Beyond Current Horizons

technology, children, schools and families

New technology and habits of mind

Eva Vass

University of Bath

December 2008

> "When I was a child, I was sometimes allowed, as a special treat, to look at my grandmother's stereopticon slides. You looked at two pictures side by side through a pair of glasses and they blended into one three-dimensional image of a peculiar world, often long-skirted women wearing floral hats and holding bicycles. Today, I realize that riding a bicycle was the mark of a confident and modern woman liberated from the strictures of Victorian society. And now, through the lens of my grandmother's mind, I think I can see a picture of that distant pre-scientific world." (Flynn, 2009, p87)

Abstract

The centrality of technology in human life has manifested itself throughout history in all cultures and civilisations. This paper examines the role of new technology in restructuring processes of thinking and knowing, and its impact on social practices of knowledge building. It highlights the transformative force of new technology, necessitating changes in our 'habits of mind' to manage the increasing complexity of the contemporary information landscape. Also, it shows that convergent new technology remediates processes of shared knowledge building, creating virtual, collaborative, continuously evolving arenas of activity. Thus, new media contexts afford new forms of social collectivity in virtual space, requiring a fresh understanding of collective action and creation, the ability to belong to different social groups that may not meet face-to-face, the skills to artfully reconnect thought and practice in a simulated world, and the confidence to establish new relations to authority.

Keywords: technology, learning, habits, mind, participation, interaction

1. Technology and human practices

Technology has always been at the core of human practices, mediating our engagement with, and involvement within, our social and physical environment and shaping what we know, how we develop and how we use this knowledge. Cole (1998), taking a socio-cultural perspective, explains the mediational essence of technology as follows:

> "The environment in which human beings live is an environment transformed by the artefacts of prior generations, extending back to the beginning of the species. The basic function of these artefacts is to coordinate human beings with the physical world and each other; in the aggregate, culture is seen as the species-specific medium of human development." (1998, p17)

In this sense, the environment of the infant is not a natural habitat but one created by people (Macmurray, 1961). Culture does not only supplement and extend human capacities and skills, but it is seen as a key ingredient of them (Cole, 1998). The mediating function of cultural artefacts in human activity – including technical or material tools as well as psychological ones such as spoken language – has implications for social practices and identity formation. The emergence of new tools is often associated with the redistribution of power and authority, and seen as the key determinant of the relationships between the individual and the community (Nsamenang and Lamb, 1998; Rogoff, Mosier, Mistry and Göncü, 1998; Schieffelin and Ochs, 1998; Super and Harkness, 1998). As Nsamenang and Lamb remark, "both social and technological intelligence are embedded in the ecocultural imperatives that focus and channel individuals to acquire the right moral posture, the appropriate social graces, and the technical skills required for acceptable, functional membership in the culture" (1998, p251).

McLuhan (1964) describes three major technological eras in human history, the periods of oral communication, literacy, and that of electric flow of information. Each of these periods had its characteristic arrangements for human practices, including specific educational technologies for knowledge building. Thus, educational practices and theories mirror and converge with the technological trends that are dominant in a particular cultural-historical period (Wegerif, forthcoming; Sharples, Taylor and Vavoula, 2007). For instance, the establishment of Western education in the first half of the 20th century reflected the goals and needs of the industrial economy (Sawyer, 2006, p41). This led to the emergence of child-focused educational institutions which have been organised around the transmission model of learning (also referred to as factory-style 'assembly line instruction' (Rogoff, Paradise, Arauz, Correa-Chavez and Angelillo, 2003).

In turn, each new culture centering around an emergent technological tradition constitutes a social platform for experimentation with new ways of thinking and being (Allan and Lewis, 2006, p844). In the industrial era, such experimentation was focused around 'producing' knowledgeable children in a factory model: "Our schools are, in a sense, factories in which the raw products (children) are to be shaped and fashioned into products to meet the various demands of life" (Cubberley, 1916, p338, in Rogoff et al, 2003, p181). The technological transformation contemporary cultures are witnessing heralds the start of the 'electronic era' (Logan, 2004) or 'the Network Society' (Castells, 2000), where electronic information networks provide the basis for the organisation of societal structures and activities. The novelty of these networks is that they afford opportunities for social interaction that are temporarily and spatially unbounded. Such networks foster community building and sharing of a virtual kind, and enable the participants to experiment with and develop virtual or 'alternative identities' (Cliff, O'Malley and Taylor, 2008 p19).

There has been a growing interest in exploring and predicting the benefits and potential dangers of the current technological advancement. In particular, the implications for education and schooling have been hotly debated. For instance, with regards to the impact of new technology on 'Generation Y' (people born between 1978 and 1993, followed by the 'Google Generation', born after 1994) Weiler describes the moral panic as follows:

> "Much commentary has been circulating in academe regarding the research skills, or lack thereof, in members of "Generation Y"... The students currently on college campuses, as well as those due to arrive in the next few years, have grown up in front of electronic screens: television, movies, video games, computer monitors. It has been said that student critical thinking and other cognitive skills (as well as their physical well-being) are suffering because of the large proportion of time spent in sedentary pastimes, passively absorbing words and images, rather than in reading." (2004, p46)

But are these current changes truly that detrimental? Or rather, are we encountering (and resisting) yet another technological juncture, a major technologically-induced transformation in thinking, learning and knowing? If so, our most crucial challenge is to understand how new technology restructures (augments, enhances or constrains) our thinking capacity and performance. Responding to this challenge, this paper looks at the recent technological impact on our cognitive capacities and intellectual endeavours.

Habits of mind

The accelerating rate of IQ increase in most developed countries in the last century has baffled social scientists for decades. Psychometric reports indicate that the mean IQ of school children a hundred years ago would have been just under 70 (Flynn, 2009), at the lower end of today's IQ scores. Jim Flynn points out that the gains over time are so incredible that one could be driven to the rather absurd conclusion that most of our ancestors from the early 20th century were mentally retarded (Flynn, 2009). Flynn uses the concept of 'habits of mind' to offer a more attractive explanation. He argues that the average person today is more habituated to the kind of abstract, hypothetical logic valued in IQ tests (eg the Wechsler Intelligence Scale for Children, WISC), and so they will gain better test scores than their grandparents. In turn, he associates this relatively recent cognitive habituation with the shift from pre-scientific to post-scientific operational thinking (a cultural tool or technology in itself), describing this process as the result of 'reciprocal causality': "if an activity causes a rise in a cognitive skill, then that enhanced cognitive skill must be a pre-requisite for performing that activity" (2009, p86).

Cognitive habituation is not simply a historical issue, but a cultural one. For example, the habituation of the average individual to abstract logic and hypothetical problem solving is prevalent in Western, literacy-based cultures, but uncommon in communities unexposed to post-scientific operational thinking. The following brief episode from Luria's interview-based studies among peasants in the Soviet Union illustrates Flynn's point (Luria, 1976, cited in Flynn, 2009, p80).

> *White bears and Novaya Zemlya (pp108-109)*
> Q: All bears are white where there is always snow; in Novaya Zemlya there is always snow; what colour are the bears there?
> A: I have seen only black bears and I do not talk of what I have not seen.
> Q: But what do my words imply?
> A: If a person has not been there he cannot say anything on the basis of words. If a

> man was 60 or 80 and had seen a white bear there and told me about it, he could be believed.

The dialogue reveals a startling discrepancy between the abstract reasoning and pure logic emphasised by the researcher and the mindset of the research participant, who insists on the importance of experience in making assumptions and decisions about the world. As Flynn comments on the pre-scientific mindset of our ancestors and non-Western cultures, "Their minds were simply not permeated by scientific language and they were not in the habit of reasoning beyond the concrete" (2009, p82).

It is easy to see the link between such variations in cognitive habituation and our use of technology, which makes Flynn's position an extremely useful starting point. The observed IQ gains imply technologically induced changes in our ways of thinking, being and positioning ourselves in our world. If, as he puts it, these changes signify a 'liberation of the human mind' (2009 p82), then it is a priority for social research to investigate the potentials and possibilities brought forward by more current technological advancements. This paper adopts 'habits of mind' as an overarching concept and explores the changing cognitive demands associated with new technology, with special focus on the internet, computer/video games and television.

2. Thinking, learning and technology

Different theoretical frameworks conceptualise learning in various ways, with significant variations in terms of the role assigned to the learner and the teacher, the relevance attributed to the context, and the description of processes and outcomes of learning. Similarly, there are differences in the assumptions about how technology shapes human cognition and action.

