

Techknow**ledge**

FOR SCHOOLS

**UPDATED REVIEW OF THE
GLOBAL USE OF MOBILE
TECHNOLOGY IN EDUCATION**

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Introduction

Techknowledge for Schools (formerly Tablets for Schools) is an educational charity that supports schools and educators to transform learning through technology. Research lies at its heart, and in partnership with independent research agency Family Kids & Youth (FK&Y) the charity has built the largest body of research in the world looking at mobile learning in UK schools. Since 2011 FK&Y has carried out over 12,000 online interviews with students, 500 online interviews with teachers, over 700 online interviews with teacher leaders, over 60 focus groups and in-depth interviews with students, teachers and parents, 20 case studies and 60 hours of ethnographic observations. Techknowledge for Schools shares its research on its website to help schools make informed choices and transform teaching and learning.

In addition to carrying out research in schools that are using mobile technology in the UK, FK&Y has been closely following the global adoption of mobile technology for learning. On behalf of Techknowledge for Schools, FK&Y has written 3 literature reviews, evaluating the way in which technology is used in education and in schools globally, the latest of which was published in 2014.¹ This report updates the 2014 review. In addition to summarising the most recent research into the effectiveness of mobile technology in education, this updated report monitors the development of mobile technology adoption globally and the debates which surround these developments.

¹ Clarke, B. and Svanaes, S. 2014: *An Updated Literature Review on the Use of Tablets in Education*. London: Techknowledge for Schools.

Management Summary

Young People's Use of Digital Technology

- The use of mobile technology by children and young people has become increasingly prevalent and many schools seek to acknowledge this by integrating technology into teaching and learning. Frequently this is with the aim of equipping young people with the skills for living and working in a digital age.
- Organisations such as Go.On UK, as well as the House of Lords Digital Skills committee, have recently argued that the education system should do more to support the development of such skills.
- There are concerns however that digital technology may have a detrimental effect on young people's education. In 2015 the UK government announced it was undertaking a review of the potential for mobile technology in the classroom to be a distraction, how this might impact learning and what support teachers need to manage it.
- Research by the LSE in 2015 has argued that banning the use of mobile phones in school may have a positive impact on students' performance.

A Lack of Evidence of the Impact of Mobile Technology in Education

- Academic research is continually attempting to assess accurately the impact of mobile technology on teaching and learning. Despite these efforts there is still some concern that there is little evidence of a direct impact on learning from technology.
- Some researchers, such as Michael Fullan², have argued that the lack of evidence is partly caused by research rarely taking the context in which technology is used into account. It is argued that research should view technology as a tool to deliver a certain pedagogy or learning strategy, and assess its strengths and weaknesses in delivering new ways of teaching and learning.
- Other researchers (including FK&Y) have already begun to look at this. Flipped learning in particular is a learning strategy which is currently receiving attention and several research studies assessing the impact of this approach are currently underway³.
- However despite such concerns, recent published papers in peer-reviewed journals indicate that there is a growing evidence base illustrating that technology has a beneficial effect on education.

Additional research needed

- A report by the OECD (15.09.15)⁴, arguing that there is very little evidence of technology having a positive impact, has received attention in the media. The report and the coverage it received was met with some criticism however by both academics and school leaders.

² Fullan, M. and Donnelly, K. 2013: *Alive in the Swamp: Assessing Digital Innovations in Education*. London: Nesta

³ See <http://techknowledge.org.uk/research/research-reports/transforming-learning/>

⁴ <http://www.oecd.org/education/new-approach-needed-to-deliver-on-technologys-potential-in-schools.htm>
Accessed 10.11.15

- Professor Mark Brown, director of the National Institute for Digital Learning at Dublin City University points out that the PISA tests, from which the OECD report draws its attainment evidence, have long been criticised by academics and school leaders for their narrow scope.⁵
- Similarly Dr Monica Bulger of the Oxford Internet Institute has argued that the methodology behind the OECD report is flawed, particularly the way it measures technology use.⁶
- Dr Bulger concludes that any assessment of educational technology must use multiple methods to capture the ways in which technology is used in school and importantly should involve children in the process of evaluating their performance.

Global Mobile Technology Use in Education

- Several countries have introduced large scale mobile technology deployment schemes in recent years, often as part of an initiative to make education more up to date and relevant to the 21st century.
- Countries where large scale deployment is currently underway include Malaysia, India, Lebanon, Finland, the Netherlands, France, Northern Ireland, Scotland, Jamaica and Columbia.
- Large scale deployment is not without its challenges however and in many countries, including the US, Turkey, Thailand and South Africa, such schemes have been delayed or even abandoned.
- Reasons for this include excessive breakages, a lack of Wi-Fi and technical infrastructure, a lack of appropriate educational content, concerns for student wellbeing, and cost.
- The evidence from countries where schemes have been unsuccessful indicate that research was not used effectively to establish the parameters for successful adoption of technology in schools.

⁵ <http://www.irishtimes.com/news/education/we-must-avoid-moral-panic-over-technology-in-schools-expert-says-1.2353063> Accessed 10.11.15

⁶ <http://blogs.lse.ac.uk/parenting4digitalfuture/2015/11/11/is-using-technology-for-learning-a-good-idea/> Accessed 19.11.15

1. Children and young people's use of mobile technology

Children and young people's use of mobile technology continues to grow and it encompasses a greater variety of tasks, from learning, to socialising, to entertainment. The use of mobile technology is beginning at an increasingly younger age. Research carried out by the University of Sheffield (2015) has found that a third (31%) of children under five own their own tablet.⁷ Ownership remains high even amongst the youngest children; the research finds that a quarter of children under three have a device of their own. Due to the intuitive nature of touch screen devices, many children are using their tablets independently and more than a third (35%) of parents of pre-schoolers say their child plays with the tablet on their own. Based on these findings, the researchers at Sheffield argue that more support for parents is needed and they therefore recommend family digital literacy programmes in Early Years settings and in schools.

