with this complex habitat, children develop forms of cognitive and attitudinal organization that enable them to interpret the world and perform it … [but] conventional school curricula and pedagogical procedures are out of step. (Smith & Curtin, 1998, p. 212)

> ICT resources, whether hardware or software, can support the creation and development of ideas if they reflect an approach to open-ended exploration in design and use. (Loveless, 2002, p. 24)

If the failure to demonstrate clear benefits of ICT use in the classroom is due less to the limited potential of ICT than to the limited (instrumental, reductionist) expectations of educationalists, this would have far-reaching consequences for teacher training, classroom management and curriculum design. A more visionary, even revolutionary agenda was visible early on in such texts as Snyder's (1998) *From Page to Screen*. Following the new social literacies approach (Street, 1984), the chapter contributors claimed that 'printed texts are by nature selective and exclusive … hypertexts on the Web are by nature inclusive' (Burbules, 1998, p. 103), that computer games harness 'the ability to process multiple streams of information simultaneously, and the propensity to experiment in free-form, ill-defined problem domains' (Johnson-Eilola, 1998, p. 191), and that technology liberates children from 'the

single, exclusive, intensive focus on written language [which] has dampened the full development of all kinds of human potentials' (Kress, 1998, p. 75).

In short, according to more radical approach than that reviewed thus far, the potential of technology is that it may liberate teachers and pupils from the rigid hierarchies which have locked them to their desks, curricula and assessment straitjacket, mobilising multiple activities as mediators of learning—not only reading and writing but also creating, designing, performing, searching and playing. Such transformations, it is hypothesised, render the role of the learner more flexible, negotiable, precisely because knowledge itself is fluid, open to interpretation. Turkle (1995) interprets this as a profound shift from a culture of calculation, where 'the modernist computational aesthetic promised to explain and unpack, to reduce and clarify' to a culture of simulation based on tinkering and experimentation, 'getting the lay of the land rather than figuring out the hierarchy of underlying structure and rules' (p. 35).

Ten years on from these visionary predictions, a burgeoning body of academic work on new digital literacies and participatory culture has been stimulated by these ideas, exploring the character and practices of the culture of simulation (e.g. Jenkins, 2006; Bekerman *et al.*, 2009). However, in the major government-funded studies that seek to evaluate educational benefits of ICT in schools, it seems that this alternative vision has made little headway in reframing or challenging the measures by which educational benefit might be evaluated, with traditional test scores or exam grades remaining the priority in terms of outcome measures (although see LeBaron & McDonough, 2009). Nonetheless, some of the ideas behind this alternative model have been variously incorporated within educational settings, albeit often in terms of ad hoc initiatives rather than general classroom practices.

For example, in scoping a refreshingly open and positive vision of children's creativity, thoughtfulness and desire to learn anywhere, anytime, Jenkins (2006, p. 4) identifies a range of soft skills that emphasise play, improvisation, experimentation, simulation, multimodal navigation and remixing, multitasking, networking, negotiation and ability to judge diverse information sources. By contrast with the skills and knowledge tested in traditional scholastic tests, this emphasises processes over outcomes, collaborative learning over individual achievement, peer-based over hierarchical teacher/pupil relations, and flexible modes of discovery over subject-specific knowledge. While these skills capitalise on both the affordances of digital networked media and the motivation and preferred learning style of many young people, if this alternative vision is to be advanced, there are significant challenges for both teaching and assessment. Many experiments, mainly small-scale, are underway to explore how this might be possible.

Nyboe and Drotner (2008) provide an illustrative case study. In this Danish animation project, school routine and teacher–pupil hierarchies were set aside to enable pupils to co-design a digital animation over a two week period, the researchers observed how pupils' decision-making, design, construction and implementation all emerged from lively and often playful peer interaction. Findings showed how learning itself is social rather than purely individual, being enabled by discussion, negotiation, imagination and conflict resolution. In this project, then, pupils both learned about

software, media production, and team working but also gained the media literacy required to analyse and critique the multiplicity of representational forms and rhetorics that surround them in daily life. In short, peer culture was harnessed to deliver learning outcomes valued by teachers, children and, most likely, future employers.

Contrasting cases also exist, however. Willett (2005) describes her observations of ten boys aged 9–13 in a Saturday morning workshop on computer game production—learning to use Photoshop and Flash animation. As she notes, it was difficult in practice to ensure all children learn in the sequenced steps that the task may require, particularly if learning to use complex professional software; similarly it is difficult to ensure that teacher support is available just when the child is ready to advance his or her understanding—'just in time learning', much mooted by radical educationalists, is not easy to provide. An observation from the *UK Children Go Online* project reported similar difficulties in an after-school computer club. In one instance, a 10-year-old girl playing a maths game had to navigate a ship around a map of Scotland by entering the direction (in degrees) and the distance (in km) for each leg of the journey. Since she did not read the instructions she missed the point about using a compass until the researcher pointed this out to her. Even so, she crashed the game repeatedly, receiving no feedback either from the game itself or from her teacher, before eventually giving up, never learning what she had done wrong (Livingstone, 2009).