Traditional cognitive psychology restricts the study of human thinking to mental processes that occur *within* the individual. This approach is encapsulated by the information processing perspective, where the mind is conceptualised as an information processing device with symbol systems and mental structures that change and transform as a result of perceiving, interpreting and incorporating new information. In recent decades an alternative perspective has been gaining ground, defined by some as the situativity perspective, where the focus is "on interactive systems of activity of which the individual is only one part" (Derry and Steinkuhler, 2003, p803).

Contemporary situativity approaches can all be linked to Lev Vygotsky's theoretical framework, which emphasises the mediating role of the social and cultural context in human practices. They encompass, among others, situated cognition (Lave, 1988), socio-cultural theory (Wertsch, 1998), activity theory (Nardi, 1996), embodiment theory (Glenberg, 1997) and distributed cognition (Hutchins, 1995). Most importantly, theories linked to this perspective refute the idea that the mind of an individual can be studied in isolation, extracted from the surrounding environment. Gee (2008) documents the consequent emergence of new descriptors for thinking, such as 'embodied' (Clark, 1997), affective (Damasio, 1999, 2003), technological (Hutching, 1995, Latour, 1999) interactive (Greeno, 1998; Lave and Wenger, 1991) and sociocultural (Gee, 1992) (all cited in Gee, 2008).

Learning therefore is seen as "the acquisition of many specialised abilities for thinking" (Vygotsky, 1978, p.83), or growing expertise in the use of available and valued cultural

tools (Säljö, 1999). Motivation for learning is inextricably linked to membership, expert status and full participation in the relevant 'communities of practice' (Lave and Wenger, 1991). It is worth reflecting on the epistemology of practice, as it largely determines what issues are seen as important, and structures the way in which those issues are addressed and resolved. Thus our epistemology of practice basically shapes (and is shaped by) our cultural context, developing into an epistemic frame or the 'grammar' of the culture (Shaffer, Squire, Halverson and Gee 2005, p107). Technology of any sort has the capacity to both expand as well as constrain the repertoire of cognitive competencies (Rogoff, 2003). Equally, technology is transformed via the process of appropriation by its users who 'make it their own': "the cultural tool both lends itself to being used in various kinds of ways and at the same time imposes various kinds of constraints" (Light and Littleton, 1999, p11). The concepts of co-evolution or reciprocal causality are therefore especially useful when examining the relationship between learning, thinking and new technology (Bruckman, 2004).

What is so special about new technology?

In order to address this question, we need to turn to Logan's (2008) conceptualisation of new technology, or 'new media'. He reminds us that any technology can be regarded as 'new' in any given situation, as long as it is "new to the context under discussion" (Logan, 2008, p5). In our contemporary contexts, the term 'new media' is typically used to denote forms of digital media that are interactive in nature, afford two-way communication and build on a certain level of computing (Logan, 2008). Buckingham (2007a) lists the internet, mobile phones, computer games, and interactive television as forms of digital media. Other commentators link new media to the notion of *convergence* (Jenkins, 2006a), ie the possibility of combining different technologies, applications or modes of communication such as text, audio, digital video, mobile devices, the Web and so on; *remediation* (eg Bolter and Grusin, 1999) ie old and new media mutually refashioning each other; *interactivity* which is interaction between users and between user and technology. These concepts remind us of McLuhan's crucial point regarding the relationship between old and new technology: "A new medium is never an addition to an old one, nor does it leave the old one in peace. It never ceases to oppress the older media until it finds new shapes and positions for them" (1964, p278).

In what follows, this paper explores four core themes related to the issue of technology-mediated changes in cognitive habituation: i) exercising the mind; ii) information behaviour, iii) connectivity and symbolic social networks; and iv) merging roles.

3. Changing habits of mind

3.1 'Exercising the mind' (Johnson, 2005)

In a recent article, Nicholas Carr talks about the web 'rewiring' the 'neural circuitry' of regular internet users, such as bloggers. He reflects on his personal experiences as follows:

> "I am not thinking the way I used to think. I can feel it most strongly when I am reading. Immersing myself in a book or a lengthy article used to be easy… deep reading that used to come naturally has become a struggle… Once I was a scuba diver in the sea of words. Now I zip along the surface like a guy on a jet-ski." (2008,

p2)

His reflections mirror popular, widely publicised sentiments about the way new technology (such as electronic or video games and television) 'stupefies' the consumers of contemporary culture, creating new generations of virtual non-readers "for whom maturity is a process of mental atrophy" (Andrew Solomon, cited in Johnson, 2005, p18). Embedded in this negative view is the conceptualisation of reading as fundamental in developing cognitive skills associated with attention, concentration, sustained effort or the use of imagination. In contrast, the use of popular electronic media is not seen as a form of mental exercise, and is often deemed as educationally worthless or even detrimental.

So how does new technology affect our habits of mind through the mental exercise it promotes? Let us look at representation first. Kress and Van Leeuwen (2006) argue that modes of representation, for example textual or visual modality, vary across culture and time. A significant impact of new technology - intensified by the blending of the internet and digital media - is that textual representation has lost its long-lasting dominance: "most texts now involve a complex interplay of written text, images and other graphic or sound elements, designed as coherent (often at the first level visual rather than verbal) entities by means of layout" (Kress and Van Leeuwen, 2006, p17). The richness of representation that we are exposed to in contemporary contexts is in sharp contrast with the singular modality of traditional textual (or print-based) media.

It is quite likely that such complexity puts new cognitive demands on the individual, requiring swift switches between segments of information presented in different modalities. Also, according the CIBER (Centre for Information Behaviour and the Evaluation of Research) team at UCL (University College London), new technology may enhance the parallel processing skills of young users (CIBER, 2008, p18). On the other hand, the mind habituated to the swift processing of multimodal representation may find it hard to re-adjust to traditional fully text-based representation. Oblinger (2008) notes that students regard the primarily textual communication characteristic of educational institutions as 'flat' and prefer to be engaged in more sensory-rich activities. Also, Buckingham (2007b) contends that children find it easier to understand audio-visual media content than verbal (printed or textual) content.

A related issue is multi-tasking. That the younger generations are capable of multi-tasking is highlighted in the academic literature. As a young Net Generation user admits: "I'm usually juggling five things at once" (Windham, 2007, in Oblinger, 2008, p11). However, this may not be a general life-style trend; the CIBER team (CIBER, 2008) report no decisive evidence that younger generations multi-task in every area of their lives. Nevertheless, it is obvious that our minds are now habituated to a different kind of exercise regime which draws on specific features of new technology. We are challenged by, and we respond to, the interactivity, multimodality and sensory richness of our contemporary information landscape.

A similar argument can be made when looking at the changing pace of television programmes and films. Bordwell (2002) notes that, over the last 40 years, Hollywood films have become much faster, from 300 to 700 shots per film in the 1930-60s to 3000-4000-shot movies by the century's end. (The average shot length has shortened from 8-11 seconds per shot to 3-8 seconds, with some films even going below 3 seconds per average shot, eg *The Crow, Sleepy Hollow, El Mariachi, Dark City* or *Armageddon.*) Even when the frames are kept longer in contemporary cinema, the camera stays in motion, contributing to the fast pace of the imagery. Although the speed does not typically reduce the coherence of the plot, "the style aims to generate a keen moment-by-moment anticipation... look away

and you might miss a key point" (Bordwell, 2002, p24).

This trend is explored further by Johnson (2005). He points out that, contrary to the popular opinion that mass media 'dumb consumers down', contemporary television culture is actually getting more and more cognitively challenging. In addition to the changing pace, he also notes multiple threading, with as many as 10 parallel threads in a plotline (for example, the lives and adventures of 21 characters are intertwined in an episode of the TV series *24*). Furthermore, different threads may actually be layered on the top of each other in one single scene (eg in *Sopranos*). Multi-threading has been a popular feature of TV soap operas for decades. What is unique in the contemporary trend is the combination of parallel threading with subtle narration that covers serious themes and topics and offers little or no 'hand-holding'.