The UK communications regulator Ofcom's '2015 Children and Parents: Media Use and Attitudes'⁸ report finds that 75% of children aged 5-15 use a tablet, up from 64% in 2014. The growth in use is greatest among 5-7 year olds, 69% of whom now use a tablet compared to 54% in 2014. Four in ten (40%) children aged 5-15 own their own tablet and among children aged 5-11 tablets are the most commonly used device to go online. The Ofcom report suggests that despite children's increasing use of online resources for entertainment, socialising and learning, more can be done to support the development of their critical understanding of information found online. According to the report, one in five (19%) 12-15 year olds believe results featured by a search engine are 'always true', while a similar proportion (22%) do not consider the veracity of results at all. One in five (18%) 8-11 year olds believe information on websites used for homework is 'always true'.

2. The need for digital skills

Over the last few years it has been argued by several experts,⁹ including Martha Lane Fox, that more should be done to support young people's development of digital skills. This in part led to the introduction of coding to the school curriculum in September 2014. Some argue however that more can be done to promote these skills and that they should encompass more than the ability to write code. 'Make or Break: The UK's Digital Future'¹⁰, a report published in 2015 by the House of Lords' Digital Skills Committee warned that the UK would soon be facing a significant digital skills shortage and is currently unprepared for the impact technology will have on the labour market. The review, which included Techknowledge for Schools' research, urged the government to address the digital

⁷ Marsh, J., Plowman, L., Yamada-Rice, D., Bishop, J.C., Lahmar, J., Scott, F., Davenport, A., Davis, S., French, K., Piras, M., Thornhill, S., Robinson, P. and Winter, P. 2015: Exploring Play and Creativity in Pre-Schoolers' Use of Apps: Final Project Report. <http://techandplay.org/tap-media-pack.pdf> Accessed 2.12.15

⁸ http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/children-parents-nov-15/childrens_parents_nov2015.pdf Accessed 20.11.15

⁹ See also <http://news.sky.com/story/1220071/computer-coding-skills-for-children-crucial>; Nesta http://www.nesta.org.uk/sites/default/files/next_gen_wv.pdf and <https://www.gov.uk/government/speeches/michael-gove-speaks-about-computing-and-education-technology> Accessed 2.12.15

¹⁰ <http://www.publications.parliament.uk/pa/ld201415/ldselect/lddigital/111/111.pdf> Accessed 10.11.15

divide and make digital literacy a core subject at school. It further argued that young people must be taught the necessary skills for the future, including an understanding of computer science and cybersecurity, but also skills associated with creativity and innovation.

Go.On UK, a charity which promotes digital skills, has similarly warned that in the UK over 12 million people and a million small businesses lack the skills needed to prosper in the digital era.¹¹ As part of its research the charity found that digital skills varied across the country and that women are slightly less likely to have necessary digital skills. Lack of digital skills was found to be linked to lower socio-economic status and the absence of digital infrastructure, especially in rural and coastal areas. The charity has argued that digital skills will be crucial to future employment and that more must be done to address gaps in this essential skills base.

3. Digital technology and changes to education

In a 2012 report for the innovation charity Nesta, Luckin et.al suggested that despite significant investment, educational technology is yet to have a proven impact on learning.¹² It is argued that the lack of evidence is partly due to research too often looking at educational technology, rather than viewing it in the context of pedagogy and learning design. Luckin and colleagues state that innovation in education has failed in two regards; it has 'put technology above teaching and excitement above evidence.'¹³ The Nesta report points out that there is evidence to suggest that technology can have an impact as a tool for certain learning styles, for example learning from experts, collaborative learning, learning through inquiry and learning through making, and that more research should be directed towards assessing these. Techknowledge for Schools recently published research (December 2015) has looked at the connection between use of mobile devices in schools and skills deemed necessary for future employment¹⁴.

Michael Fullan has written extensively on educational reform and what role technology can play in this. Fullan and Kathryn Donnelly, in another report for Nesta¹⁵, argue that despite increasing investment in educational technology and a strong growth in the ICT industry, there is still limited research showing evidence that technology has a positive impact on learning. It is further argued that impact is dependent not only on the advancements in technology but also advancements in pedagogy and in our understanding of how to implement change. Fullan and Donnelly suggest that in order for innovative technology to truly transform learning, initiatives must 'combine how we learn with how to ensure engagement, with how to make change easier'.¹⁶ Educational technology, they suggest, has so far been used merely as an added element to traditional ways of learning, rather than being allowed to transform the overall system of learning. While technology continues

¹¹ <http://www.bbc.co.uk/news/technology-34570344> Accessed 10.11.15

¹² Luckin, R., Bligh, B., Manches, A., Ainsworth, S., Crook, C., Noss, R., 2012: *Decoding Learning*. London: Nesta

¹³ Ibid, page 63.

¹⁴ See <http://techknowledge.org.uk/research/research-reports/future-skills/> and <http://techknowledge.org.uk/research/research-reports/transforming-learning/>

¹⁵ Fullan, M. and Donnelly, K. 2013: *Alive in the Swamp: Assessing Digital Innovations in Education*. London: Nesta

¹⁶ Ibid, page 9.

to evolve and offers many benefits to education, these will only happen if pedagogy and our understanding of how to implement change similarly develops. Fullan and Donnelly list four criteria which new learning systems must fulfil in order to have a positive impact on education:

- Irresistibly engaging for students and teachers.
- Elegantly easy to adapt and use.
- Ubiquitous access to technology 24/7.
- Steeped in real life problem solving.

