



# **WHAT ARE THE DIGITAL SKILLS THAT WILL BE NEEDED IN THE FUTURE?**

**Professor Christina Preston and MirandaNet Fellows**

A report requested by Digital Skills Taskforce

**“What are the digital skills that will be needed in the future?”**

This report has been prepared by the MirandaNet Fellowship at the request of Ed Milliband and the Labour party who are asking expert communities to consider the question, “What are the digital skills that will be needed in the future?” The aim of this data gathering is to 'look at what can be done to develop home grown talent for our digital industries and for the digital needs of all sections of the economy.’

The international MirandaNet Fellowship, founded in 1992, is always pleased to be consulted on UK and global policy issues as the professional organisation has nearly 1,000 members in more than 80 countries who are united in their commitment to investigating and disseminating the value of digital tools in all phases of education. The community represents an effective continuing professional development approach to identifying what educators need to know and keeping each other informed. MirandaNet has a strong global presence in third world and BRIC countries as it is free to educators to join on the web. The overheads are met by the ICT industry: companies elect to pay an annual subscription in order to gain professional development from networking with expert members and conducting research and development projects with MirandaNet co-researchers.

Nineteen members have contributed to this report over ten days: some have answered in depth; others have only tackled one or two questions where they had an expert opinion. Building on this date the report is in two sections: in this first section the MirandaNet founder has provided a context for members’ comments taken from other recent MirandaNet debates, reports and research. In the second section a summary of the key points made by members in relation to the eleven questions that have been asked each question is tackled independently. Where relevant answers from members have been summarised and/or lists have been made. But where there is clearly some interesting detail we have resisted the urge to smooth these over in generalities. A summary would be quicker to read but would also dumb down the real challenges in this area.

**Section One: the political and social landscape**

In looking generally at what can be done to develop home-grown talent for our digital industries and for the digital needs of all sections of the economy, MirandaNet Fellows’

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key point is that the computing landscape in education has changed significantly since the Coalition took power. In particular there has been a minimum engagement with professionals in the field so this effort to explore professional opinion is welcomed.

The effects of the recession since 2009 have been compounded by the inevitable reduction in government funding and the political impetus to disband central authorities in education and teacher education in universities. The fragmentation of the UK market as a result has been a serious problem for the ICT UK industry who often now have to contact individual schools to make sales. Making sales outside the UK is easier where education policy and purchasing is more centralised.

But there has been a serious reduction in the UK's ability to sustain its role as a leading contender in the world market as well as at home because of the closing of Becta, the former government agency for ICT. There is a consensus that the organisation had become too large and was in some areas stifling innovation, but it was funding valuable long-term research projects that contributing to the UK lead in the ICT area.

The Becta website is the greatest loss as this was an international showcase for UK research into products and services and advice for the profession. MirandaNet and the company associates are aiming to restore in some part through an international partnership with the Education Futures Collaboration deploying MESH, Learning Designer at the London Knowledge Lab, Institute of London and Ingots who provide DfE approved accreditation for action research with teachers - an approach to combining research in schools with real change. Advice about specific sources of funding for improved software for the international grassroots MESH project would be valuable from politicians.

A major MirandaNet concern is the limited availability of quality continuing professional development (CPD) in digital technologies across the country, especially now that computing has been introduced as a curriculum component. As far as we know professional training is continuing the 2011 trend MirandaNet Fellows identified in our extensive study, The Landscape for ICT CPD (1): to be localised and focused on the technical use of the product without the underpinning pedagogy and the ownership that our research suggests is essential in the effective uptake of digital tools. In addition, teachers have few channels where they can publish their knowledge and expertise to a wide audience and influence policy like the doctors do in the Cochrane review (2).

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**Section Two: a general reflection from MirandaNet Fellows**

In this section we are highlighting some general thoughts that were made by the community of practice (3) and some comments that are representative of the MirandaNet community thinking. For example, Roger Broadie is an adviser whose reply summed up members' points about systemic change and holistic thinking. This holistic approach tends to be overwhelmed where each question is replied to separately - a danger that policy makers who send out such questionnaires should be aware of.

*When the lead question is about digital skills one's thinking is immediately skewed towards the skills involved in using technology, whereas the really important skills are the skills to be successful in a world that has been changed by technology.*

*The critical impacts of technology are enabling communication and collaboration, making visual and aural communication more important than textual, making what people do more visible and accessible, giving access to information and providing computer-based tools. This changes the nature of work from hierarchically-led largely individual activity dictated by 'experts' to collaborative work requiring individual creativity in how work is done and what the outcomes could and should be. And of course learning being childrens' work should also be changing this way.*

*The current school curriculum in the UK and the assessment regime are no-where near enough aligned to what is needed in a digital age and hence the questions are not deep enough.*

*If the key skill in a digital world is working creatively in collaboration with others, multimodally, on real tasks informed by massive amounts of information and using computer tools and computing techniques, we have to ask first how the education system is going to assess and accredit this, and then how the curriculum and organisation of schools should be constructed to enable young people to successfully achieve what is being accredited. Without grappling with the big black cloud of how schools and individual pupils will be assessed, there is little chance of meaningful change. What you get is what you measure.*

In this context Dai Barnes, a leading teacher in computing, asked an important question that summed up many comments about the fact that industry had a stronger role in this questionnaire than the teaching profession as far as deciding qualifications was concerned:

*Am I missing something, or are we trying to get the tail to wag the dog?*

*If looking for doctors, we would start from the profession and work the education in reverse. Surely, it is a matter for industry to endorse a graduate qualification that caters to their needs, and for schools to structure their curricula to enable young people to earn a place on that course. Everyone has contributed valid points but the discussion most probably should start with what the person starting out in that industry must have in the way of qualifications? To continue the medicine analogy, all areas of specialism need to be incorporated into that.*