According to Johnson, the narrative complexity requires a level of intellectual labour unseen in early television. So the intellectual work that once happened on-screen now happens off-screen: instead of being led through the narrative by carefully positioned signposts that draw attention to significant details ('flashing arrows', as Johnson puts it), the viewer is challenged to do all the analytic work and make sense of the plot with limited support. The cognitive complexity of popular TV programmes (eg *Lost*) has led to the creation of online forums and blogging communities (eg abclost.blogspot.com, a blogging site for *Lost*).

Partially, such increase in mental stimulation may be the consequence of what the average person is habituated to today (eg through exposure to computer or video games). Therefore, the average viewer can handle such cognitive complexity and, using the concept of reciprocal causality, has become habituated to this sort of multi-layer, circumspect approach to thinking and problem solving.

Finally, let us look at the issue of exercising the mind in the context of gaming. Computer and video games are often blamed for the reduced attention span in younger generations, who are probably the most enthusiastic and regular gamers. (In his review for CIBER, Barrie Gunter (2008) reports that 50% of the 5-15 year olds in the UK play computer or video games on a daily basis.) Linked to this assumption is the claim that younger generations are used to and need to be entertained otherwise they lose interest quickly (eg Kipniss and Childs, 2005; Hay, 2000, both cited in Williams and Rowlands, 2008). This claim is refuted in the CIBER report (CIBER, 2008) which, based on extensive review of research, found no conclusive supporting evidence. Similarly, one could argue that the real impact of games on cognitive capacities is masked by our focus on the changing performance and attitudes of the younger generations in formal educational contexts.

Contrary to popular belief, gaming does not necessarily provide instant gratification and quick entertainment. Computer games require attention, motivation and perseverance for long stretches of time, quite often coupled with extensively delayed rewards (Johnson, 2005). Consequently, the problems reported in formal educational contexts are less likely to be due to the reduced ability among students to keep focused and work hard on a task. They are more likely to be explained by the way in which learning opportunities are organised in formal school contexts to structure and facilitate particular ways of thinking and participation.

In the context of video or online gaming, new technology opens up spaces for new cognitive strategies uncharacteristic of formal school settings, which Johnson describes as 'probing and telescoping'. These new 'habits of mind' are stimulated by the unpredictable, continuously evolving, hugely interactive and 'collateral' learning experience found in gaming culture (Johnson, 2005). Furthermore, as Johnson warns us, popular culture is not

suited well to exercise our minds in the traditional sense, "to follow a sustained textual argument or narrative that doesn't involve genuine interactivity" (2005, p187). Thus, regardless of how advanced young gamers may be in meeting the complex cognitive challenges in informal gaming contexts, their skills will not equip them for the intellectual work required at school. Equally, interactivity and participatory approaches are not typically encouraged in education, which may also explain the problems young generations encounter when engaging in intellectual activities in formal learning contexts. Buckingham sees this as the 'new digital divide' (2007a), a growing gap between the young generations' experiences with new technology outside the classroom, and their school based experiences (including those involving new technology).

Even though media education and information technology (or ICT) are becoming well-established in the UK and elsewhere (see Erstad, Gilje and de Lange, 2007, for an interesting account of the Norwegian context), young people often find the use of technology at school "boring, frustrating and irrelevant in their lives" (Buckingham, 2007a, p112). Similarly, in his report on an attempt to incorporate games in A-level Media Studies, McDougall (2007) describes both students' and teachers' difficulties with bridging the gap between informal gaming for pleasure, and gaming as a school-based activity with specific assessment outcomes. As a student reflects on their bafflement: "Conventionally, education is not something you do for fun as a child" (McDougall, 2007, p129).

Note, however, that from the point of view of interactivity and participation, the critique of our education system is not particularly new. For example, Rogoff and colleagues (Rogoff et al, 2003) carried out intensive research on the cultural-historical dimensions of how learning and teaching is structured in different societies. Their research identified the major limitations of the Western-style assembly-line instruction model, when compared to the intent-participation model prevalent in non-Western cultures (eg indigenous Mexican communities). Rogoff and colleagues maintain that the main problem with formal education as we know it is that it segregates the child from the ongoing cultural activities and social practices of the adult world. Consequently, formal educational practices remove the intrinsic motivation to learn that is inherent in the participatory framework of intent-participation settings. Importantly for this paper, new technology removes some of the barriers to participation and interaction which have been associated with the educational model of the industrial era. It helps us return to a more participatory and more interactive framework. However, we also need to emphasise that the participatory and interactive frame afforded by new technology is largely virtual and symbolic in nature, in contrast to the intent-participation cultures examined and documented in Rogoff and colleagues' work (2003).

To conclude, there is clear indication that new technology changes our ways of 'exercising the mind.' The real issue is not whether new technology leads to quantitative changes (eg decreasing or increasing our attention span), but how exactly it resources and channels human thinking, establishing new, qualitatively different exercise regimes for the mind. The emergence of new technologies seems to have fostered and stimulated new styles of learning and thinking of increasing complexity, with a clear emphasis on interactivity and participation.

One possible reason why the positive aspects of this cognitive re-habituation are not more widely recognised is that most of the activities associated with new technology are leisure-based. As Riley (2008) points out, youth culture is often seen as pleasure-centred. The leisure activities afforded by new technology can thus easily be interpreted as new forms of pleasure-seeking, with the amount of time spent on games, internet or television indicative of intoxication. The concept of 'habits of mind' gives us an alternative angle, one which recognises the source of motivation for contemporary leisure activities in the cognitive

challenges they pose, and in the satisfaction gained from skill mastery. Thus, as consumers of leisure media, we are habituated to novel, complex forms of intellectual engagement. Such "enhanced problem solving in visual and symbolic contexts... is necessary if we are to fully enjoy our leisure" (Flynn, 2009, p86). If this is so, our leisure orientation has changed and, in turn, it has transformed our thinking. This cognitive shift has a clear impact on what sort of intellectual challenges we seek, both in leisure-based activities and in non-leisure learning situations.

3.2 Information seeking behaviour

The second theme, interlinking with the previous one, concerns the ways in which new technology has impacted on our information seeking behaviour. Contributing to the extensive CIBER project (CIBER, 2008), Williams and Rowlands's (2008) review concludes that, in recent decades, the internet has become a crucial medium for education, recreation and communication. Most importantly for this section, the internet has become the main source of information for students either for personal, academic or professional purposes. Commentators also note the increasing discrepancy between information seeking in printed texts versus internet based, digital information seeking. The CIBER team's report (CIBER, 2008) lists the following key features of digital information seeking behaviour:

- 'horizontal information seeking' (skimming, reading 1-2 pages of an online source then 'bouncing back', and often never returning)
- navigation (extended time spent on finding one's way around)
- 'power browsing' (relatively little time spent on each site)
- 'squirreling behaviour' ('squirreling away' material by downloading it)
- checking the reliability of information by quick 'cross-checking across different sites' (p10)

But how is this new information behaviour facilitated and resourced by the internet? To address this question, we need to return to the issue of representation. Linked to the visual/textual divide is the topic of linearity and the availability of paths for comprehension.

> "In densely printed pages of text, reading is linear and strictly coded. Such texts must be read the way they are designed to be read - from left to right and from top to bottom, line by line. Any other form of reading (skipping, looking at the last page to see how the plot will be resolved or what the conclusion will be) is a form of cheating and produces a slight sense of guilt in the reader." (Kress and Van Leeuwen, 2006 p204)

In contrast, partially due to the multimodality of the internet, reading paths on a web page may be circular, diagonal, spiralling and so on. According to Kress and Van Leeuwen, reading paths shape and contribute to the meaning. In essence, we are faced with two modes of reading, or 'two regimes of control over meaning'. Linearity means that the order and connection between the elements is set, therefore the meaning does not have to be conveyed in the individual elements (Kress and Van Leeuwen explain this as a 'syntagmatics' imposed on the reader). On the other hand, non-linearity requires a 'paradigmatics': elements are selected and presented according to some sort of a paradigmatic logic, but the reader has the freedom to put these elements in order and link them together:

> "In the design of such texts there will be pressure to put more of the meaning in the

> individual elements of the composition, to use more highly coded images - symbolic and conceptual images, tightly written, self-contained items of information, stereotyped characters, drawings or highly structured images rather than realistic photographs, and so on." (2006, p208)

In addition to the features of multi-modality and non-linearity, another crucial characteristic of websites is that they offer various reading paths. Although there might be some sort of a hierarchy embedded in the design of a webpage, whereby the reader can identify the most salient elements and navigate in between them using the 'suggested' route, these reading paths are not prescribed or mandatory. Yet, the multiple pathways that websites offer are not random either, but created as 'plausible' reading paths. Alternative reading paths mean that the reader can decide how to traverse in the textual space. In this sense, they are more 'interactive' than print-based texts. The viewers who 'power browse', skim read and hop from site to site make use of these salient representational features of the web (which can also be seen in billboards, newspapers or advertisements).