In another report Fullan, along with Maria Langworthy, argue that what they perceive to be ‘new pedagogies’ are models of teaching and learning that are both enabled and accelerated by digital technology and resources, and that take place in environments that support ‘deep learning’.¹⁷ Fullan and Langworthy define ‘deep learning’ as that which ‘develops the learning, creating and “doing” dispositions that young people need to thrive now and in their futures’¹⁸ and which is often situated in real-life problem solving. These pedagogies, they suggest, should require students not only to acquire knowledge but also to connect the knowledge to real world problems, using digital technology to make this connection between school and the wider world. According to the authors:

It is through this final step of ‘doing’ things with knowledge that students gain the experience, self-confidence, perseverance and proactive disposition they need to create value in our knowledge-based, technology-driven societies.¹⁹

4. The impact of mobile technology in education

4.1 Can technology have a beneficial effect on education?

Despite concern about an apparent lack of evidence of the impact of mobile technology on educational attainment, recent published papers in peer-reviewed journals indicate that there is a growing evidence base that illustrates that technology has a beneficial effect on education.

A recent literature review of 23 academic papers has argued that there is early evidence of a positive educational impact from using mobile technology. Haßler et.al.²⁰ found that 16 out of the 23 papers they reviewed reported positive student outcomes, while five reported no difference and two reported negative outcomes. It should be noted that these findings are not necessarily based on controlled assessment studies, but rather self-reported benefits or teacher perception of benefits. The authors argue that the inclusion of multiple features in one device (e.g. integrated camera and sound recording applications), touch screen functionality, easy customisation and portability are some of the characteristics that make tablets particularly useful in education. The authors point out however that positive outcomes are dependent on other variables including a supportive school culture that promotes teacher empowerment, a strong technical team and sound change

¹⁷ Fullan, M. & Langworthy, M. 2014: *A Rich Seam: How New Pedagogies Find Deep Learning*, London: Pearson.

¹⁸ Ibid, page i.

¹⁹ Ibid, page ii.

²⁰ Haßler, B., Major, L., Hennessy, S. In Press: “Tablet use in schools: A critical review of the evidence for learning outcomes.” *Journal of Computer Assisted Learning*.

management principles underpinning the process. It is further found that one-to-one mobile devices can have a particularly positive impact on communication and collaboration within the school.

A small qualitative study carried out in Belgium (2014) looked specifically at teacher responses to the implementation of mobile technology and how these affected the impact of technology use in the classroom.²¹ Montrieux et.al found that teachers in their study could be split into two categories. The first group contained *instrumental teachers* who believe tablets can offer instrumental benefits to learning (for example by relieving teachers of the need to print or to book computer suites) but that tablets do not change their role as a teacher in any way. The second group contains *innovative teachers* who believe tablets can offer innovative changes by allowing them to deliver content in a different way. Innovative teachers believe mobile technology changes their role as a teacher by allowing them to act as a coach or a facilitator and to have different relationships with their students, aided by the personal learning device. Deeper changes to learning from the implementation of mobile technology is in other words dependent on this second group of teachers, while the first group is likely to produce more superficial changes. It is further argued that in order to facilitate deeper changes to teaching and learning, schools must offer continuous training on didactic methods that allow teachers to make the most of mobile technology. According to Montrieux et.al, an important challenge for school leaders is to engage those teachers who only see instrumental benefits, but who do not wish to have any further training, either due to time constraints or a lack of enthusiasm or confidence. Innovative teachers, according to the authors, should be promoted within the school. In addition focus should be directed towards encouraging more teachers to make deeper changes to their learning strategies around which they design lessons.

An article in the Telegraph (24.11.15) also points out that teachers in the UK are likely to require extensive support in order to make changes to their teaching. According to a survey carried out with 500 teachers in the UK, nearly half rarely use technology in the classroom, citing a lack of training and confidence as holding them back.²² Over a third of teachers say they are unsure of how to integrate technology into their teaching, and it therefore often goes unused.

4.2 Can technology have a detrimental effect on education?

In contrast, other recent research studies have argued that technology holds the potential to have a detrimental effect on education, for example by being a source of distraction. Other reports have highlighted the lack of evidence of educational technology improving attainment, questioning the return on investment.

²¹ Montrieux, H., Vanderlinde, R., Courtois, C., Schellens, T., De Marez, L. 2014: "A qualitative study about the implementation of tablet computers in secondary education: The role of teachers in this process", *Procedia: Social and Behavioural Sciences*, Vol 112.

²² http://www.telegraph.co.uk/education/educationnews/12013650/Classroom-technology-barely-used-by-half-of-teachers.html?utm_content=buffer5eac2&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

In particular a report by the OECD (15.09.15)²³, arguing that there is very little evidence of technology having a positive impact, has received attention in the media. The OECD report suggests that computer use in schools has not led to improvements in attainment levels but in some cases has rather been associated with a negative impact on academic performance. However the OECD also stated that the report's findings should not be used as an excuse not to use technology, but rather as a prompt to find more effective ways of integrating and using it in the classroom.

The report and the coverage it received was met with some criticism by both academics and school leaders. Professor Mark Brown, director of the National Institute for Digital Learning at Dublin City University argued that the PISA tests, from which the OECD report draws its attainment evidence, have long been criticised by academics and school leaders for their narrow scope.²⁴ In 2014, 80 academics worldwide wrote an open letter to the OECD asking for the PISA tests to be replaced because they were seen to distort educational outcomes. Professor Brown argues that it is time to critically evaluate what role schools should play in the 21st century and whether tests such as PISA evaluate this sufficiently. Dr Monica Bulger of the Oxford Internet Institute has similarly argued that the methodology behind the OECD report is flawed, particularly the way it measures technology use.²⁵ As she explains, ICT use was self-reported by school leaders and this data was then weighted to be proportionate to the number of 15 year olds in the school. ICT use in schools was defined by 'frequency of browsing the internet for school', with analysis defining 'once a week or more' as high frequency use. Dr Bulger argues that this is not an accurate way to measure ICT use and impact:

Thus, the measure of educational technology use is constructed from principal reports of whether internet browsing occurs once a week in their school, and is then applied to all students within that school, regardless of their actual experience, yet analysed against individual student performance on the PISA tests.²⁶

Dr Bulger concludes that any assessment of educational technology must use multiple methods to capture the ways in which technology is used in school and importantly should involve children in the process of evaluating their performance.