*Possibly this is asking too much of the digital industries because they develop so fast and are spearheaded by only a handful of sustaining companies. You wouldn't ask a school how they're going to provide more doctors. You might ask a school how it is going to get more young people doing science, or, indeed, computing in its many strains.*

Members agreed that pupils and students should be properly prepared for the world of work but were concerned that teaching and testing for digital skills only was not enough. How to accredit teachers and pupils in Computing and for what was a continuing theme. Jocelyn Wishart, a teacher educator, makes this point:

*I can't help feeling that too often the technical skills are prioritized by those not in education over the critical thinking skills, digital skills require evaluation, application and synthesis. There is much that can be done with currently available apps and tools so my votes go for criticality and reflection, audience awareness, usability.*

Chris Yapp, a consultant with several years in multinationals behind him makes a similar point:

*A lot of the challenges in the business world come from lack of project/programme management rather than the technical skills. However, the problems often start earlier by weak systems analysis. Agile methods help, but only if culture is supportive. So big need for full life cycle of problem identification and solution and delivery.*

In this context the OECD Pisa<sup>1</sup> intention to assess collaborative skills next year was widely applauded by MirandaNet members. This was felt to be very influential and

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<sup>1</sup> <http://www.oecd.org/pisa/keyfindings/pisa-2012-results.htm>

would give more credence to the UK approach to learning that has not been reflected in the mechanist kind of testing that has been the norm.

In terms of apprenticeships Ian Lynch, Ingots, summed up a view that well designed research should be set up to prioritise methods through which businesses can work most effectively with educators and government and then fund projects to make it happen. There are already sources of funding, he says, such as that from the EU Erasmus Plus programme but combining this with teacher training would make better use of resources.

Dominic Norrish, another leading ICT teacher, also says that now that Becta is gone, the evidence base needs to be improved significantly, so that schools can focus on the 'how' rather than the 'should we?'. NFER's approach of mapping technology's affordances to teaching and learning techniques which have well understood and evidenced impact would, short of RCTs, seem to be a good starting point. For example, we know that high-quality and timely feedback has an impact – what role can technology play in enhancing this currently time-consuming and variable process?

Ros Asher, another adviser as well as a judge of the BETT awards, provides a holistic summing up of the kind of collaborative community approach that will take the UK forward:

*Finally, a bold national vision for educational change that embraces the opportunities of new technologies, needs to be set in the context of improved educational, social and economic prosperity. It should be developed in partnership with professionals and learners in education and in industry, supported by robust research and evaluation, and interpreted by education professionals. Spearheaded by government working with education and industry professionals a successful policy will encourage innovation and creativity and will create high quality impact, achievement and sustainability. Clear communication and opportunities for parents, carers, students and the wider community to contribute and confidence in education and industry professionals to lead on implementing and evaluating policy will be paramount to its success.*

What MirandaNet would like to see is a political party that is sophisticated enough to develop the strategies to stimulate this kind of activity. We hope we will have more opportunities to support this consultation.

We can also a practical approach to this by offering to run a MirandaMod <sup>2</sup>debate which can be streamed as we have evidence that a debate of this kind between professionals can raise the level of group insights.

For further elucidation of the points here please get in touch with:

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**Professor of Educational Innovation, University of Bedfordshire**

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### **Notes about MirandaNet**

One way for the education Industry to reach the profession and potential clients is to work through the existing professional organisations. We offer as an example, the MirandaNet Fellowship, established in 1992, that was the first Face Book for educators. The organisation, free to members, is modelled on a system of self-led improvement called a community of practice (3). In research terms communities of practice are seen as the best method of securing system led change.

The MirandaNet Fellowship now has nearly 1,000 members in more than 80 countries. The visitors to the website show that there is a global hunger from professionals and parents to know what works and what the research says. More than 850,000 pages are read each year of teachers' varied publications and 6,000 unique visitors read up to 11 pages. Visitors often return. These figures show that the global demand from education professionals and policy makers is increasing for reliable information about classroom practice and research in the use of digital products to improve learning. Much of the MirandaNet that is published research is funded by industry which also gives the teachers involved as co-researchers an important low cost professional development opportunity: the practical, grassroots-based iCatalyst programme for professional learning based on action research principles.

In terms of global connections especially third world collaborations, MirandaNet Fellows have developed iCatalyst systemic change projects using digital tools in places as far flung as Bulgaria, China, Chile, Czech Republic, England, Friesland, India, Mexico, Saudi Arabia and South Africa. Many of these contacts have been made through BESA introductions. Each international MirandaNet chapter continues to link to the international MirandaNet base where the language is English. We are seeing increasing interest from the BRIC countries and the USA: currently we are starting communities in Thailand and Pakistan. Some of the associate companies who have

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supported these action research projects in schools are: Apple, GroupCall, IRIS Connect, LightSpeed, Microsoft, Promethean, Oracle and Steljes. Current MirandaNet associates are: BrainPop, Brother, Engage, Follett, GroupCall, Iris Connect, LightSpeed, MERU and Tablet Academy. In support of the ICT industry MirandaNet will be running workshops for BESA, UKTI and MirandaNet companies that will help them to develop their international research and marketing base (see appendix). The new programme of seminars that are streamed will be held at the London Knowledge Lab and resourced by Brother.

MirandaNet also has a partnership with four innovative projects that can be used to improve UK industry collaboration with teachers and dissemination to international partners:

- **Hands-On ICT:** a free and open source environment we are developing in the EU LLL programme with partners in Greece, Slovenia, Spain and the Netherlands. The Hands-On ICT environment could be a host for teacher-designed modules and case studies in the practice and pedagogy surrounding UK products and services. It will be another source of dissemination for materials testing UK products and services that are quality assured by teachers;
- The **Learning Designer** project that provides teachers with a template for publication that is based on many years of classroom investigation by Professor Diana Laurillard and her team at The London Knowledge Lab;
- The **MESH Guides** project led by Professor Marilyn Leask at the University of Bedfordshire where teachers can contribute their case studies to pathways that are used to reach professional judgements on the current evidence in the same way that the doctors use the Cochrane review;
- **INGOTS** accreditation that in tune with our research into action research provides free optional tools and flexible systems for teacher trainers so that they can decide the best way to motivate the teachers. This system is achieved within the nationally recognised qualifications systems including performance points and is endorsed by the DfE.