The image of users traversing through "the crazy quilt of the internet media" (Carr, 2008, p3) brings us back to the dominantly interactive and participatory nature of cognitive practices facilitated by new technology. Internet, or new technology in general, is not simply a new resource for the same activities (in this case, information seeking), it fundamentally changes the activities it is used for. But how can we explain the necessity – or the value – of such changes in predominance from linearity to non-linearity, from textual to multimodal representation, from a single, mandatory comprehension path to a range of possible reading paths? And what are the benefits of these changes in terms of our cognitive capacities of information processing?

In his recent account of *information foraging theory***,** Pirolli (2007) describes such changes as a process of cognitive adaptation, necessitated by the human *informavore*'s (Miller, 1983, in Pirolli, 2007) propensity for information foraging. From an evolutionary perspective, technological turning points help create more efficient ways to manage our increasingly rich 'information environment' in a co-evolutionary fashion: our epistemic drives and strategies (or technologies) co-evolving with the environment. One can see each revolutionary turning point in human technology (eg the shift from orality to literacy, the introduction of printing press, the appearance of electric devices or that of electronic and digital media) as enhancing the process of gathering, using and producing relevant information or knowledge. Our amplified information-foraging efficiency equips us with knowledge and skills to deal with the growing complexity and richness of our information environment. At the same time, the technology developed for our enhanced efficiency contributes to the further increase in the complexity of the information environment we have created. So for example, the abundance of information that we need to wade through and consolidate on the internet causes what Pirolli refers to as 'poverty of attention' (2007, p13) thus requiring new, more efficient ways of information search and management.

Inevitably, our increased efficiency has potentially negative repercussions. These can be explained by the shifts in cognitive habituation, with changing attitudes towards traditional technologies such as reading. Carr (2008) suggests that heavy internet users (eg bloggers) may give up on reading books altogether. Johnson (2005) too, talks about "the death of the typographic universe" (Johnson, 2005, p185), often attributed to the dominance of popular culture. Consequently, as Leon Watts (2008, personal communication) contends, we are "habituated to marshalling and consolidating volumes of information at the expense of reflection on the rhetorical integrity of an individual force". Interestingly, we can see this trend filter into forms of traditional media; Carr (2008) notes that the New York Times now dedicates its second and third page to article abstracts, for the 'hurried reader'.

But will we ever stop reading? Will the kind of intelligence associated with deep, sustained reading truly disappear, only to be found in the remaining havens of formal educational institutions? And if so, is this a problem? Maryanne Wolf (2007) argues that reading is not an instinctive skill which therefore needs to be consciously practiced. If so, contemporary users of new technology may not develop a routine for regular reading practice. Furthermore, Wolf notes that sustained, undisturbed deep reading creates a platform for 'deep thinking': contemplation, the formation of associations or inferences, and imagination. Following this argument, one could conclude that the jet-ski type of reading characteristic of internet users is detrimental to our intellectual development in traditionally valued directions.

Yet other commentators are more positive. Williams and Rowlands (2008) note that the extent of reading in the UK has not reduced in recent decades. On the contrary, we seem to read more today than a couple of decades ago: with regards to book reading, the documented increase is four minutes per day (from an average of three minutes per day in 1975 to an average of seven minutes in 2000), with a similar increase in reading newspapers and magazines. Williams and Rowlands (2008) also cite a recent study by Synovate (Synovate 2007) revealing that 49% of young people read regularly; and a report by Clarke and Foster (2005) on the positive attitude of UK-based primary and secondary school pupils towards reading. In line with these findings, Jenkins (2006c, p19) argues that new forms of literacy do not replace textual literacy. Nevertheless, they argue that traditional literacies must respond to the media change, to ensure that traditional literacy skills are maintained and harnessed in the technological expansion of human skills and capacities.

In terms of the negative aspects, we also need to emphasise the technology-induced changes in our information environment. Buckingham (2007a, p113) reminds us of the "mass of confusing, contradictory and often unreliable information found in new media such as the Web". Recent studies challenge the popular assumption that younger generations - the 'cyberkids' and 'digital natives' of the Google generation - somehow have the inherent capacity and technological expertise to master the complexities of the new information landscape. Being 'techno savvy' may help with technical issues (eg how to navigate on the internet), but it does not turn someone into a search expert with 'information fluency' (Oblinger, 2008). For instance, the CIBER team's report (2008) indicates no improvement (or deterioration) in young people's information skills, and concludes that "digital literacies and information literacies do not go hand in hand" (p20). Similarly, Jenkins (2006c, p15) talks about the 'transparency problem' both in terms of internet use and computer gaming. They mention Howard Gardner's work on young users' evaluation of websites indicating that in their decisions on the credibility of information, format and design weighed more than actual content. Jenkins also highlights that gamers may be good at reflecting critically on the format and the design of the game, but not on the impact of the game on their own thinking and being: how the whole game-world may structure their 'perception of reality'. Thus, users – regardless of their technical expertise – need guidance and support in developing new media literacy skills or 'information fluency' (Oblinger, 2008). In other words, new media users need to become critical consumers and understand

> "the ways media representations structure our perceptions of the world; the economic and cultural contexts within which mass media is produced and circulated; the motives and goals that shape the media they consume; and alternative practices that operate outside the commercial mainstream" (Jenkins, 2006c, p20).

This section outlined the links between changing patterns in information seeking and the

unique features of our contemporary information environment. Once again, we saw how technological transformations necessitate changes in our habits of mind, specifically, how they structure, channel and constrain the ways in which we access, process and use information. The next two sections will focus on the technological restructuring of social practices.

3.3 Virtual forms of collective experience

Games: isolation or simulated experience?

New media are often blamed for the physical and social isolation of the younger generations. For instance, the largely sedentary activity of video or online gaming is often seen as responsible for the hyperactivity and listlessness observed among many youngsters (Jenkins, 2006b). We need to problematise this popular belief, and recognise the role of earlier technological changes (eg those linked to transport) in the reduction of children's mobility and space. In this sense, new media can be seen as preserving or recreating what is lost through the world of virtual free play.

Children's loss of independent mobility, their removal from the outdoor environment and consequent domestic confinement has been the subject of growing body of research (Freeman, 2006). Piaget and colleagues once wrote that "At nine or ten, a child is free as a man and can roam at will all over the town" (Piaget, Inhelder and Szeminska, 1960, pp23-24). Today's children do not have such independent mobility. The development of new transport systems (especially private vehicles) as well as the redesigning of the urban landscape (with the centralisation of facilities in leisure complexes and shopping centres) has led to the disconnection between where children live and where daily activities (school, leisure, shopping etc) take place. Thus, children are now dependent on their parents and other familiar adults to transport them around from one activity setting to another. Linked to this, parents have grown increasingly concerned about their children's safety; in Valentine's report (1996, in Freeman, 2006) 34% of interviewed parents with children aged 8-11 saw cars as the most potentially dangerous aspect of children's environment. Furthermore, the removal of children from their local communities has led to another trend in children's socialisation which commentators refer to as 'stranger danger': the growing weariness of parents of the potential threat posed by strangers in the public arena.

It is clear that, by removing children from their local neighbourhood, we deprive them from the learning experiences these places offer. For instance, independent mobility in the child's local environment is often associated with increased spatial awareness, autonomy and independent decision making (Freeman, 2006). Also, free, unstructured play is widely regarded as essential in the Western child's social, emotional as well as cognitive development. Although television has the ability to bring the world to the child, passive 'spectatorship' cannot substitute for active explorations in one's immediate or extended environment (Jenkins, 2006b).