Other research studies have also focused on whether mobile technology can have a detrimental effect on education by being a source of distraction. A report by Beland and Murphy (2015),²⁷ published by the London School of Economics, has argued that a ban on mobile phones in schools can positively impact exam results. The authors acknowledge that mobile technology can offer significant benefits, but claim that mobile phones are often also a source of distraction for young people and that this can reduce productivity. As part of the research, schools in four British cities were monitored; results found that exam results increased by 6% in those schools that had introduced bans on mobile phones. Low achieving and low-income students were found to benefit the most.

²³ <http://www.oecd.org/education/new-approach-needed-to-deliver-on-technologys-potential-in-schools.htm>
Accessed 10.11.15

²⁴ <http://www.irishtimes.com/news/education/we-must-avoid-moral-panic-over-technology-in-schools-expert-says-1.2353063> Accessed 10.11.15

²⁵ <http://blogs.lse.ac.uk/parenting4digitalfuture/2015/11/11/is-using-technology-for-learning-a-good-idea/>
Accessed 19.11.15

²⁶ Ibid.

²⁷ Beland, L. and Murphy, R. 2015: *Technology, Distraction & Student Performance*. Department of Economics Working Paper Series

The possible link between students from low-income families and the additional potential for distraction from using mobile devices is one that is being examined further. In 2015 the UK government announced²⁸ a review of poor pupil behaviour and the possible impact of mobile devices in education. Government advisor and former teacher, Tom Bennett, is leading the review which will examine whether there is a link between mobile devices, distraction and disruptive behaviour. The review will also explore what additional training teachers may need to effectively deal with low level behavioural challenges in the classroom. The Department for Education has stated that if used effectively, technology can enhance students' educational experience, but teachers may need more training in order to facilitate this effectively.²⁹ For the last year Techknowledge for Schools 'Transforming Learning' research³⁰ has also argued that teacher support and training in using mobile devices effectively in teaching is essential.

4.3 The impact of learning strategies such as flipped learning

Educational researchers are attempting to determine the effect of active forms of learning which often make extensive use of digital technology, such as flipped learning, comparing these with traditional styles of teaching that rely heavily on lecturing. In flipped learning, what was traditionally classroom content (teacher-led instruction) is replaced with what was typically homework (assigned activities to complete). This approach aims to foster ownership over learning and to offer students the ability to work at their own pace.

Flipped learning is considered to be part of what has become known as 'active learning', during which students engage in activities, as opposed to attending lectures.³¹ A meta-analysis of 225 studies carried out by Freeman et.al at the University of Washington (2014) found that active forms of learning at university undergraduate level improved test scores by around 6% compared with traditional lecturing.³² The effect was found to be greater with smaller class sizes (≤ 50). To assess the impact of flipped learning in particular, Dorian Canelas, a professor at Duke University,³³ is delivering both a flipped and a traditional section of a chemistry course in order to compare impact. Effects will be measured not only by students' test scores but also by students' perceptions of what other skills they are developing from being more active in the classroom. Results are yet to be published.

Meanwhile the innovation charity Nesta has announced that it is working with 12 schools in England and Scotland to assess the impact of flipped learning.³⁴ The research is part of the charity's Digital Education Programme, which supports projects exploring innovation in education and ways to encourage young people to use digital technology in creative and innovative ways. The flipped learning project will focus specifically on the impact of this style of teaching in lower secondary

²⁸ <https://www.gov.uk/government/news/impact-of-smartphones-on-behaviour-in-lessons-to-be-reviewed>

²⁹ <http://www.theguardian.com/education/2015/sep/13/mobile-phone-impact-school-lessons-scrutiny>

³⁰ <http://techknowledge.org.uk/research/research-reports/transforming-learning/>

³¹ <http://www.crlt.umich.edu/tstrategies/tsal> Accessed 23.11.15

³² Freeman, S., Eddy, S.L., McDonough, M., Smith, M.K., Okorafor, N., Jordt, H., Wenderoth, M.P. 2014. "Active learning increases student performance in science, engineering, and mathematics." *Proceedings of the National Academy of Sciences of the United States of America*. Vol. 111, no. 23.

³³ <https://campustechnology.com/Articles/2015/04/15/Where-Flipped-Learning-Research-Is-Going.aspx?Page=1>

³⁴ <http://www.nesta.org.uk/project/digital-education/flipped-learning>

maths. Teachers taking part in the project will work with Nesta to create resources linked to the curriculum based on the Khan Academy³⁵. Fieldwork is currently being carried out (autumn 2015).

A review of 28 articles on flipped learning by O’Flaherty and Phillips (2015)³⁶ has similarly investigated what effect this style of learning may have on performance and student satisfaction. According to the authors, there is evidence that flipped lessons have higher student satisfaction rates compared with traditional lessons. The review also finds some indirect evidence of improvements in student performance, but importantly these are only short term effects and more controlled research studies are needed to determine the effect on attainment. It is suggested that flipped learning has the capacity to support lifelong learning and 21st century skills, but that there is currently insufficient evidence to prove this. The review also argues that there is a need for more teacher training; in many schools there is a misunderstanding of the relationship between pre-tasks and lesson time and how to design flipped learning.

4.4 Predictions for the future of ICT

A report produced in 2015 by the New Media Consortium (NMC), the Norwegian Centre for ICT in Education, The Swedish National Agency for Education (Skolverket), and the National Agency for IT and Learning in Denmark (Styrelsen for It og L ring) has made predictions for the future of ICT in Scandinavia.³⁷ The predictions are compared with predictions made by NMC for ICT use in the US and in Europe in 2014. The predictions were the result of roundtable discussions by groups of educational experts in each of the three regions.