#### Notes

1. Pachler, N, C. Preston, J. Cuthell, A. Allen and Pinheiro Torres (2011) The ICT CPD Landscape in England, Becta. Pachler, N, C. Preston, J. Cuthell, A. Allen and Pinheiro Torres (2011)
2. Cochrane research reviews <http://www.cochrane.org/cochrane-reviews>
3. Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge, UK: Cambridge University Press.

#### Websites

**Hands-On ICT Project** [handsonict.eu](http://handsonict.eu)

**INGOTS** <http://theingots.org/community/about>

**Learning Designer** <https://sites.google.com/a/lkl.ac.uk/ldse/>.

**MESH** <http://www.meshguides.org/>.

**MirandaNet Fellowship** [www.mirandanet.ac.uk](http://www.mirandanet.ac.uk)



## Appendix

### Summarised Comments

- For children starting on GCSE now, the largest growth in jobs by the time they leave school/college/Uni is expected to be in the “Internet of Things”. The ability to programme sensors or use measurements from sensors will cut across health, construction, vehicles, smart cities and many other areas.

On a recent project, the issue of maths was raised in art students. In Korea for instance, geometry is very strong among arts students but much weaker in the UK. This has created challenges in various VR/AR apps.

*Chris Yapp*

- As someone currently working to try and support Primary schools introduce computing curriculum, the obvious immediate need is quality professional development opportunities for staff. Not just in 'coding' - the whole curriculum, Digital literacy, IT and CS.

Beyond that in the longer term we need a radical re-think on curriculum structure. We are still using a 19th century curriculum structure which makes it extremely difficult (if not impossible) to enable learning of the fundamental skills required in 21st Century - collaboration, team work, multi-discipline activities etc.

*Martin Longley*

- A general comment on the digital skills discussion, which is not without debate in the Netherlands (NL) because a lot of the skills mentioned are very generic. I would prefer to have it more explicit and concrete. In NL there is a change in focus to more manufacturing IT skills. As I said at CIPES in Brussels we see the development from learning to use ('80-'90' ties) to using to learn ('90-2010) to learning to create (making apps, robots/Lego, animations etc 3D-printing)

So in proposals I should focus on them.

So we have:

1. 21st century skills in educational practice developing material for making apps, robots/Lego, animations etc 3D-printing together with practice based research

2. Keep small schools open (Stephen Heppell is a really good advocate in this) use ICT. Political an interesting issue for the next elections.

3. Use the activities and concepts of Samsung's Smart Educational Hubs program in NL. Contact Samsung Europe in the UK.

*Jan Lepeltak*

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Question 4 raises the perennial beef, the need to integrate assessment practice and Q5, another one, the need to resource teachers with time to plan ahead and accessible digital tools (designed for classroom not office use) for learner centred strategies.

I am not in FE or an employer so don't feel up to commenting on the latter Qs but they remind me of the proverb - you can lead a horse to water but you can't make it drink - I feel that perhaps a focus on learners and motivation would be more helpful. What is in all this for the learners?

*Jocelyn Wishart*

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*Roger Broadie*

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*David Fuller*

- Industry are making the right noises, see <http://www.cbi.org.uk/media-centre/press-releases/2012/11/cbi-calls-for-overhaul-of-school-system-to-deliver-for-all/>

But there is a reluctance about getting too involved with school-level qualifications. And on top of this they had their fingers burnt with the Diploma developments Labour pushed that absorbed a lot of time and went nowhere.

And the political problem is that about the only way the soft skills and collaborative work abilities can be assessed is through teacher-led assessment rather than examinations, which they don't like as they think it cuts across the school accountability regime. As a step in the right direction everyone should have a look at what Ian Lynch is achieving with the INGOTS assessments, which

are at least moving assessment of individual work from an exam process into a portfolio of work process - <https://theingots.org/community/>

*Roger Broadie*

- And as well as ingots, the Naace/TLM open systems computing qualifications - ofqual approved, league table points contribution and build on the experience of ingots to provide level 1,2&3 qualifications.

*Jan Webb*

- Technically speaking you can use TLM qualifications for children or adults. The ITQ is done by Birmingham Adult Education and in the prison service as well as in Schools. The Computing though I'd specifically designed around the new national curriculum POS so is likely to be done mainly by children in KS3 and 4. Level 3 qualifications KS4/5.

*Ian Lynch*

### Responses from Ros Asher

#### **1. Which digital skills are most urgently needed? What are the digital skills that will be needed in the future?**

To prepare students to meet current and future demands and opportunities of an increasingly technological world, we must integrate technology within a core and a wider curriculum that are developed by education professionals working with industry and the wider community. This should include the contribution of students and parents/carers.

#### **2. How can perceptions of digital careers be improved? How can we help students, parents and teachers better understand the breadth of opportunity and the different entry points?**

Implications from continuous and swift advances in technology, in life and work situations, need to be translated and prepared for - in and out of school, higher education and work placements - in ways that transform the way we learn. This means a commitment to innovation in education, with provision for ongoing review, development and training that enables teachers, leaders, administrators, policy makers and inspectors to widen their repertoire and practice so that new skills and pedagogies

arising from these developments are integrated. It requires review and creative development of modes of learning, assessment & evaluation, teaching, infrastructure and productivity, so that technology is used in ways that engage young people in powerful learning that equips them to thrive in a technological world

**3. What responsibility do businesses have in helping to improve digital skills across every age group?**

This requires an ambitious, step change rather than an evolutionary model for educational change that meets the need for higher order skills and problem solving approaches, with students engaging as active participants in meaningful learning experiences. It requires teachers to provide direction, facilitation and experiences that enable learners to practice how to apply their knowledge using cognitive and technological skills and to solve real life problems using a range of interactive media and interdisciplinary collaboration. It should enable students to communicate safely within and across schools, communities and countries.