Interestingly, digital media – and especially the convergent forms of new media – may afford very similar developmental opportunities to the ones linked to independent mobility in physical space. Work by Shaffer and colleagues (2005) indicates that games bridge the gap between thought and action (or between abstract ideas and real problems), once separated by the predominance of (and our habituation to) post-scientific operational thinking. The bridge that online or computer games create can lead to the emergence of a new habit of mind, one where thought and practice are re-connected through our

adventures in a simulated world. Jenkins has a similar argument regarding the value of virtual experiences, describing computer games as contexts which recreate the free, open play children in contemporary Western societies no longer have access to. In our explorations of changing thinking styles and cognitive practices, it is also worth considering Charles Crook's (1999) argument about cultural tools 'remediating exploratory activity systems'. In sum, due to its fundamentally interactive and participatory nature, new technology provides a platform for the free exploration of a virtual landscape and participation in shared activities in virtual space. The next sections will elaborate on the process of virtual participation.

Virtual communities and cyber-cooperation

Let us start with the social practices linked to gaming. As noted in earlier sections, interest in computer or video games means that the individual will be drawn to (and stimulated by) the kind of cognitive challenges and reward structure these games present, and will develop the cognitive skills that are needed to meet such challenges. However, the development of expert gaming knowledge is an essentially social process, motivated by the values, goals and practices of a community of gamers (these values include: risk taking, entrepreneurship and expertise). Motivation for learning is inherent in the desire to become an expert gamer. Gamers are not autonomous problem solvers, but engaged in 'social collectivity' (Logan, 2008) in virtual space.

Jenkins refers to these new contexts for social participation (not restricted to gaming communities but also encompassing different types of online social networks) as 'participatory cultures,' "with relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing one's creations, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices" (Jenkins, 2006c, p3). Gee (2004) uses the term 'affinity spaces' to describe informal learning contexts structured around the use of new media. He contends that these offer 'powerful learning opportunities' by generating shared practices that i) bridge the gap between participants of different age, class, gender, education etc, ii) bring along more democratic or symmetrical forms of teaching and learning between experts and novices, and iii) blur the distinction between the role of the teacher and the student.

There are obvious links between these conceptualisations of virtual participation and the non-Western 'intent participation' models documented by Rogoff and colleagues. Cover (2004, p174) defines participation as a 'strongly held and culturally based desire' which was basically undermined and negated in the previous technological era. Thus, one could argue that new technology may recreate the structure for 'learning through participation' in the form of cyber participation. As Cover (2004, p188) reflects on electronic gaming: "Interactivity... evidences the possibility of democracy as a cultural demand, drive or desire that appears through unexpected, multifarious and diverse sites in different ways, at different times."

For instance, the convergence of internet and gaming has led to novel forms of online gaming, such as alternative reality games (ARGs), with a very strong participatory orientation. Although some ARGs are commissioned for marketing purposes (commercial ARGs), most of them are developed by independent individuals and groups for education, training or leisure (Dena, 2008). Massively Multiplayer Games (MMORPGs) are online social virtual games seen as the entertainment forms of ARGs (Dena, 2008). ARG players from different parts of the world collaborate over a long period of time "to uncover clues and plot points, solve puzzles, create content, converse with and rescue characters" (Dena, 2008, p42). These games can involve millions of people (the commissioned ARGs *Beast* or *I Love*

Bees had three million players each), who join the game at different entry points and take on different roles, including going on mission, solving problems through talking, or remaining causal participants who track the experience. We are just beginning to explore the social and educational benefits and implications of alternative reality games (de Freitas and Griffiths, 2007; Dena, 2008). For instance, Schaffer and colleagues discuss the affordances of 'epistemic games', which build on virtual collaboration and simulated experience to create educationally valuable contexts for social activity (eg *Madison 2200*, an epistemic game based on the practices of urban planning, where virtual community activities may have real-life consequences).

Connectedness, symbolic networks and television

Also related to the issue of 'social collectivity' is the globalisation of communication, with new trans-national cultures emerging with new understandings, values and lifestyles, and with a novel, emergent relationship between local and global.

> "These symbolic communities use global media forms and images, but they re-work and re-shape them in the light of local social experiences. This is particularly evident in the case of contemporary youth cultures, where particular styles of music and visual imagery (graphic design, fashion, video) combine to form new aesthetic 'languages' which express and define new social identities." (Niesyto and Buckingham, 2001, p168)

Buckingham introduces the term 'glocalisation' to capture the process of fusion between local cultures on a global scale, and lists Brazilian telenovelas, Japanese animation and Jamaican reggae music as illustrative examples (Buckingham, 2007b p45). The emergence of new technologies has intensified the process of glocalisation (Niesyto and Buckingham, 2001), with the use of new-media becoming more and more pronounced among the youth and children. As a result of the glocalisation of childhood experience, the younger population may relate more closely with their peers across the globe than their own parents or senior relatives (Kenichi Ohmae, 1995, in Buckingham, 2007b, p46). This would strengthen earlier arguments about the grass-roots, democratic, participatory nature of leisure activities supported by new technology. Young generations are habituated to new avenues of collective practice, where relationships are more symmetrical and intellectual endeavours are more experimental or innovative. "We might see YouTube, Second Life, Wikipedia, Flickr, and My Space… as meeting spaces between a range of grass-roots creative communities, each pursuing their own goals, but each helping to shape the total media environment" (Jenkins and Deuze, 2008, pp5-6). Once again, this may be regarded as a shift in the habits of mind of the younger generations, where new technologies (global media) remediate processes of relating, thinking and knowing. The next section will elaborate on the way in which new technology has restructured roles (and rules) of participation, with an obvious impact on our cognitive disposition.

3.4 Changing roles – the technological restructuring of participation

For this section, it seems essential to address two closely related processes: the reintegration of *consumption and production* and the merger of *learner-teacher roles*.

'Prosumers' (Toffler, 1980, in Logan 2008)

First of all, in participatory cultures centering around new technology, the line between the

creation and consumption of media content (idea, knowledge or creative product) has become blurred. McLuhan, as early as in the 1960s, attributed the reintegration of consumption and production to the dawn of computing: "Automation affects not just production, but every phase of consumption and marketing; for the consumer becomes producer in the automation circuit" (McLuhan, 1964, p349). Forty years later, based on extensive review of research, de Freitas and Griffiths (2007) argue that the traditional separation between media (such as press, television and radio) has collapsed. As the previous sections have already indicated, we are currently witnessing the convergence of different modes of old and new media. Consequently, the traditional 'broadcast model', with a few people responsible for the production of media content which is to be delivered to large audiences of consumers, no longer applies. In new media settings or 'activity spaces' (de Freitas and Griffiths, 2007) the production and consumption of media content are inseparable.

According to commentators on gaming culture, especially on games for educational purposes, production has become a part of the learning process with critical emphasis on the development of learner-driven content (de Freitas and Griffiths, 2007). Also, Dena reflects on how the 'collective intelligence' (Levy, 2000) of players resources the jointly-created space of alternative reality games (ARG), moving from 'primary producer content' towards 'participatory creation' (Dena, 2008, p54). Although the content of these games may have been developed by a primary producer (or a team), through play it becomes the raw material for joint creation by 'massive global audiences' (Dena, 2008), which Jenkins describes as collective 'transmedia storytelling'.

Similarly, when examining the activities on social networking sites, wikis or blogging sites, we also see the fusion of consumption and production. Jenkins (2006c) cites Lenhardt and Maddens' (2005) report on the Pew Internet and American Life project, which has found that 57% of young internet users could be regarded as 'media creators', having been involved in the creation of a blog or a web page, in sharing creative media content (artwork, images, audio or video files) and/or in remixing media content shared by others. The blurred distinction between production and consumption leads Buckingham (2007a) to problematise the notion of 'audience' in new (ie digital) media education, arguing that the term does not do justice to the level of engagement digital technology affords. Buckingham (2007a) argues that the term 'user' is more appropriate to depict the shift in role, involvement or agency. Indeed, 'users as producers' is seen as a key theme in convergent media (Pepler and Kafai, 2007, p13).

However, as Jenkins reminds us, the Pew study did not actually cover all new creative forms that are gaining popularity among the young new media generations. These convergent media include podcasting, game modding and most fascinating of all, machinima. Machinima is a blend of machine and cinema, enabling computer generated cinema production in real time.