The report outlines the pedagogical trends, new technology trends and the challenges that are expected to shape education in Scandinavia, Europe and the US. Pedagogy and technology trends are further categorised as fast trends, mid-range trends and long-term trends. The Scandinavian panel identified Bring Your Own Device (BYOD), cloud computing, flipped classrooms and games and gamification as digital strategies and technologies which will be in mainstream use in classrooms in the next year. The table below outlines the technology trends predicted to be prevalent in the US, Scandinavia and Europe.

³⁵ The education website which features free video tutorials and lectures <https://www.khanacademy.org/>

³⁶ O’Flaherty, J. and Phillips, C. 2015: “The use of flipped classrooms in higher education: A scoping review.” *Internet and Higher Education*, 25.

³⁷ Johnson, L., Adams Becker, S., and Hall, C. 2015: *2015 NMC Technology Outlook for Scandinavian Schools: A Horizon Project Regional Report*. Austin, Texas: The New Media Consortium.

Table 1: NMC Horizon technology trends predictions

NMC Horizon Report 2014 US Edition	2015 Technology Outlook for Scandinavian Schools	NMC Horizon Report 2014 European Schools Edition
Time-to-Adoption: One Year or Less		
Bring Your Own Device Cloud Computing Mobile Apps Tablet Computing	Bring Your Own Device Cloud Computing Flipped Classroom Games and Gamification	Cloud Computing Flipped Classroom Mobile Apps Tablet Computing
Time-to-Adoption Horizon: Two to Three Years		
3D Printing Games and Gamification Learning Analytics Makerspaces	Learning Analytics Makerspaces Open Content Social Networks	Games and Gamification Learning Analytics Massive Open Online Courses Mobile Learning
Time-to-Adoption Horizon: Four to Five Years		
Flexible Displays The Internet of Things Virtual and Remote Laboratories Wearable Technology	The Internet of Things Robotics and Programming Speech-to-Speech Translation Wearable Technology	Personal Learning Environments Virtual Assistants Virtual and Remote Laboratories Visual Data Analysis

In terms of pedagogical development, a radical rethinking of the role of the teacher and the expansion of digital learning assessments are predicted. The report also identifies what are seen to be the most important challenges facing innovative use of ICT in education. Integrating technology in teacher education and facilitating personalised learning are identified as inherent, but solvable, challenges. More difficult challenges identified include how to protect student data, how to implement experiences from other sectors of society (for example business and industry), and how to shift to deeper learning strategies. The more problematic challenges are thought to be centred on how to encourage students to be co-designers of learning, creating systemic policies for better learning and keeping formal education relevant to young people.

5. The global use of mobile technology in education

Many schemes have been introduced across the world which integrate mobile technology into teaching and learning, some more successful than others.

5.1 Global schemes that have been implemented

Asia

In 2012 the Malaysian government launched a programme that aimed to bridge the gap between rural and urban education.³⁸ The '1Bestarinet School in Cloud' programme is a 4G virtual learning platform which uses internet resources as well as participating teacher input to provide students with learning material. The goal of the programme is to connect over 10,000 schools and 5.5 million students across the country. The programme is in place already for some schools but is scheduled to be rolled out further and to be improved over a 15-year period. It is executed by Xchanging Malaysia, a joint venture of Malaysia's YTL Corporation and the UK-based business solutions company Xchanging PLC.

Xchanging is hoping to replicate the Malaysian government's programme in India and is due to begin a pilot in India by the end of 2015.³⁹ In 2011 India introduced the low-cost Aakash tablets with the aim to provide access to information and communication to school children around the country.⁴⁰ The project however experienced technical problems and in 2014 the government re-launched the programme with the Aakash 4. The tablets were originally introduced at the cost of £25 per device, but the cost was later dropped to £14. The tablets were part of an objective to introduce low-cost ICT to educational institutions, linking 25,000 colleges and 400 universities through e-learning. Currently (December 2015), the colleges and universities were reportedly yet to receive their devices.⁴¹

In Kazakhstan, the government announced in 2010 an eLearning programme designed to make the country's education system the most technologically advanced in the region. The programme was to improve broadband connectivity and implement computer hardware, multimedia content, interactive whiteboards and teacher training in all schools across the country. By 2015 however the programme had only been fully implemented in 16% of schools.⁴²

Africa and the Middle East

The African remote learning company Eneza Education introduced a mobile phone teaching system in Kenya in 2011 which texts questions to students.⁴³ Currently serving 500,000 users in Kenya, of

³⁸ <http://www.thehindubusinessline.com/news/education/how-cloud-helps-malaysia-bridge-ruralurban-education-divide/article7785081.ece> Accessed 17.11.15

³⁹ Ibid.

⁴⁰ <http://www.theguardian.com/technology/2013/dec/20/indian-government-to-release-cheapest-tablet-2014> Accessed 17.11.15

⁴¹ <http://www.dnaindia.com/india/report-a-year-on-aakash-project-still-on-ground-2057363> Accessed 17.11.15

⁴² http://www.oecd.org/edu/school/OECD%20School%20Resources%20Review_Kazakhstan_FINAL_CRC_with%20cover.pdf Accessed 17.11.15

⁴³ <http://www.bbc.co.uk/news/business-34699190> Accessed 17.11.15

which 70,000 are active on a monthly basis, the aim is to eventually reach 50 million students in Africa. The courses target 10-18 year olds but can also cater to school drop-outs up to the age of 25. Aligned with the national curriculum, the subjects covered include maths, science, Kiswahili and English. Eneza Education chose text messages as opposed to online resources due to areas of rural Kenya lacking data networks and broadband and many young people being unable to afford internet enabled devices.

In Lebanon the Open Your Tomorrow programme⁴⁴ aims to give tablets to all students between the ages of 6 and 18. The tablets will be offered to students at a heavily subsidised price for use at school and at home. The Lebanese Ministries of Telecommunication and Education are collaborating on the project with companies such as Intel and Airwatch,⁴⁵ as well as telecoms operators Alfa and Touch, to deliver the tablets and necessary infrastructure. The Ministry for Education is currently working with publishers to encourage them to produce engaging and interactive learning materials. The programme aims to distribute 400,000 tablets in its first two years.