**4. How can schools ensure students acquire the digital skills and understanding they will need in the future? What support is needed? What are the tripwires? How can schools make better use of technology in and out of the classroom?**

The ever increasing range and complexity of technology and information available in education and work situations means that school and higher education students, apprentices and employees need to develop the skills and capacity that enable them to access information and data efficiently, analyse and interpret it effectively, evaluate it critically, identify fact from propaganda, and understand ethical, moral and legal issues, including access to and use of information.

**5. How can we encourage better use of technology across all stages of education to teach students better, enrich their learning and improve efficiency?**

Schools need to look and be very different to the models being shaped by current education policy, which represent a retrograde step in relation to what is needed to ensure the future life and work skills needed for successful social and economic growth.

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There needs to be investment in innovation to transform the way education is perceived and delivered to match the best developments in industry. As well as preparing students for the way the world works now it needs to enable them to be flexible, creative and entrepreneurial, so that they can adapt, embrace and capitalise on future developments and new ways of working.

**6. What needs to be done to ensure that the new computing curriculum in England is successfully implemented?**

Central to this would be embracing and valuing learning in a range of places, real and virtual, and the importance of learning for life and a culture of liberal education for life, as well as in educational establishments and work placements.

**7. What role can apprenticeships play in boosting the UK's MHGT for digital skills? What would a really good apprenticeship in digital skills/IT look like? What would help companies of all sizes offer apprenticeships?**

This approach requires a national imperative and continuous investment in high quality, creative, personalised professional development for staff and leaders in education and in business. It continues to challenge the view of the role of teacher / instructor / mentor and needs the development of an ever increasing repertoire of teaching, learning and assessment strategies that enable a customised approach to develop independent learners, to meet their individual needs and to enable them to be confident, critical and creative users of technology, preparing them to use technology in new ways in their future work, life and leisure.

**8. How can further education and higher education better equip students with the digital skills that are necessary?**

Preparation for college, the world of work and lifelong success needs to include how to apply relevant skills and knowledge in a culture of continuous change with an increasingly sophisticated workforce, challenged by technology and global competition.



**9. How can careers guidance at every stage be improved to ensure that people receive the necessary information, advice and guidance to help them make informed choices? Who should deliver this advice and how?**

As well as technological skills, it is essential that students can build strong interpersonal, written and communication skills in preparation for the workplace. Entry level jobs now have higher reading and mathematical requirements - particularly relating to technical information and manuals. Preparation for this needs to be incorporated in school and college texts.

**10. Ongoing learning and re-skilling of the existing workforce will be a vital component of ensuring that the UK responds to the challenge of technological advance. How do we up skill the existing work force – both in and out of employment? How can we provide better opportunities for career transitions, career pathways for all ages?**

Finally, a bold national vision for educational change that embraces the opportunities of new technologies, needs to be set in the context of improved educational, social and economic prosperity. It should be developed in partnership with professionals and learners in education and in industry, supported by robust research and evaluation, and interpreted by education professionals. Spearheaded by government working with education and industry professionals a successful policy will encourage innovation and creativity and will create high quality impact, achievement and sustainability. Clear communication and opportunities for parents, carers, students and the wider community to contribute and confidence in education and industry professionals to lead on implementing and evaluating policy will be paramount to its success.

**Responses from Roger Carlsen**

**1. Which digital skills are most urgently needed? What are the digital skills that will be needed in the future?**

The *most* urgent skill needed in our education centers is the development of a real-time digital communication culture. There are individuals from various cultures and constituencies. Few are currently fully participating in a digital communication culture.

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We know that for maximum participation, 1) participants must be invited - not forced to participate; 2) there must be social connections with others, and 3) a desire to communicate for either information that is sought or entertainment that is desired. The sustainability of the real-time communication culture is fundamental and essential to success of educational technology that enhances learning and complementary skill building.

Anything less than a real-time digital communication culture is to court a system of educational failure. The future demands we must grow a digital/ICT culture. This should start in our schools.

<http://craigconnects.org/2013/11/5-free-tools-to-track-social-media-engagement.html>

<http://www.dreamgrow.com/69-free-social-media-monitoring-tools/>

<http://readwrite.com/2012/05/23/5-push-to-talk-apps-that-turn-your-smartphone-into-a-walkie-talkie#awesm=~oDeP46hJcg7zeK>

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For example: In the United States technicians, (e.g., cable television, Internet, and phone installers) typically have holstered walkie-talkies where other technicians use a twitter-like communication among technicians. This is an approach that I see growing in importance for educators and students.

The requirements for such an approach would be tablets or small interactive computing devices that individuals could use. Considerations for heavy bandwidth use would also be anticipated with a 'use it and we'll grow it approach'. This would be coupled with a 'don't use it and it goes away alternative'.

Digital Skills Needed Now



— But not just soft skills as a layer on old thinking

Digital Skills Needed in the Future



— Nimbleness and a readiness to *utilize* not use yesterday's thinking and technology.

[The key here is the word utilize. Most individuals use utilize as a synonym for use. Don't. In this case utilize is quite correct when coupled with learning and communication technologies.]

