

Research Challenge: Socio-technical Change

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Central Question: Which technological developments may be most important to society over the next 25 years?

BLURRED BOUNDARIES AND PERMEABILITY

The major technological developments that I see being most important to society over the next 25 years cohere around the notion of augmentation/enhancement of human thinking capacity, activity, performance and communication through the use of computing technology both inside and outside the body. The key theme will be the blurring of distinctions between boundaries, at many levels – a blurring between the personal/private and the public; between the individual identity and group identity, and therefore between individual output and group output; between what is part of the digital landscape and what is 'reality'; between formal and informal learning; between work, play and education.

This blurring will be a result of the ubiquitous presence of computers that permeate the fabric of the environments we live in. Below is a series of snapshots from the web which capture some of the technological advances and some of their societal impacts:

UK Grand Challenge in Computing on Ubiquitous Computing

"There is burgeoning population of 'effectively invisible' computers around us, embedded in the fabric of our homes, shops, vehicles, farms and some even in our bodies. They are invisible in that they are part of the environment and we can interact with them as we go about our normal activities. However they can range in size from large Plasma displays on the walls of buildings to microchips implanted in the human body. They help us command, control, communicate, do business, travel and entertain ourselves, and these 'invisible' computers are far more numerous than their desktop cousins. How many computers will you be using, wearing, or have installed in your body, in 2020? How many other computers will they be talking to? What will they be saying about you, doing for you, or to you? By that time computers will be ubiquitous and globally connected. Shall we be able to manage such large-scale systems, or even understand them? How do people interact with them and how does this new pervasive technology affect society? How can non-computing people configure and control them? What tools are needed for design and analysis of these constantly adapting and evolving systems? What theories will help us to understand their behaviour?" (GC2/4 Ubiquitous Computing)

UK Grand Challenges in Computing Memories for Life

"This is a unique project, funded by the EPSRC, bringing together a diverse range of academics in a bid to understand how memory works and to develop the technologies to enhance it.

We are our memories. Our memories underpin every thought we have, every fact we learn and every skill we acquire. In today's technology-rich society this human memory is now supplemented by increasing amounts of personal digital information; emails, photographs, Internet telephone calls, even GPS locations and television viewing logs.

We believe bringing together psychologists, neuroscientists, sociologists and computer scientists will lead to a more effective use and management of both the human and computerised memory. It will place the technology in the context. The challenges that lie ahead include the development of prosthetic memories, the storing and retrieval of a lifetime's worth of memories and the issues of trust and privacy such databases will entail.

We aim to produce an understanding of what is common in memory systems and use that knowledge to improve efficiency, recall and information management across human, personal, social and work domains. This is a problem of international scope, and beyond what can be achieved by a single research team or research grant, and offers the possibility of revolutionary advance. As such, Memories for Life has been recognised as a Grand Challenge for computing, by the United Kingdom Computing Research Committee. The digital age presents opportunities that will impact on our memory needs. Memories for Life will foster the research." (GC3)

BioSecurity:

In a few years, we'll be using fingerprint, voice, iris, or retinal scans to log on to Web sites and make purchases. Sounds a lot better than storing passwords under your keyboard, right? But remember: Your body is your password--so don't lose it.

<http://www.pcworld.com/article/id,141682-page,2-c,desktoppcs/article.html>

The Holodeck (predicted mainstream date: 2016)

The long-predicted virtual-reality revolution may finally be imminent, thanks to the popularity of 3D movies and of online worlds such as Second Life. A future "holodeck" could be enhanced by scents shot at your nose by a "smell cannon." Japanese researchers are working on the device now. <http://www.pcworld.com/article/id,141682-page,4-c,desktoppcs/article.html>

Self-Aware Computers (predicted mainstream date: 2019)

Though unlikely to turn murderous (in contrast to the late, lamented HAL 9000), machines driven by artificial intelligence will, within 15 years or so, be handling many routine tasks.