Europe

In Finland the government has announced that from 2016 the teaching of cursive handwriting will be dropped from the national curriculum and replaced by the teaching of typing.⁴⁶ In order to implement this, every pupil will be issued with a tablet. Speed and touch typing will be the focus and the Board of Education has stated that these skills are more relevant to 'everyday life' than cursive writing.

In the Netherlands a group of state funded independent schools, known as 'Steve Jobs schools', have received attention recently.⁴⁷ The pupils at these schools have replaced notebooks and blackboards with personal iPads and do not have formal lesson plans. Instead, children drop into 30-minute workshops on various subjects, depending on their needs and interests as determined by a personal learning plan. The school estimates that approximately 45% of the learning is done on the iPad.⁴⁸ In allowing children to work independently and take responsibility for their own learning, the schools are aiming to make education more rewarding and engaging for children, and to closely align education with the skills needed in the 21st century. Although no formal evaluation of the schools has yet taken place, the first year of exam results were 'as expected' and teachers have reported an increase in motivation and independence.⁴⁹

⁴⁴ <https://www.youtube.com/watch?v=TdDlnxyHzCI> Accessed 17.11.15

<http://www.mpt.gov.lb/index.php/en/about-mpt-2/mpt-in-press/111-project-open-your-tomorrow>

⁴⁵ <https://www.air-watch.com/downloads/resources/airwatch-intel-case-study-open-your-tomorrow.pdf>

Accessed 17.11.15

⁴⁶ <http://www.telegraph.co.uk/news/worldnews/europe/finland/11391999/Finland-to-teach-typing-rather-than-handwriting-in-schools.html> Accessed 17.11.15

⁴⁷ <http://www.theguardian.com/teacher-network/teacher-blog/2014/oct/07/text-books-school-ipad-steve-jobs-classrooms> Accessed 17.11.15

⁴⁸ <https://www.tes.com/article.aspx?storyCode=6424542> Accessed 17.11.15

⁴⁹ <http://www.theguardian.com/teacher-network/teacher-blog/2014/oct/07/text-books-school-ipad-steve-jobs-classrooms> Accessed 17.11.15

In France, the technology company Archos announced its partnership with the government programme 'The Grand Digital for Schools Project', in 2015.⁵⁰ As part of the programme, Archos will offer Android tablets and Chromebooks to schools at reduced prices. The French government has announced that the programme aims to give 50,000 mobile devices to school students by the end of 2015 and a further million devices in 2016.

According to the Irish Times⁵¹ approximately 100 of Ireland's 700 post-primary schools are substituting textbooks for digital materials accessed through mobile technology. At a handful of these schools textbooks have been completely replaced by digital materials. According to the Irish Times, these schools want to acknowledge the role of digital technology in young people's lives and attempt to harness this in order to increase student engagement and motivation. Schools have however faced challenges when trying to incorporate digital resources, particularly a lack of teacher training. According to one principal interviewed by the newspaper, teachers need to know how to integrate mobile devices into teaching, rather than merely using them as a replacement for textbooks. It is further suggested that teachers are often intimidated by students' levels of digital literacy and feel they lack the confidence to integrate technology into their teaching, views supported by Techknowledge for Schools Transforming Learning Research⁵². Head teachers however argue that mobile technology in these schools plays an essential part in teaching children skills needed in the 21st century, findings also reflected in Techknowledge for Schools Future Skills research⁵³.

In 2015, Northern Ireland Education Minister John O'Dowd announced that the government would be investing £7 million in new technology for teachers, school librarians and pupils.⁵⁴ The investment was expected to deliver 15,400 portable devices for teachers and new library software for pupils.

In February 2015 the Highland Council in Scotland announced plans to provide every child at school with access to a tablet.⁵⁵ This came after Alness Academy in the Highlands reported that introducing tablets had led to students producing better work. Although it was acknowledged that the investment would come at a significant cost, the chairman of the Education Committee argued that the benefit to education would balance the cost of the technology.

The Caribbean

In September 2014 the Jamaican government launched plans to distribute tablets to all schools in the country, benefiting 600,000 students and teachers. In March 2015 it was reported that 20,000 of a total 25,000 devices had been distributed for the pilot stage of the programme. According to government sources, schools have seen an increase in attendance since the introduction of the tablets, especially among boys.⁵⁶ Following the pilot the full programme will now be rolled out

⁵⁰ http://www.archos.com/corporate/press/press_releases/PR_Education_150223_US.pdf Accessed 17.11.15

⁵¹ <http://www.irishtimes.com/news/education/pack-your-tablets-irish-schools-ditch-the-textbooks-to-go-digital-1.2017467> Accessed 17.11.15

⁵² <http://techknowledge.org.uk/research/research-reports/transforming-learning/> Accessed 4.12.15

⁵³ <http://techknowledge.org.uk/research/research-reports/future-skills/>

⁵⁴ <http://www.northernireland.gov.uk/news-de-100915-odowd-invests-7million> Accessed 17.11.15

⁵⁵ <http://www.bbc.co.uk/news/uk-scotland-highlands-islands-31428804> Accessed 17.11.15

⁵⁶ <http://jis.gov.jm/20000-tablets-distributed-students/> Accessed 10.11.15

across the country. The opposition party in Jamaica has however called for an audit of the billion dollar project, questioning whether it offers value for money.⁵⁷

South America

In 2015 the Columbian government announced an initiative to provide over 900,000 tablets to teachers and students. The tablets are to be used at school and at home and will enable teachers to offer access to a greater range of educational content. The tablets are being provided by Columbian telecommunication companies and the government.⁵⁸

5.2 Challenges encountered in large scale deployment

Despite increasing interest in mobile technology in education, large scale implementation of one-to-one devices has proved to be challenging and in many countries deployment schemes have been delayed or even cancelled.