**2. How can perceptions of digital careers be improved? How can we help students, parents and teachers better understand the breadth of opportunity and the different entry points?**

Maximum, student, parent, teacher and administrator success is not something that can be immediately measured. Nevertheless, MHGT is something where indicators will emerge. The future is not fully known, thus, indicators will be diverse and will pop out clearly. (See example below) be seen. During the progress towards There are, however, prerequisites and almost indispensable qualities that we must all recognize and understand potential of a diverse and fully participatory digital communication culture. As I see it there are three major entry points, the school, the home, and through one's social network.

Schools are the single entry point where educators, administrators can make a dramatic impact, fast. It just takes money and resolve. Note, however, that without the support of political leaders and administrators But, it is only when students' homes and their personal learning and social networks converge to join the culture of the school that the full horse power of the the breadth of opportunity and the different entry points?

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Example: There were no studies that drove the move from rotary telephones to digital telephones. It happened. While a few individuals saw the benefits of the digital phone, most users now see the advantages of digital phones and all of it's iterations.

The goal should be to make progress towards the "tipping point" (a series of incidents and smaller changes the occur until those changes cause a substantial and major change) and then sustain "making progress". The only way that happens is through voluntary use.

Recognition of the importance of technology



— Too many use technology for tight or simple entertainment. In such cases, technology may not add much to learning. On the other hand, popular criticism of Twitter in education may well be wrong, especially where the purposes of Twitter use are left to students.

Participation in helping to reach a “tipping point”



— Note a tipping point is different from the tipping point. More and more tipping points are slamming education, businesses, and virtually all areas or almost all cultures. To not be experiencing a tipping point probably means that one is not a player in a relevant area of one’s culture.

### **3. What responsibility do businesses have in helping to improve digital skills across every age group?**

Businesses have a responsibility to be profitable and hire locals when all things are equal. Once schools have established their efficacy in preparing employees I believe that a balance can occur whereby schools and businesses can collaborate in the preparation of a digitally talented workforce.

I developed a unit for a course I proposed:

*Teaching the Future to Future Leaders: Scenarios to help leaders to see the elephants.*  
What happens when soft factors become hard factors? (Strategic Surprise)

Without a digital infrastructure and a highly talented teacher workforce there is little that education has to offer business. If, however, education centers could collaborate with businesses to educate employees, businesses might be asked to share their gain that was offset by their reduction in their expenditures for employee training. This could also give business a seat at the planning table where some mutually beneficial curriculums could be developed.



Business responsibility to improve digital skills in schools

— This is a difficult question to deal with especially because of the recent global downturn of profitability. Unless education brings *more* to the table there is little reason for business to collaborate.

Higher levels of education can be relevant for business success. This may, however, require new kinds of collaboration/partnerships.

**4. How can schools ensure students acquire the digital skills and understanding they will need in the future? What support is needed? What are the tripwires? How can schools make better use of technology in and out of the classroom?**

Knowledge and digital skills necessary for a bountiful future are unknown. Schools can provide the basic knowledge so that businesses and communities can avail themselves of the ‘tools of the day’. The UK Systems Society International Conference held identified the goal as, in 2008 identified as *Building Resilience: Responding to a Turbulent World*.

We do know that in our futures we will more volatility, uncertain, complex, and offer us greater ambiguity (VUCA). Schools and businesses must ensure citizens that they have the digital skills and understanding they will need.

<http://hbr.org/2014/01/what-vuca-really-means-for-you/ar/1>

<http://www.slideshare.net/dcaron/its-a-vuca-world-cips-cio-march-5-2009-draft>

**5. How can we encourage better use of technology across all stages of education to teach students better, enrich their learning and improve efficiency?**

Press the *social media buttons*. See references to question 1, above.

In classrooms and schools, I believe we should use “back channeling”; that’s a start. Students can have a guide on the side (perhaps librarian, other students, or even the teacher or other teachers). Teachers can have access to other educators or even retired master teachers.

<http://net.educause.edu/ir/library/pdf/eli7057.pdf>

**6. What needs to be done to ensure that the new computing curriculum in England is successfully implemented?**

I don't believe you can develop a 'best' curriculum. Even if you could, a best curriculum would evolve and change rather quickly. The curriculum must be viewed as a dynamic plan with multiple points of view.

I recommend that groups of individuals form groups to study other global areas and that existing excellent curricula be made available for ongoing study.

Educational gaming really needs to be explored and embraced by more educators and educational groups. It is not, "Gamification vs Education - Irreconcilable Differences <http://www.onlineuniversities.com/blog/2012/09/gamification-vs-education-irreconcilable-differences/#>. Written in 2012. Gamification is almost everywhere. This is a natural area for educators to become more deeply involved.

Involve Gamification in one's curriculum.



—To continue the discussion of ramification would be to hijack the purpose of this paper.

Another area for curriculum study should be through 'virtual learning spaces'.

**7. What role can apprenticeships play in boosting the UK's MHGT for digital skills? What would a really good apprenticeship in digital skills/IT look like? What would help companies of all sizes offer apprenticeships?**

I have little to say here. This just means I have nothing that I believe would be important to add.

Global partnerships are where I would head but I'm not sure this is the time or place for this discussion.

A few years ago I founded and oversaw a "learning Clinic", a one-to-one after school tutoring program for high risk and special needs students. I used university pre-service teachers as tutors. One primary strategy was to place tutors in close proximity to other

tutor/tutee locations. What happened? The tutors listened and began interacting with other tutors. So long as the tutoring wasn't distracting, student performance dramatically and rapidly improved.

Education should continue to explore MOOCs. Some of my colleagues and friends are interested in using MOOCs to identify and recruit bright students from outside the country into their programs. Bringing the best and brightest from outside one's country to study with local students is an excellent strategy to explore. A former Dean once told me that the best way to improve undergraduate test performance was to recruit rich, smart students. I would add, mix your community of learners together. This is closely related to the paragraph above.

As an iteration of an internship, bring the brightest students that one can find outside your country to study with students inside your country. Offer these students internships to keep them here.