<http://www.pcworld.com/article/id,141682-page,5-c,desktoppcs/article.html>

Future for ubiquitous computing

"Designing ubiquitous computing to be more manageable is one area of concentration, and Buxton envisions two possible development tracks for ubiquitous computing:

One in which a "**society of devices**" begins to complement each other and collectively improves user experience while simultaneously lowering the complexity of real-world engagement; and another in which chaos ensues ..." *Interview with Bill Buxton*

Self modifying computers

"Computers will read and alter their own source code, continually improving it and eventually overtaking human intelligence.

Computers will also be miniaturized as they become embedded in clothing, and each will be a node in a universal, self-organizing network where communications automatically find the most efficient path of transmission. **People and technology will converge ..."**

Ray Kurzweil: "IT Will Be Everything" Computerworld (01/09/06) P. 28

Semantic Web + self modifying computers?

- Networks that 'understand' what they are doing
- Networks that 'understand' the data they are carrying
- Networks that can configure and repair themselves
- Computers that can alter their own source code

TRENDS:

Always on, always connected:

This way of spending your life explicitly challenges the norms in society – you may be engaged in f2f conversation with someone whilst texting someone else; walking down the street chatting aloud to your pal through hands-free; through connectivity, you have the means to challenge accepted authority figures (e.g. teachers in school) by googling stuff. As teachers, we lose control and we lose certainty.

Social Software

The liberalising effect of putting huge amounts of computing power in the hands of individuals is realised in social software which supports community building, sharing, decentralizing, networking and creativity. This is potentially a huge challenge to traditional forms of education and educational institutions are wrestling with the problem of how to respond to what is a dialectical process - on one hand, according to some commentators, nothing more than a technological development (and fad), but which is regarded by many others as a fundamental societal change.

These trends challenge education on every front.

"Web 2.0 does represent a profound change in how people use the internet and more importantly interact with each other. This has big implications for education, because once people have been touched by the web 2.0 bug they expect the same kind of openness, decentralisation, flexibility, user control in other institutions. If one considers what this means in terms of educational context, assessment methodology, student interaction, what constitutes a course, the role of the academic, the learning environment, etc then there is little that is left untouched in higher education."
Martin Weller, The Open University

They also challenge what education is **for**. We know that the numbers of people signing up for formal courses in higher education is dropping, and in some subject areas this has reached crisis point. Why is that? Is it co-incidence? Are people finding other ways of satisfying their learning needs?

Social Software for Learning: What is it? Why use it? (Scott Leslie, Bruce Landon, The Observatory on Borderless Higher Education, Jan 2008):

- "How can we harness social software in a way that does not inhibit its effectiveness by trying to force it into institutional and pedagogical models in which it does not fit well?"
- When should we be facilitating social software for our learners and when should we just be getting out of the way of their own use of social software to support their own learning?
- How can we disaggregate the currently entrenched, monolithic learning management systems (LMS) that, far from enabling freedom, harnessing motivation or promoting openness, reveal in their very nomenclature a focus instead on control, on 'managing'?
- If LMS resist liberation, how then can they at least be transformed into platforms that better enable these freedoms instead of approaching them as afterthoughts, or added on 'features' to enclose within their walls?
- Following Dron, how do we design for learning in a way that leverages the advantages and successes of social networks?
- How can we "prepare for disruption" and "develop institutional capabilities for decentralized education technologies"?
- How can we shift from centralised approaches to ones which respect the ongoing nature of the learner and that their personal learning environment choices are neither accidental nor inconsequential, but instead integral to their ongoing success as lifelong learners?

If students are to cope with the increasingly complex problems they face, they will need to graduate not simply knowing 'what and how,' but also with the ability to tap into networks in which they've become situated not because of their credentials but because of their contributions, conversant with collaborative, distributed and rapid forms of co-production, co-operation and organisation. Social software, along with its sister phenomena of peer production, crowd sourcing, open content and the "mass amateurisation of everything," offers an opportunity for both pedagogical and organisational transformation that can result

in lifelong learners and permeable organisations which are an integral part of, instead of apart from, true borderless higher education.”