Turkey's plans to introduce tablets and interactive smartboards to every public school in the country are reported to be significantly delayed.⁵⁹ As part of the Movement to Increase Opportunities and Technology (Fatih)⁶⁰ project, 12,000 tablets and nearly 1,500 smartboards were introduced into 52 pilot schools in 2012. The pilot was part of a larger bid to supply 10.6 million devices over four years. By the end of 2014, 1.2 million students were to receive tablets and 100,000 classrooms were to be equipped with interactive smartboards. The government's 2014 progress report however shows that over the three years the programme had been running, only 10% of the project had been implemented, while the cost, which was estimated to be \$1.5 billion, had already surpassed \$8 billion. Technical infrastructure was planned to be radically improved at 2,800 schools, but this was only carried out at 135 schools. The government did however reach its target of distributing 125,000 tablets to teachers.

In 2012 the Thai government announced that it would be deploying 1.8 million tablets to schools, making it one of the biggest deployment schemes in the world.⁶¹ Following the military coup in 2014 however the new government has cancelled the scheme and the devices have been recalled for inspection.⁶² According to the government the tablets will be redistributed as classroom materials, but pupils will no longer have personal ownership of the devices and they will not be able to take them home. Some of the devices will also be reserved for disadvantaged children. Students will be able to use their own tablets or smartphones for educational purposes. The government stated that

⁵⁷ http://www.jamaicaobserver.com/news/JLP-increases-call-for-audit-of-tablets-in-schools-project_19229459
Accessed 10.11.15

⁵⁸ <http://www.mobility-labs.com/2015/colombian-students-and-teachers-will-receive-900-000-tablets-for-free>
Accessed 10.11.15

⁵⁹ http://www.todayszaman.com/anasayfa_fatih-project-is-a-failure-despite-promise-to-revolutionize-public-education_381413.html Accessed 10.11.15

http://www.todayszaman.com/anasayfa_govt-falls-far-short-of-online-learning-targets-in-fatih-project_374577.html Accessed 10.11.15

⁶⁰ <http://fatihprojesi.meb.gov.tr/tr/english.php> Accessed 10.11.15

⁶¹ <http://home.hit.no/~hansha/documents/subjects/PRG112/reports/F1-01-11-rapport.pdf> Accessed 17.11.15

⁶² <http://www.bangkokpost.com/learning/learning-from-news/608188/schools-ordered-to-take-back-tablets>
Accessed 17.11.15

the one tablet per child programme had been cancelled because it did not offer enough return on investment and the savings from the programme will be redirected to struggling and impoverished schools.

In the province of Gauteng in South Africa tablets were introduced to schools in 2012 to help students with their learning. This year the education council of Gauteng announced that 88,000 tablets were to be withdrawn from schools due to theft.⁶³ The tablets had been given to government schools in an effort to improve education quality but after several break-ins at local schools the scheme has been cancelled.

In the US in 2015, a school district has asked for a refund over a \$1.3b iPad project.⁶⁴ The Los Angeles school district is seeking a \$1.3billion refund from Apple after a project to introduce iPads to 650,000 students has been discontinued. The schools argued that the security and filtering systems delivered were not working and that the digital curriculum provided by project partner Pearson was incomplete. The exercise was further complicated by a lack of sufficient Wi-Fi in many of the schools involved. The programme was designed to help children from disadvantaged backgrounds succeed by providing them with access to information technology. The superintendent of the Los Angeles school district resigned last year after it was revealed that he had maintained a close relationship with representatives from Apple and Pearson which was believed to have influenced the procurement process.⁶⁵

Los Angeles is not the only school district to cancel or pause a deployment scheme in the US. In Fort Bend, Texas, the iAchieve programme was launched in 2012 with the aim to revolutionise the delivery of science lessons with a custom built app. In order to deliver this the school district purchased 6,300 iPads. A year later the \$16 million programme was cancelled.⁶⁶ In North Carolina a \$35 million iPad deployment programme was also cancelled in 2013 due to high levels of breakages.⁶⁷ Another school district in North Carolina has halted its deployment of Amplify tablets due to technical problems and a lack of curriculum appropriate content.⁶⁸ According to an article in the American newspaper, The Atlantic, many school districts are now taking a more cautious approach after many large scale deployments have failed.⁶⁹ Some are choosing to trial different devices, including tablets and Chromebooks, whereas others are choosing BYOD schemes to reduce the economic risk to schools.

An article by Bloomberg News similarly finds that the challenges faced by several school districts that have introduced mobile technology, including problems such as damages, connectivity issues, loss

⁶³ <http://www.timeslive.co.za/scitech/2015/05/14/government-withdraws-88000-tablets-from-schools-due-to-theft> Accessed 17.11.15

⁶⁴ <http://www.bbc.co.uk/news/technology-32347651> Accessed 17.11.15

⁶⁵ <http://time.com/3514155/ipad-john-deasy-laUSD-superintendent-resigns/> Accessed 10.11.15

⁶⁶ <http://www.texasobserver.org/run-school-ipad-program/> Accessed 10.11.15

⁶⁷ http://blogs.edweek.org/edweek/DigitalEducation/2013/10/big_one-to-one_tablet_initiati.html Accessed 10.11.15

⁶⁸ <http://www.bloomberg.com/news/articles/2015-06-26/news-corp-said-to-wind-down-school-tablet-sales-as-buyers-balk> Accessed 17.11.15

⁶⁹ <http://www.theatlantic.com/education/archive/2014/08/whats-the-best-device-for-interactive-learning/375567/> Accessed 17.11.15

and theft of devices, have deterred other districts from investing in technology.⁷⁰ The article finds that despite increased spending on ICT, schools in the US have in general been slow to adopt digital learning materials. After a decline between 2007 and 2011, sales of printed learning materials have remained stable, whereas the uptake of digital learning content has been slow. A lack of sufficient broadband connectivity also prevents schools from developing digital learning strategies. Currently, just over a third (37%) of schools meet the Federal Communication Commission's (FCC) internet speed goals for digital learning.