**8. How can further education and higher education better equip students with the digital skills that are necessary?**

Social media and back channeling are my two suggestions.

Higher education teachers, however, appear to not be prepared or have little desire to participate. Their loyalty is primarily directed towards their subject specialty and the traditional university curriculum. Too many higher education faculty receive and keep tenure based on refereed publications.

**9. How can careers guidance at every stage be improved to ensure that people receive the necessary information, advice and guidance to help them make informed choices? Who should deliver this advice and how?**

Students probably would be advised to have exposure to digitally enhanced settings.

It would no doubt help if families would have access to technology.

**10. Ongoing learning and re-skilling of the existing workforce will be a vital component of ensuring that the UK responds to the challenge of technological advance. How do we up skill the existing work force – both in and out of employment? How can we provide better opportunities for career transitions, career pathways for all ages?**

Vocational schools and higher education require a “shared partnership” where curriculum is co-developed by both businesses and education. Towards this end I would explore a shared appointment with key committee memberships.

Another approach might be the development of another profession, exploring learning and mentoring agents to investigate educational and work arenas. Their primary focus would be, “technologies of cooperation”.

**11. What can be done to ensure that politicians recognise the importance of digital skills?**

I am unfamiliar with politicians and political pressure groups. In the US, our current political system appears to not be working as one would like.

Two stories that may or may not be relevant. I think they may be but you decide.

When I think of politicians I’m reminded of a true story that happened to me while presenting to School District Superintendents and their representatives. I had just finished telling the audience how important ‘word processing’ was for an author. One superintendent at the break told me, “My word processor, makes coffee.”

I was contacted by the spouse of a school principal from a nearby state in the U.S. Apparently, an excellent principal who could neither read nor write but who was a talented speaker and a real people person had been nominated as State Principal of the Year. His secretary had cleaned up the Principal’s work for almost 20 years. Together, the secretary and Principal, hid this from the community.

Together these stories form at least part of what I believe are problems with politicians; if politicians have the proper backing, good sound bites that simplify messages, and a competent staff we get clunkers. So, my advice is to find informed politicians and mobilize those who believe in education. Unfortunately, at least here in the United



States, teachers do not vote their profession unless it involves how we fund schools - local funding levys.

### Responses from Ian Lynch

#### **1. Which digital skills are most urgently needed? What are the digital skills that will be needed in the future?**

The most urgent digital skills requirement is for teachers. Without a skilled teaching force all of the rest of education becomes less efficient and the longer we wait the more that will persist.

While immediate operational skills seem most urgent they are the most difficult to pin down and most susceptible to change. As an example, take the skills related to word processing one of the most widespread activities over the last 20 years.

Virtually everyone has used MS Word at some time or another yet very few people make use of more than about 10% of the functionality. Defining three classifications of task will help identify where priorities should be targeted.

1. Word processor tools used by a great majority of users routinely.
2. Word processor tools used by a small minority of users for specialist applications.
3. Word processor tools helpful to most users but which most users don't have much knowledge.

For 1. Examples would be editing text, cut and paste opening and saving files, spell checking.

For 2. Defining macros, managing footnotes and indexes.

For 3. Understanding file filters, interoperability, security, document layout conventions.

There will be overlap, the reason to categorise these things is to see that the most efficient way to target skills is to focus on the things that are not trivially simple to pick up but would help most people. A lot of this is likely to be in fundamental issues that

span applications. While we will need specific applications to illustrate these issues and form a context for learning, it is more likely that it is the generic knowledge and understanding that underpins the skills that are most valuable as an investment not just for now, but for the future.

This is not the same as saying everyone needs to be a computer scientist or a programmer, it is more about understanding the technological structures on which programs operate than it is the details of the code. Computational thinking is considerably more abstract than what is being considered here. We are talking more about understanding the engineering than simply the academic pure science behind it.

## **2. How can perceptions of digital careers be improved?**

There is arguably a wider anti-technical/practical culture that goes beyond digital technologies.

When I went to the CTC Trust as one of 6 curriculum directors in 1990, I was the only member of the team with a technical background – well I say technical because it was physics, maths and some software engineering all derived from a standard academic route from grammar school through university into teaching. Bearing in mind that at the time the CTCs were the government's flagship for technical education, ask yourself if it had been a flagship for music or the arts whether the development team would have just one professional with formal training in the target field? One musician say and 5 scientists and one boss who was tone deaf? There was a director for MFL, a director for post 16 ed (An English graduate), a director for business, a director for technology but from an art background, a director for IT (English Graduate) and me – director for maths, science and anything remotely technical to do with computers. The CEO by her own admission was a deskilled languages teacher.

A lot of political symbolism and not too much substance seems to have characterised technology from TVEI to the present day. Money spent on hardware and infrastructure results in the impact on the curriculum being more about grafting technologies to fit the status quo. Witness obsolete IWBs in most classrooms to reflect teacher at the traditional chalk face, CLCs gathering dust and a craze for ipads, modern day fashion accessories. Nothing apparent to fundamentally change the way teachers work. In fact there is further regression in the removal of practical work from A level science further

reinforcing a perception that anything practical is a low priority and theoretical academia is king.

Changing people is a necessity in any cultural shift and that is not politically attractive. It takes time, certainly more than one parliament, to see real impact. It is expensive and it might even reduce standards initially because of the opportunity cost in the current teaching programmes. Make no mistake if there is a real will to change attitudes to digital careers we need greater profile and celebration of the human success of the technologists than is currently evident.