> "The production of machinima - a portmanteau of machine, cinema and animation - involves computer generated imagery (CGI) rendering using 3D real-time, interactive games engines, rather than the expensive 3D animation software used in the industry... Rendering in this way is done in real-time on PCs using the available tools and resources from the game, which include demo recordings, available camera angles, level and script editors, available backgrounds, characters and skins." (de Freitas and Griffiths, 2007, p13)

It is a relatively new form of media crossover with a unique range of possibilities. (A website – *machinima.com* – enables users to gain expertise via tutorials and forums, share their

machinima, give feedback on other users' artwork, or enter contests.) The most special feature of machinima is the way the tools involved are 'modded' by the user-producers and developers, and utilised in ways that were not originally intended. So the *user-as-producer* idea applies to content (modifying shared media content) as well as design (altering the purpose of the media tool).
Note that such playful, inventive application of tools is not restricted to our technological era. Wertsch (1998) has coined the term 'appropriation' to conceptualise tool-mediated action and capture the propensity of the human intellect to make these tools 'our own'. Appropriation means much more than having access to tools: our technical skills and competencies develop through 'transformative use' which redefines both the activity and the tool itself. What is unique in the contemporary technological landscape is the extent to which we rely on – or are habituated to – this experimental, probing, inventive mindset. Inventive re-adaptations of, and crossovers between, existing and new technologies reveal the emergence of a new kind of learning (de Freitas and Griffiths, 2007) with media *convergence* enabling us to use our cognitive capacities in 'powerful new ways' (Jenkins, 2006c).

In line with this argument, Gee (2004) contrasts convergent media contexts – defined as experimental, innovative and generative – and formal education settings – described as conservative, static and institutional. Furthermore, Jenkins (2006c) challenges us to view new participatory cultures as a form of 'hidden curriculum'; arguing that competence in the inventive use of convergent media will be "shaping which youth will succeed and which will be left behind as they enter school and the workplace" (p3). These commentators highlight the need to recognise new (or convergent) media as the educational technology of the future; mainly restricted to informal learning contexts and leisure today, but determining the life experiences of the adults of the future.

Expert and novice - shifting roles

An added aspect of media convergence is the free, democratic distribution of all media content on the world wide web, changing the dynamics between experts and novices. For example, Schaffer and colleagues (Schaffer et al, 2005) describe an online gaming site (Apolyton.net), where access to expertise, information or support is open. The site enables gamers to create and access newsfeeds, to get involved in forums, or to exchange game screenshots and game files; it has its own radio station and university to help newcomers learn the game. Members of the Apolyton.net gaming community have developed a hugely successful learning context, where the roles of the teacher and the learner (expert and novice) are malleable. Through forums, newsfeeds and FAQs, gamers are simultaneously engaged in teaching and learning, and knowledge is created by the open discussion of problems, and the active and voluntary sharing of information, ideas, reflections or solutions.

Similarly, 'modding' in online games (where the modder is either a developer or a player with experience in game development) reveals a more horizontal approach, where each modder is involved in the production as well as the consumption of the game (de Freitas and Griffiths, 2007). Furthermore, studying the participation of online fan communities, Black (2005, in Jenkins, 2006c p9) found that participants played the roles of expert and novice simultaneously. Through the process of 'beta-reading' (editorial feedback) on individual contributions, they received comments on their own writing (novice) and gained expertise through commenting on other people's work (expert).

Therefore, the 'user-as-producer' mindset is closely linked to the closing gap between the role of the learner and teacher. It is obvious that young generations are breaking away from

the traditional transmission model, and are instead habituated to a more democratic, collective approach towards knowledge building. This mindset is in sharp contrast with traditional school practices, with the implication that new media participatory cultures will essentially reshape and reconstruct our understanding of and beliefs about school, culture, community and employment (Jenkins, 2006c).

4. Implications for education

New activity spaces, new skills, new future

> "If one takes the view... that human mental activity depends for its full expression upon being linked to a cultural tool kit - a set of prosthetic devices, so to speak - then we are well advised when studying mental activity to take into account the tools employed in that activity." (Bruner, 1986, p15)

Responding to Bruner's timely wisdom, this paper explored the fundamental changes in our habits of mind and the consequent transformation of our social practices in the era of new technology.

First, it was shown that the emergence and convergence of new media affords powerful forms of learning, knowing, thinking and problem solving. These habits of intellectual functioning may not all be fundamentally 'new' (eg innovative thinking has always been an essential part of human practices); it is the extent to which they pervade our everyday lives that is unprecedented. This is especially so when we look at the leisure activities of the younger generations, mediated by convergent media. The key characteristic features of these new media activity settings were described as:

- increasing complexity, cognitive challenges and stimulation
- mobility and flexibility: multiple pathways for communication and shared practice
- sensory-rich, multimodal representation of media content
- non-linearity and multiple reading paths in our increasingly rich information environment
- continuously evolving, dynamic contexts for mediated activity
- emphasis on interaction and participation; social collectivity
- the reintegration of media consumption and production
- virtual, simulated experience reconnecting thought and practice
- convergence of and multiple crossovers between different new technologies.

Thus, new media contexts create dynamic, continuously evolving, collective arenas of activity, most markedly and immediately so for leisure and informal learning.

Secondly, the paper has shown that, in a co-evolutionary fashion, technological transformations brought about a shift in cognitive preferences, especially among the young generations and those regularly engaged in activities mediated by new, convergent technologies. The characteristics of this new mindset were outlined as:

- cognitive habituation to complexity (eg parallel processing skills, multi-tasking)
- propensity for experimentation: probing, 'telescoping'; constant re-adaptation and remixing of old and new technologies
- shifting preferences in meaning making and knowledge building from primarily textual content towards multimodal content
- shifting cognitive tendencies from route following towards route mapping; loss of

predominance of traditional reading
- new information foraging techniques with increased efficiency (eg power browsing, horizontal information processing)
- engagement in more grassroots, democratic forms of social practice; collective intelligence
- 'prosumer' mindset
- habituation to learning through the simulation of embodied experience
- growing capacity to collaborate with others in virtual space.

Thus, new media contexts foster new habits of mind, requiring a fresh understanding of collective action and collective creation, the ability to belong to different social groups that may not meet face-to-face, the skills to artfully reconnect thought and practice in a virtual landscape, and the confidence to establish new relations to authority.

Naturally, while new technology affords certain new ways of thinking, knowing and learning, it may also make more traditional forms (for example reading in the traditional sense) less dominant. It also contributes to the almost overwhelming complexity or 'hypercomplexity' (Dena, 2008) of contemporary technological societies. Although beyond the scope of this paper, we need to consider the potential dangers and problems arising from this complexity with regards to identity, personal relationships or real-life physical existence. It is imperative that in our explorations of the technological transformation of social practice we are mindful of these challenges.

Learning or leisure?

It was shown that some of the spontaneously evolving new-media participatory cultures have actually created a cross-over between leisure and institutional learning. Also, commentators highlight the benefits of introducing games (eg 'serious games' or 'epistemic games') (Jenkins, 2006a; Gee, 2004), or digital media production (Erstad and colleagues, 2007; Buckingham, 2003) in educational practices. They note that convergent media may act as the 'transactional learning space' between leisure activities and school-based work (Erstad and colleagues, 2007), afford new forms of learning (eg de Freitas and Griffiths, 2008) and thus revolutionise education as we know it (Jenkins, 2006c). However, others (McDougall, 2007; Van Eck, 2006) stress the discrepancy between the style of thinking, learning and knowing prioritised in formal educational contexts and the cognitive mindset afforded by new technology in informal leisure environments. Although we are ready to recognise that young generations are interacting with new technology in novel ways, for most of us (including the young people themselves), this does not count as learning.

Building on Sayer's conceptualisation, McDougall (2007) argues that the 'disconnect' between the world of informal 'pleasure learning' and the 'systemworld' of education is so huge that any attempts to build bridges between the two run into serious difficulties. Indeed, the grassroots, collective style of participatory cultures conflicts with the assessment culture and elitism characteristic of traditional institutional learning, where the emphasis is on individual progress and achievement. Thus, our attempts to import or 'colonise' new technology in educational practice without fundamental changes in the institutional structure actually undermines the transformational potentials of this technology for learning, thinking and relating. Using Twining's (2002) categories, it is essential that we go beyond the introduction of new technology to 'support' and 'extend' pedagogy by allowing new technology to 'transform' pedagogical practices.

Possible and plausible futures

Mindful of the tension between the current institutional framework for educational practice and the learning of the future envisaged by commentators, this section will outline possible futures (what could happen) and plausible futures (what is likely happen) (Amara, 1981).