⁷⁰ <http://www.bloomberg.com/news/features/2015-04-07/news-corp-s-1-billion-plan-to-overhaul-education-is-riddled-with-failures> Accessed 10.11.15

6. Conclusions

Schools in the UK and globally continue to explore the way in which mobile technology can best support teaching and learning. As the use of mobile technology becomes increasingly prevalent among young people, many schools seek to acknowledge this by integrating technology into teaching and learning. Often this forms part of an objective to equip young people with the skills for living and working in a digital age. Organisations in the UK such as Go.On UK as well as the House of Lords Digital Skills committee have recently argued that the education system should do more to support the development of such skills.

Elsewhere in the world several countries have introduced large-scale mobile technology deployment, often as part of an initiative to make education more up to date and relevant to the 21st century. Countries where large scale deployment is underway include Malaysia, India, Lebanon, Finland, the Netherlands, France, Northern Ireland, Scotland, Jamaica and Columbia. Large scale deployment is however not without its challenges and in many countries, including the US, Turkey, Thailand and South Africa, such schemes have been delayed or even cancelled.

Alongside these developments, academic research is attempting to assess accurately the impact of mobile technology on teaching and learning. Despite these efforts there is still a lack of evidence of a direct impact on learning from technology. Academics, such as Michael Fullan et al⁷¹, argue that the lack of evidence is partly caused by research which rarely takes *the context* in which technology is used into account. According to these academics, research should view technology as a tool to deliver a certain pedagogy or learning strategy, and assess its strengths and weaknesses in doing so. There is a particular need for research which considers the use of technology to deliver new pedagogies or ways of learning which differ significantly from more traditional, lecture-based forms of learning. Some researchers have however already started looking at this^{72 73}. Flipped learning in particular is a learning strategy which is currently receiving attention and several research studies assessing the impact of this are currently underway.

While research attempts to understand the impact of mobile technology on learning, there is some disquiet expressed. Policy makers, educationalists and academics voice concern about the potentially disruptive effect of technology. In 2015 the UK government announced that it would be undertaking a review of the potential for mobile technology in the classroom to be a distraction,

⁷¹ Papers used in the review: Fullan, M. and Donnelly, K. 2013: *Alive in the Swamp: Assessing Digital Innovations in Education*. London; Nesta, Fullan, M. & Langworthy, M. 2014: *A Rich Seam: How New Pedagogies Find Deep Learning*, London: Pearson.

⁷² Papers used in the review: Freeman, S., et al. 2014. "Active learning increases student performance in science, engineering, and mathematics." *Proceedings of the National Academy of Sciences of the United States of America*. Vol. 111, no. 23.; O'Flaherty, J. and Phillips, C. 2015: "The use of flipped classrooms in higher education: A scoping review." *Internet and Higher Education*, 25.; Upcoming Nesta report

⁷³ See Techknowledge for Schools research <http://techknowledge.org.uk/research/research-reports/transforming-learning/>

how this impacts learning and what support teachers need. The unease about technology being a potential distraction and the challenges to classroom management are clearly issues schools planning to implement mobile devices must consider.

Given the concerns about the impact of digital technology and questions of whether it offers a return on investment, it is increasingly important for school leaders to have access to evidence of impact and case studies exhibiting the experiences of other schools. This is particularly important to avoid some of the pitfalls experienced by schools that have introduced mobile technology.

This report has shown that in several countries, large scale deployment schemes have been either delayed or cancelled, due to challenges such as insufficient Wi-Fi and technical infrastructure, breakages, lack of appropriate content and concerns for student wellbeing. It is clear that schemes have been introduced without regard to a growing evidence base of research which clearly point out such challenges. Careful planning, teacher training and best practice guidelines are essential for any successful deployment.

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Appendix 1

Family, Kids & Youth

Family Kids & Youth is an award winning agency specialising entirely in research with families, children and young people, providing both global research and consultancy. Our business is solely about the lives of children and those who care for them. In the last year alone we have conducted over 30,000 online interviews with children, parents and teachers, 100 focus groups with children aged 5 to 16, over 100 groups with parents and teachers and in-home and in-school ethnography on subjects ranging from children and their use of media, need states, behaviour change, volunteering, play, diet and exercise. The FK&Y team has recently worked on projects with children and young people for the BBC, the Money Advice Centre, Unilever, IKEA, The Prudential, The University of Cambridge, The Department of Health and The Department for Education. We are the main consultants and suppliers of research to IKEA on family and children's research. Authors of IKEA's '[The Play Report](#)', the largest study ever carried out in 25 countries on parenting and play, we have recently repeated this research in 12 countries with over 16,000 parents and 12,000 children.

Family Kids and Youth is currently carrying out the on-going research for the charity [Techknowledge for Schools](#) which is looking at the way in which mobile devices can be utilized in school to improve children's lives. We have also been the long-term evaluators for the Cabinet Office and [Youth United](#), looking at the notion of behaviour change in childhood and adolescence through young people's involvement in community activity and [our report](#) on volunteering was published in August. Our research on [digital advertising and marketing to children](#) on behalf of CAP and the ASA was published in February 2015.

Family Kids and Youth is a Company Partner of the Market Research Society (MRS), and holds membership with the British Educational Research Association (BERA), ESOMAR and the British Psychology Society (BPS), abiding by the codes of conduct of these organizations, including those guidelines involving research with children. Last year we were appointed onto the new [UK SBS government research roster](#) as a supplier of research with children and young people. All members of staff have DBS clearance.

The FK&Y team has academic qualifications in psychology and sociology and founder Dr Barbie Clarke's research at the University of Cambridge has focused on children and their use of social media. FK&Y works closely with the Faculty of Education, Cambridge and the Department of Education, Sussex, and advisors include Professor David Buckingham, University of Loughborough and Professor Colleen McLaughlin, University of Sussex, both of whom sit on the FK&Y Techknowledge for Schools Pedagogy Group.

<http://www.kidsandyouth.com/>