Despite the negatives, we have still managed to produce some of the most innovative digital engineers and technologists in the world. Steve Furber and Sophie Wilson of Acorn between them designed as much innovative technology as Microsoft and Intel combined on a tiny fraction of the budget, arguably because of the budget constraints. Clearly it is not just down to money. We are decidedly bad at celebrating these stars of technology. If it was pop music or football they would be household names yet the ARM technology they invented is now arguably the most important invention in mobile technology and no-one has heard of them. If it was a book - J K Rowling. If it was a film - Richard Attenborough. Yet the value of these pales into insignificance compared to the FTSE 100 ARM Ltd. Changing the perception of digital careers is not within the compass of education providers alone or even very significantly, it is down to the political and media classes because they have the control of mass communication to the people from single unified sources.

### **3. How can we help students, parents and teachers better understand the breadth of opportunity and the different entry points?**

Involvement of community groups including employers and open source projects in courses and qualifications will act as a vehicle for understanding opportunity because the learning will then better reflect the needs of employers. We need national competitions to celebrate exemplary good work that solves real world problems, more than contrived practical exams that mainly contribute to candidate selection.

A most important signal to send out is that practical technological competences are valued as much as academic attainment in exams. This means providing real incentives to teachers and their pupils to undertake really useful practical digital projects. Not just those pupils that can't achieve a C grade, but the A\*s too. Such projects will make the

breadth of opportunity self-evident and might even stimulate a few more entrepreneurs. This is not going to happen while virtually all the credit is accrued from academic end of course exams. No-one is going to sacrifice league table positions, especially when managing and organising practical projects is much harder work than teaching intensively to pass a written exam. I'm not saying that we should abolish exams, I'm saying we need to think in a much more intelligent way about the effects of assessment methods on the way teaching and learning is implemented. How can we manage and organise assessment to incentivise the behaviours we want to achieve? It is obvious that assessment has a massive effect on the way teaching is conducted so we need to get out of denial and change the way we do it. It does not necessarily mean abandoning performance measures, it does mean doing assessment a lot, lot better.

#### **4. What responsibility do businesses have in helping to improve digital skills across every age group?**

More than 50% of people are employed in small businesses. Most of these are struggling to survive and so without funding, the amount of responsibility that can be delegated to them is limited. Large companies can and do support apprenticeships. But let's face it, a lot of the employees in large businesses are just as inept technically as those anywhere else. Instead of thinking in terms of "their responsibility" which seems to imply looking for someone to blame, it would be better to do some research to prioritise methods through which businesses can work most effectively with educators and government and then fund projects to make it happen. There are already sources of funding such as that from the Erasmus+ programme of the EU but combining this with teacher training would make better use of resources.

#### **5. How can schools ensure students acquire the digital skills and understanding they will need in the future?**

Firstly the curriculum has to reflect knowledge and understanding that underpins practical competences in current and new technologies. As identified above, research to establish the core transferable competences is badly needed. Editing text is fundamental and goes beyond word processing to web pages. Graphics manipulation is needed in many applications, audio and video are now routine media but with many technical issues from patent encumbered data structures to tradeoffs between different

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properties of file formats. There needs to be real incentives to make full use of the power of technology to support all learning and to provide credit for competence in doing this. The main difficulty is in changing the way teachers work and that will not happen without providing positive incentives.

## **6. What support is needed?**

The support needed is ironically in providing the technology to support collaborative learning coupled to the training of teachers to use it and understand its pedagogical basis. Collaborative approaches to assessment is a good starting point. Training a critical mass of teachers and clearly demonstrating how their quality of life can be improved will then make scaling much easier. Using things that all teachers have to do and making it simpler is the best incentive minimising costs. Some investment in training initially will proliferate if the learning really does make a difference.

## **7. What are the tripwires?**

The main tripwire is thinking that this is a technological problem. It is a pedagogical problem first with scope for technology to support some of the solution but the pedagogy has to come first. That pedagogy needs two key strategies. One is to improve learning based on research evidence and the other is to do it in such a way that will motivate take up. That is the tripwire because most well-intended initiatives usually fail due to the implementation not the policy.

## **8. How can schools make better use of technology in and out of the classroom?**

Start thinking really critically about whether constraints put on the way schools work with technologies are for the pupils' safety or to mitigate against legal action. Young people are using technology outside school, often unfiltered and unregulated. It is far more dangerous to let them continue to do that without understanding the issues than it is to teach them responsibility and why it is necessary. Most schools have not even scratched the surface of what is available for free yet there is constant pressure for more money to up grade to the latest gadget. While we want to reflect current and future technologies, the fact is that a lot of the most innovative stuff is innovative at

least in part because it is free. Children need to appreciate that while there is a saying that "you get what you pay for", there is also "a fool and his money are soon parted". Central government needs to provide clear leadership by adopting open systems and open standards across its departments and help drive the technical culture alluded to earlier in this document. Technological culture is not for someone else, it means you and me.

**9. How can we encourage better use of technology across all stages of education to teach students better, enrich their learning and improve efficiency?**

Provide the right incentives. Reward good and effective use and show disapproval of poor or inefficient use. OFSTED should have a role here but that means much better trained inspectors.

**10. What needs to be done to ensure that the new computing curriculum in England is successfully implemented?**

Provide clear examples of appropriate interpretations of the programmes of study and assessment. NAACE has already initiated a large scale project in partnership with Mirandanet and expects to make significant progress in the coming year. It will involve free on-line testing to ascertain pupil progress normalised against all other participants. It can be done for free for every school because we know how to use the technology to do it. It is simply a matter of motivating take up.

**11. What role can apprenticeships play in boosting the UK's home grown talent for digital skills?**

Apprenticeships can provide progression routes directly from the 14-19 provision to employment with a flexible mix of formal learning and developing competence in the work place. This is again related to a change in attitude to how assessment takes place. For most children, the school is their workplace so why not start in school with IT competence being judged directly from its support for real tasks in the classroom. That then transfers directly to competence based assessment by direct observation in the work place. Perhaps the most significant impact apprenticeships can have is in

improving school assessment and the professional status of teachers in carrying it out with low bureaucratic overhead.