It seems that the more optimistic signs in case studies such as these capitalise more successfully on the motivating, flexible and creative affordances of ICT, often combined with a willingness on the part of teachers also to engage in more flexible and creative ways with pupils. The costs are clear—the process is highly resource intensive, and the outcomes must be allowed to be open-ended. The most pessimistic signs, by contrast, tend to be associated with uses of technology to support what Cassell (2004) calls the pedagogic relation between 'an expert and a novice' (p. 19)—in other words, a stress on hierarchical, instrumental learning. Notably too, the computer workshops observed by Willett and Livingstone rely heavily on software design which, in each case, is highly problematic. As has often been argued, what matters is less the technology than how it is used.

While there are many reasons to remain optimistic about new initiatives to transform the learning process, it must be acknowledged that, first, traditional exam results and, indeed, possession of the knowledge they are designed to test, continue to be crucial for pupils' future success (and failure). Second, if one turns the same critical gaze on these initiatives as on traditional attempts to enhance test scores, just as there is a lack of convincing evidence that ICT supports traditional educational outcomes, so too is evidence scarce that ICT enable creative, alternative forms of learning. As the review by LeBaron & McDonough (2009) makes plain, evidence for ICT having benefits as part of an alternative pedagogy is scattered, based on multiple small studies rather than having been subject to substantial (national and/or longitudinal), independent evaluations as reviewed earlier for traditional learning outcomes. The problems of missing failed cases (small interventions that did not work and so go unreported), of unsystematic comparisons (not based on those who do versus do not

receive an intervention) and of confounding factors (most obviously, the considerable teacher effort and enthusiasm that often accompany such interventions) cannot be ignored.

To redress this situation, it is vital to develop a clear and shared conceptual vocabulary to analyse learning processes along with new modes of assessment, so as to permit media (or digital) literacies a place within the established curriculum, preferably without turning soft skills into a new and burdensome set of targets (see Lombardi, 2008, on 'authentic' assessment methods and Hobbs, 2007, and Burke & Hammett, 2009, on alternative methods of assessment in media literacy education). It is also vital to move beyond a situation in which 'teachers seeking to encourage hybridity of local literacy practices and school practices still remain without guidelines and administrative support' (Kim, 2003, p. 19). Third and perhaps most important, it is vital that society decides how radical to be in aiming merely to improve or wholly to redesign the power relation between teachers and pupils, classroom and home (c.f. Facer, this issue).

Conclusion

> There clearly exists a tension between teachers' desire to foster learners' creativity while at the same time striving for high attainment and effective class management. (European Commission, 2009, p. 24)

> Schooling in the digital age is a complex, compromised and often contradictory affair [… but] this is not to say technology cannot act as a focus for improvement. (Selwyn, 2011, p. 136)

We are, it seems, at a particular juncture in the introduction of ICTs into education and, therefore, at a particular juncture in the research enterprise designed to guide and evaluate this process. Notwithstanding the apparently unlimited capacity of ICTs, especially the internet, in terms of information and educational potential, it is far from proven that greater pedagogic benefits result. Livingstone (in press) distinguishes three forms of critique relevant to grand claims made for the new technologies, asking in essence, what's really going on, how can this be explained, and how could things be otherwise?

The first, 'analytic critique', demands a sceptical analysis of any and all claims, especially when they concern the supposed transformation of society—in this context, the transformation of education, knowledge, childhood. Standing back and asking 'what's really going on?' prioritises the critical examination of influential claims, the careful checking of claims against rigorous evidence, and the impartial identification of mistakes, qualifications or biases. Thus this paper has argued that, in brief, the jury is still out as regards evidence that ICT supports learning. The best that could be said for the role of ICT in the traditional classroom is that, even if ICT is unimaginatively used only to further traditional outcomes, and even if it produces only moderate improvements in basic literacy and science, while also enhancing pupil motivation and compensating for some forms of disadvantage, this would still be a valid enterprise. There is some merit to this position. ICT, especially the internet, can enable

the widespread sharing of valuable resources in both traditional and interactive forms, affording the means of collaborative learning distributed over time and place as needed. If used well, it is also popular with children, thus motivating their learning (Passey *et al*., 2004). There are also signs, tentative as yet, that some uses, under some conditions, are associated with improved test scores measuring standard educational outcomes.