Enabling technologies

- **Miniaturisation** of computing technology: e.g. dust, motes; computers in jewellery, clothing; computers embedded under the skin, in the hair.
- **Mobility**: Not only in developing slicker devices, but also the infrastructures in wireless coverage etc., Expectations are that we can perpetually connect wherever we are, thereby enabling the experience of continuous connection across time, space and device (flow computing).
- **Artificial Intelligence**: on a distributed model of just-in-time, at point of need, small, targeted intelligent behaviour, aggregating to massive augmentation of human capacity

OVERARCHING QUESTIONS:

1. Will we really find ways of letting go control, at many levels of society, to enable the realisation of some of these potentials? Authority is an important element of our society, so we usually defend the status quo robustly. Will we need to change?
2. Will the educational system become an integral part of the digital environment, as opposed to being embodied in school buildings and campuses, curricula and examinations? Will it be free of charge, or something you can buy off the web?
3. Will people really be able to self-actualise as learners in control of their own destiny? How difficult a proposition is this for some people? What does success depend upon? Previous background, natural disposition, social class?
4. Is there any actual developmental impact of these technologies on the way young people ('millennials', Generations X, Y, Z) think? Some work is already going on in these areas (e.g. the New Millennium Learners project, as well as a great deal of work in marketing). How will generations relate to one another when their life experiences are, potentially, so significantly different?
5. There are also issues, perhaps analogous to the mixed responses society has to body piercing, about computers embedded in the body. Those embedded for medical purposes are unlikely to cause much concern, but embedding computers in the body for recreational purposes, decorative purposes or learning purposes may cause consternation. Is it ethical? If we were told that, far from having identity cards, we would insert a microchip in every baby – is that ok? In what way might any of these things advantage/disadvantage certain individuals or communities?
6. How will we be able to maintain the distinction between 'real life' and digital experiences? These are already blurring (e.g. being able to buy Second Life artefacts on eBay) and we are only in very early stages of this particular journey. Will the distinction matter? If so, when and why?
7. What will be the effect on educating our society in terms of the political landscape that they perceive around them? How will people get access to information (who provided it, and how will we know who provided it?); how will we judge the validity of the information we receive? how will we form groups of like-minded others (e.g. Daily Mail readers?), how will we form opinion and articulate our views about society, and how will we demand the country be run? A great deal of people's lives will be open to scrutiny in ways we can't even imagine yet – if we blog an unpopular opinion, what is likely to be the backlash? Will government be open to the same level of scrutiny?

Disciplinary Domains

This would be a highly interdisciplinary enterprise, involving psychology, developmental psychology, philosophy, computer science, education, learning sciences, educational technology, social science, neuroscience.

Who to engage?

Many people/groups/organisations are engaged in this kind of research at the moment. It would be part of the challenge to chase these down and build a directory.

Focus

A key focal point has to be young people – does their experience of technology make them think differently about society in general? Or is that a problem hallucinated onto the situation by older generations? Is it as big a deal for young people as it is for their elders?

There are studies around about these issues, but some useful work could be done to pull the findings together into a coherent body of knowledge.

Uncertainties

This field is a stage on which the major players in state/private education are stalking one another. Many state institutions find government funding too fickle to depend upon, so are keen to extend their funding models and bring in more income. This entails discussions with private companies providing education through technology (e.g. the large publishers) who are keen to expand their markets in order to make profits. The impact on the HE sector could be massive, and it is not an easy time to be making predictions.

Again, a literature/web search to identify and pull together what is happening would be very useful.

Stakeholders

Work in this area should command the interest of ministers and policy makers because it relates to all aspects of society's engagement with education, and politics (and therefore the means by which people express their political opinions in elections).

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