**12. What would a really good apprenticeship in digital skills/IT look like? What would help companies of all sizes offer apprenticeships?**

Apprenticeships need to be based on learning outcomes in terms of competency in the workplace, under-pinned by the knowledge and understanding to enable change without having to be completely retrained when the technology changes. If we want small businesses to offer apprenticeships they need a low bureaucracy and low cost way to do it. If a company employs 10 people, taking on one extra person is 10% of the work force. If that then results in taking up another person in supporting the apprentice that is a bigger commitment still. Many such businesses are operating on a lot less than 10% profit margins and so it is easy to see how the funding of this is going to be crucially important.

**13. How can further education and higher education better equip students with the digital skills which are needed?**

In further education there is no significant difference to the needs compared to the school 14-19 situation apart from a progressive balance shift to more specific employment contexts. Focus on learning outcomes and competencies in relation to representative practical tasks and underpin them with fundamental knowledge and understanding. For Higher education require all students to contribute to an established open source project. This would add a dimension of practical useful outcome to academic study. It would also provide a significant boost to free community tools that can then be further built on by others adding value to community resources.

**14. How can careers guidance at every stage be improved to ensure that people receive the necessary information, advice and guidance to help them make informed choices? Who should deliver this advice and how?**

Set up a national careers wiki that can be kept up to date by the community. Similar to Wikipedia, this would get around the problem of keeping all the careers guidance

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professionals, many who are not specialists in digital technologies, up to date. It would be relatively inexpensive to set up and provide a ready made structure for eg employers to advertise apprenticeships and information about their business needs.

Ongoing learning and reskilling of the existing workforce will be a vital component of ensuring that the UK responds to the challenge of technological advance. How do we up skill the existing workforce – both in and out of employment?

Provide priority funding to adults that undertake TechLevel 3 qualifications in digital technologies or Level 1 and 2 progression pathways to get to level 3.

**15. How can we provide better opportunities for career transitions, career pathways for all ages?**

Provide coherent progression pathways through the levels of the qualifications and credit framework and provide incentives for the production of open courses eg MOOCs to support progression from lower to higher levels using a combination of formal and non-formal learning.

**Additional responses**

**1. Which digital skills are most urgently needed? What are the digital skills that will be needed in the future?**

- Data Scientists. We need new curriculum for this and above all better statistics in mainstream.

*Chris Yapp*

**2. How can perceptions of digital careers be improved? How can we help students, parents and teachers better understand the breadth of opportunity and the different entry points?**

- Involvement of community groups including employers and open source projects in courses and qualifications will act as a vehicle for understanding opportunity because the learning will then better reflect the needs of employers. We need national competitions to celebrate exemplary good work



that solves real world problems, more than contrived practical exams that mainly contribute to candidate selection.

A most important signal to send out is that practical technological competences are valued as much as academic attainment in exams. This means providing real incentives to teachers and their pupils to undertake really useful practical digital projects. Not just those pupils that can't achieve a C grade, but the A\*s too. Such projects will make the breadth of opportunity self-evident and might even stimulate a few more entrepreneurs. This is not going to happen while virtually all the credit is accrued from academic end of course exams. No-one is going to sacrifice league table positions, especially when managing and organising practical projects is much harder work than teaching intensively to pass a written exam. I'm not saying that we should abolish exams, I'm saying we need to think in a much more intelligent way about the effects of assessment methods on the way teaching and learning is implemented. How can we manage and organise assessment to incentivise the behaviours we want to achieve? It is obvious that assessment has a massive effect on the way teaching is conducted so we need to get out of denial and change the way we do it. It does not necessarily mean abandoning performance measures, it does mean doing assessment a lot, lot better.

*Theo Kuechel*

- System and business design. A lot of the challenges in the business world come from lack of project/programme management rather than the technical skills. However, the problems often start earlier by weak systems analysis. Agile methods help, but only if culture is supportive. So big need for full life cycle of problem identification and solution and delivery.

*Chris Yapp*

**3. What responsibility do businesses have in helping to improve digital skills across every age group?**

- Project-based curriculum needed for 2

*Chris Yapp*

**4. How can schools ensure students acquire the digital skills and understanding they will need in the future? What support is needed? What are the tripwires? How can schools make better use of technology in and out of the classroom?**

- With growth of wearable technologies (iwatch, google glass, etc.) there is already a shortage of people with IT skills and an understanding of biology. Many apps are based on sensory stimulus and the geeks make assumptions that are biological nonsense.

*Chris Yapp*

- To address the final question in this line, the basis of a good tool to achieve 'better use of technology in and out of the classroom' exists in the Naace SRF. There is also a (minority view!) argument for the effective use of technology to be integrated into inspection frameworks to encourage all schools to engage.

*Dominic Norrish*

**5. How can we encourage better use of technology across all stages of education to teach students better, enrich their learning and improve efficiency?**

- The digital economy is driven by small-team interdisciplinary work. I'm advising one that has 2 mathematicians, 2 graphic artists, a scriptwriter and a geographer (it's real world location –based. So very much re-iterating the IT across the curriculum.

*Chris Yapp*

- This was pretty much what Becta was doing... But seriously, to advance this cause in 2014, the evidence base needs to be improved significantly, so that schools can focus on the 'how' rather than the 'should we?' NFER's approach of mapping technology's affordances to teaching and learning techniques which have well understood and evidenced impact would, short of RCTs, seem to be a good starting point. For example, we know that high-quality and timely feedback has an impact – what role can technology play in enhancing this currently time-consuming and variable process?

*Dominic Norrish*

**6. What needs to be done to ensure that the new computing curriculum in England is successfully implemented?**

- Systems thinking and games skills are bottlenecks in UK today. Music skills are in high demand, especially composition of small interconnected pieces.

*Chris Yapp*