In terms of possible transformations of school-based learning, thinking and knowing, a central feature is that mediated thought and action will become increasingly collective and interactive. This will have a revolutionary impact on education, with participation in various online and face-to-face arenas of activity becoming an integral part of ongoing classroom practices. Learning will take place in a complex world of intersecting paths in virtual and real space, blending formal educational contexts, professional practices and more informal arenas of shared activity. Learning will also become essentially mobile, not tied to the physical space of the classroom, with learners and teachers, novices and experts connecting on a global scale. Note that, as a result of these transformations, the boundaries between what is virtual and real, or what is formal and informal, will also shift or possibly break down. Similarly, we will witness the reformulation of the role of the teacher and the student. Educators and teaching professionals will still play a very crucial part in the education process, but their role will be reconceptualised as an expert advisor or moderator. They will monitor students' activities and progress, help students make informed choices about their own learning, and support students on their paths towards collective participation, active agency, self-determination and responsible life-learning. Students will have access to different virtual/real participatory frameworks where they can gain skills and knowledge in diverse subject areas. Students will belong to numerous participatory cultures during their years of education, often simultaneously at one given point in time. A key challenge for students will be to manage such layeredness of collective action in overlapping participatory contexts. Schools will function as real-life meeting places, entry points to different participatory settings, and points of orientation (like an air traffic control) from where various participatory engagements will be organised, managed and maintained. The assessment framework will shift towards strategies in line with the participatory and interactive nature of mediated learning, including e-assessment, peer assessment, or the assessment features inherent in particular technologies (eg instant feedback).

A more pessimistic (but equally possible) vision of the future is that nothing changes. Technology will be used to support and expand existing educational practices, but it will not fundamentally transform these. Consequently, the gap between students' school-based and informal learning experiences will widen. The novel forms of cognitive habituation afforded by new technology will neither be acknowledged nor fostered in school-based settings.

So what is our vision of possible futures? It is best to envisage multiple, parallel paths, each positioned somewhere in between the two extremes, with a varying degree of transformation involved. These multiple paths are made possible by the multidirectionality of the envisioned changes, involving both top-down processes (eg governmental initiatives to redesign curricular content or pedagogic strategies) and bottom-up influences. The optimism that the grassroots route has an equally strong influence stems from the observable changes in attitudes towards children in the public arena, for example, the recognition of the importance of listening to children's voices and perspectives in the government publication 'Every Child Matters' (2004, cited in Sheehy and Bucknall, 2008). Interest in developing a framework for 'learner consultation' through theorising, research and innovative practice has been growing (see, for example, the 'Consulting Pupils about Teaching and Learning Project' by Rudduck (2006), the work of the Children's Research Centre (2005) involving children and young people as researchers, or Sheehy and Bucknall's (2008) study on children's visions of technology and education). Therefore, top-down initiatives for change may actually be informed and prompted by the perspectives of

children and young people. Yet, as Sheehy and Bucknall's (2008) study indicates, consideration of children's voices needs to be combined with support in developing the skills necessary to reflect on, formulate and voice one's perspectives and envisage change: "we need to equip learners with the conceptual tools to reflect on learning and how it occurs" (pp111-112).

Nevertheless, we should be encouraged by the collaborative efforts of policy makers, researchers and educators to predict possible educational futures *with* new technology. The *Beyond Current Horizons* programme, conducted with the DCSF (Department for Children, Schools and Families), the extensive CIBER project on the Google generation (2008), the wide range of research commissioned and managed by BECTA, or the work carried out by the Schome Research group (www.schome.ac.uk), are all illustrative of the intense social and intellectual focus on envisaging an education system for 'the Information Age'. To conclude with Margaret Mead's refreshing thoughts published in Time magazine in the 1950s:

> "There are too many complaints about society having to move too fast to keep up with the machine. There is great advantage in moving fast if you move completely, if social, educational, and recreational changes keep pace. You must change the whole pattern at once and the whole group together - and the people themselves must decide to move." (1954, cited in McLuhan, 1964, p28)

References

Allan, B. and Lewis, D. (2006). The impact of membership of a virtual learning community on individual learning careers and professional identity. *British Journal of Educational Technology,* 37 (6), pp841-852.

Amara, R. (1981). The Futures Field 1: Searching for definitions and boundaries. *The Futurist,* 15 (1). pp25-9.

Bolter, J.D. and Grusin, R. (1999). *Remediation: understanding new media*. Cambridge MA, MIT Press.

Bordwell, D. (2002). Intensified Continuity: Visual Style in Contemporary American Film. *Film Quarterly,* 55 (3), pp16-28. Available from http://www.jstor.org/stable/1213701 Accessed 3 October 2008).

Bruckman, A. (2004). Co-Evolution of Technological Design and Pedagogy in an Online Learning Community. In Barab, S.A. Kling, R. and Gray, J.H. eds. *Designing for Virtual Communities in the Service of Learning.* Cambridge, Cambridge University Press.

Bruner, J. (1986). *Actual Minds, Possible Worlds*. Cambridge, MA, Harvard University Press.

Buckingham, D. (2007a). Media education goes digital: an introduction. *Learning, Media and Technology*, 32 (2), pp111-119.

Buckingham, D. (2007b). Childhood in the Age of Global Media*. Children's Geographies*, 5 (1), pp43-54.

Buckingham, D. (2003). Media education. Literacy, learning and contemporary culture. Cambridge, Polity Press.

Buckingham, D. (2000). *After the Death of Childhood. Growing up in the Age of Electronic Media.* Cambridge, Polity Press.

Carr, N. (2008). The Brain Drain. *The Independent Extra,* July 2008, pp2-4.

Castells, M. (2000). *The Rise of the Network Society: The Information Age: Economy, Society and Culture.* Vol. I. 2nd Edition. Cambridge, MA and Oxford, Blackwell.

Children's Research Centre (2005). Available from http://childrens-research-centre.open.ac.uk/ Accessed 10 November 2008

CIBER (2008). *Information Behaviour of the Researcher of the Future ('Google Generation' project). Executive Summary.* 11 January 2008. Available from http://www.ucl.ac.uk/slais/research/ciber/downloads/ Accessed 12 October 2008.

Cliff, D., O'Malley, C. and Taylor, J. (2008). *Future issues in Socio-Technical Change for UK Education. Briefing Paper for the Beyond Current Horizons (BHC) Project sponsored by the UK Government's Department of Children, Schools and Families (DCSF)*. July 24th 2008.

Cole, M. and Cole, M. (1998). Culture in Development. In Woodhead, M. Faulkner, D. and Littleton K. eds. *Cultural Worlds of Early Childhood*. London, Routledge.

Cover, R. (2004). New Media Theory: Electronic Games, Democracy and Reconfiguring the Author-Audience Relationship. *Social Semiotics,* 14 (2), pp173-91.

Crook, C. (1999). The uses and significance of electronic media during development. In Messer, D. and Miller, S. eds. *Exploring Developmental Psychology - From Infancy to Adolescence,* pp361-80*.* London and New York, Arnold.

Dena, C. (2008). Emerging Participatory Culture Practices: Player-Created Tiers in Alternate Reality Games. C*onvergence 2008*, 14 (1), pp41-57. Available from http://con.sagepub.com Accessed 19 September 2008).

Derry, S. J. and Steinkuehler, C. A. (2003). Cognitive and situative theories of learning and instruction. In Nadel, L. ed. *Encyclopaedia of Cognitive Science,* pp. 800-805. England, Nature Publishing Group.

Erstad, O., Gilje, Ø. and de Lange, T. (2007). Re-mixing multimodal resources: multiliteracies and digital production in Norwegian media education. *Learning, Media and Technology*, 32 (2), June 2007, pp183-198.

Flynn, J. (2009). *What is intelligence? Beyond the Flynn Effect* (Enlarged Paperback Edition). New York, Cambridge University Press. (Manuscript made available by author.)

de Freitas, S. and Griffiths, M. (2008). The convergence of gaming practices with other media forms: what potential for learning? A review of literature. *Learning, Media and Technology*, 33 (1), pp11-20.

Freeman, C. (2006) Colliding worlds: Planning with children and young people for better cities. In Gleeson, B. and Sipe, N. eds. *Creating Child Friendly Cities. New Perspectives and Prospects*. London, Routledge.

Gee, J.P. (2008). Video Games and Embodiment. *Games and Culture*, 3 (3-4), pp253-263.

Gee, J. P. (2004). *Situated language and Learning: A Critique of Traditional Schooling*. New York, Routledge.