Why can researchers not produce stronger evidence in favour of alternative, more creative pedagogic uses of ICT in response to imaginative developments in both academia and policy circles? Obvious difficulties inhere in the lack of clarity over different types of ICT and, more importantly, in how they may mediate or scaffold different stages in the learning process. Another is the expense of the kinds of longitudinal studies required to show benefit over time: Cox and Marshall (2007) observe that, 'to date we have had no large scale longitudinal studies of ICT's impact such as we have in the form of studies of major curriculum development projects' (p. 64). Yet another difficulty is that 'soft skills have yet to be adequately defined and their importance, relative to formal qualifications, for different groups of people and at different stages in the life cycle is unknown' (Sparkes, 1999, p. 7). As a result, it is particularly difficult to assess the contribution they make to educational outcomes, whether conceived in a traditional or a new way. Furthermore, blunt comparisons of classrooms with or without ICT rest on the false premise that only the technology has changed while all else—pupil attitudes, teacher training, societal expectations—is held constant. Instead, it is the case that the evolution of ICTs has been accompanied by, indeed, shaped by changing expectations regarding learning among teachers, pupils and society at large.

This brings us to 'explanatory critique', asking about competing theories and alternative explanations. In relation to the new technologies, too often the debate has become polarised between those who ask, what is technology doing to society and how does it impact on people's lives, and those who ask, instead, why has technology been shaped in a particular way and to serve which interests? In other words, the debate between social versus technological determinisms persists (Selwyn, 2011). Additionally, the longstanding debate over pedagogy—how children learn and how and what they should be taught—is revitalised for the digital age, with a fundamental lack of clarity over purposes undermining many well-meaning initiatives. The confusion is partly over the nature of media technologies. Are these simply *learning tools*, in which case the task is to train children in their use and to evaluate the benefits for a range of learning outcomes? Or do they herald a more fundamental transformation in *learning infrastructure*, in which case the task is to rethink the relations between pedagogy and society, teacher and pupil, knowledge and participation. While the latter sounds exciting in theory, in practice, as Nixon (2003) observes with some frustration, 'literacy educators and researchers have, by and large, judged such research about participation in the new media and online cultures to be of little relevance' (p. 408).

So, should one expect ICTs to enhance the efficient delivery of a pre-defined curriculum by authoritative teachers evaluated by standardised assessment? Or should one hope they will enable alternative, student-centred, peer-based, variable

and creative forms of knowing? It's easy to say 'both', but each pushes teachers and pupils in the opposite direction so marrying them up is implausible. Moreover, while the former has long alienated pupils, as Beastall (2006, p. 97) observes of the latter, 'in attempting to enchant the pupils, the government may have alienated the teachers'. Cartwright and Hammond (2007, pp. 402–403) concur, noting that for teachers in Australia, 'government guidance was seen as both a causal condition for ICT and an imposition', resulting in a situation where teachers 'seemed to be acting individually and collaboratively to "fit ICT in" as best they could to suit variables such as their own practice, the needs of the children and the expectations of various "stakeholders"'.

Third, ideology critique: if ICTs are shaped by the society that produced them, arguably one should take a step further and 'situate technology within the underlying unequal power relationships that exist in society' (Warschauer, 2003, p. 209). This goes beyond the identification and explanation of change to ask whether such changes are or could be democratic and empowering or, on the contrary, whether they reinforce and extend the interests of established forms of commercial and state power. The crucial question is, in whose interests are these changes? For Jenkins (2006), digital media are indeed empowering and democratising, and he celebrates their challenge to teachers, traditional forms of knowledge and the school as an institution. For Buckingham *et al.* (2001), however, digital media extend the reach of educational institutions into the home, 'curricularising' leisure and expanding the profitable marketplace of 'edutainment' and informal learning products and services.

As for the evidence, it does seem that we are witnessing the reconfiguration of pre-existing learning activities and opportunities for the majority of children and young people. Where once children went to the library to get a book for their homework, now they also search online. Where once they asked for advice from a parent, now they also 'ask an expert'. Where once they painted with paint and paper, now they do so also with a paint programme, posting their pictures online to share with others. By and large, they welcome this and relish their new-found expertise and status in the digital world. It also seems that we are witnessing some genuinely new learning opportunities, centring on possibilities of child-oriented digital creativity and on collaborative communication with those who share similarly specialist or niche forms of interest and expertise. At present, this is only evident among a minority of young people—for new opportunities, especially if they rely on out of school resources, generate new inequalities. Only publicly funded institutions—schools especially but also youth and community centres—can work to make this fairer. Yet it is the successful embedding of these and related opportunities within the formal structures of the school and the traditional curriculum, for the benefit of all children, that remains uncertain.

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Notes

1. Quotes from the *UK children go online* project (Livingstone, 2009).
2. For example, Becta's *Raising standards* booklet quotes as 'facts and figures' that '95% of teachers believe that the use of technology is raising standards in schools and colleges' (January 2010).
3. For example, a recent survey of European teachers' views on teaching creativity lists computers, educational software, videos, online collaborative tools, virtual learning environments, interactive whiteboards, online free material, online courses, music/photo/video content, blogs, social networking sites, podcasts, bookmarking and tagging, RSS feeds, digital games and mobile phones (European Commission, 2009).

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