Gee, J. P. (2003). *What Video Games Have to Teach us about Learning and Literacy*. New York, Palgrave Macmillan.

Glenberg, A. M. (1997). What memory is for. *Behavioral and Brain Sciences,* 20, pp1-55.

Gunter, B. (2008). *Information Behaviour of the researcher of the future. A British Library/JISC Study. Work Package 5 - Technology Trends*. Available from http://www.ucl.ac.uk/slais/research/ciber/downloads/ Accessed 12 October 2008).

Hutchins, E. (1995). *Cognition in the Wild.* Cambridge MA, MIT Press.

Jenkins, H. (2006a). *Convergence Culture: Where Old and New Media Collide*. New York, New York University Press.

Jenkins, H. (2006b). Complete Freedom of Movement: Video Games as Gendered Play Spaces. In Salen, K. and Zimmerman, E. eds. *The Game design reader: a rules of play anthology*. Cambridge, MA, MIT Press. pp330-363.

Jenkins, H. (2006c). *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century. An occasional paper on digital media and learning*. MacArthur Foundation. Available from http://digitallearning.macfound.org/site/c.enJLKQNlFiG/b.2029291/k.97E5/Occasional_Papers.htm Accessed 27 September 2008).

Jenkins, H. and Deuze, M. (2008). *Editorial - Convergence Culture. Convergence: The International Journal of Research into New Media Technologies*. London, Los Angeles,

New Delhi and Singapore, 14 (1), pp5-12. Available from http://con.sagepub.com Accessed 19 September 2008).

Johnson, S. (2005). *Everything Bad is Good for You*. London, Penguin Books.

Kress, G. and Van Leeuwen, T. (2006). *Reading Images. The Grammar of Visual Design.* 2nd Edition. London, Routledge.

Lave, J. (1988) *Cognition in Practice: Mind Mathematics and Culture*. New York, Cambridge University Press.

Lave, J. and Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge, Cambridge University Press.

Levy, P. (2000). *Collective Intelligence: Man's Emerging World in Cyberspace.* New York, Perseus.

Light, P. and Littleton, K. (1999). *Social processes in Children's Learning*. Cambridge, Cambridge University Press.

Logan, R.K. (in press). *Understanding New Media: Extending Marshall McLuhan*. Cresskill, N.J., Hampton. Manuscript of Chapter 1 available from www.physics.utoronto.ca/~logan/ Accessed 28 September 2008).

Logan, R.K. (2004). *The Alphabet effect*. 2nd Edition. Cresskill,N.J., Hampton.

Macmurray, J. (1961). *Persons in Relation.* London, Faber and Faber.

McDougall, J. (2007). What do we learn in Smethwick Village? Computer games, media learning and discursive confusion. *Learning, Media and Technology*, 32 (2). pp121-133.

McLuhan, M. (1964). *Understanding Media. The Extension of Man*. Cambridge, MA, MIT Press.

Nardi, B.A. ed. (1996). *Context and Consciousness: Activity Theory and Human-Computer Interaction.* Cambridge, MA, MIT Press.

Niesyto, H. and Buckingham, D. (2001). Video Culture: an introduction. *Journal of Educational Media*, 26 (3). pp167-172.

Nsamenang, A.B. and Lamb, M.E. (1998). *Socialisation of Nso children in the Bamenda Grassfields of Northwest Cameroon*. In: Woodhead, M., Faulkner, D. and Littleton, K. eds. *Cultural Worlds of Early Childhood*, pp250-260. London, Routledge.

Oblinger, D.G. (2008). Growing up with Google. What it means to education. *BECTA Research Report: Emergent technologies for learning*, 3, pp11-29. March 2008. Available from http://publications.becta.org.uk/display.cfm?resID=35877andpage=1835 Accessed 7 November 2008.

Peppler, K.A. and Kafai, Y.B. (2007). From SuperGoo to Scratch: exploring creative digital media production in informal learning. *Learning, Media and Technology***,** 32 (2), pp149-166.

Piaget, J., Inhelder, B. and Szeminska, A. (1960). *The child's conception of geometry*. New York, Basic Books.

Pirolli, P. (2007). *Information Foraging Theory. Adaptive Interaction with Information*. Oxford, Oxford University Press.

Riley, S. (2008). Identity, community and selfhood: Understanding the self in relation

to contemporary youth cultures. *Beyond Current Horizons Project*. (Manuscript)

Rogoff, B. (2003). The Cultural Nature of Human Development. Oxford, Oxford University Press.

Rogoff, B. Paradise, R., Arauz, R.M., Correa-Chavez, M. and Angelillo, C. (2003). Firsthand Learning through Intent Participation. *Annual Review of Psychology*, 54, pp175-203. Available from http://arjournals.annualreviews.org Accessed 31 May 2005.

Rogoff, B., Mosier, C., Mistry, J. and Göncü A. (1998). Toddlers' guided participation with their caregivers in cultural activity. In: Woodhead, M., Faulkner, D. and Littleton, K. eds. *Cultural Worlds of Early Childhood*, pp250-260. London, Routledge.

Rudduck, J. (2006). The past, the papers and the project. *Educational Review*, 58 (2), pp131-43.

Säljö, R. (1999). Learning as the use of tools - A sociocultural perspective on the human-technology link. In Littleton, K. and Light, P. eds. *Learning with Computers: Analysing productive interaction.* London, Routledge.

Sawyer, K. (2006). Educating for innovation. *Thinking Skills and Creativity*, 1, pp41-48.

Schieffelin, B.B. and Ochs, E. (1998). A cultural perspective on the transition from prelinguistic to linguistic communication. In: Woodhead, M., Faulkner, D. and Littleton, K. eds. *Cultural Worlds of Early Childhood*, pp250-260. London, Routledge.

Schome (2005). *The education system for the Information Age*. Available from http://schome.ac.uk Accessed November 10 2008).

Sharples, M. (2008). *A Theory of Learning for the Mobile Age.* Paper presented at the Department of Education, University of Exeter, UK. 21 October 2008.

Sharples, M., Taylor, J., and Vavoula, G., (2007). A Theory of Learning for the Mobile Age. In Andrews, R. and Haythornthwaite, C. *Handbook of e-learning Research*, pp221-247. London, Sage Publications.

Shaffer, D.W., Squire, K., Halverson, R. and Gee, J.P. (2005). Video Games and the Future of Learning. *Phi Delta Kappan*, 87 (2), pp104-111.

Shaffer, D. W. (2006). *How Computer Games Help Children Learn*. New York, Palgrave Macmillan.

Sheehy, K. and Bucknall, S. (2008). How is technology seen in young people's visions of future education systems? *Learning, Media and Technology,* 33 (2), pp101-114.

Super, C.M. and Harkness, S. (1998). The development of affect in infancy and early childhood In: Woodhead, M., Faulkner, D. and Littleton, K. eds. *Cultural Worlds of Early Childhood*, pp250-260. London, Routledge.

Twining, P. (2002). *Enhancing the impact of investments in 'educational' ICT*. PhD thesis, The Open University, Milton Keynes. Available from http://kn.open.ac.uk/public/document.cfm?documentid=2515 Accessed 14 November 2008).

Van Eck, R. (2006). Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless. *EDUCAUSE Review,* 41 (2). pp16-30.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA, Harvard University Press.

Wegerif, R. (forthcoming). The role of dialogue in teaching thinking with technology. Draft chapter to appear in Howe, C. and Littleton, K. eds. *Dialogue and Development. Routledge*. (Manuscript made available by author.)

Weiler, A. (2004). Information-Seeking Behavior in Generation Y Students: Motivation, Critical Thinking, and Learning Theory. *The Journal of Academic Librarianship,* 31 (1), pp46-53.

Wertsch, J. (1998). *Mind as Action.* Oxford, Oxford University Press.

Williams, P. and Rowlands, I. (2008). *Information behaviour of the researcher of the future. A British Library/JISC Study. Work Package II. The Literature on young people and their information behaviour.* Available from http://www.ucl.ac.uk/slais/research/ciber/downloads/ Accessed 12 October 2008.

Wolf, M (2007). *Proust and the Squid: The Story and Science of the Reading Brain*. New York, Harper Collins.

This document has been commissioned as part of the UK Department for Children, Schools and Families' Beyond Current Horizons project, led by Futurelab. The views expressed do not represent the policy of any Government or organisation.