Do tablets cure the pedagogy headache?

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"If we teach today as we taught yesterday, we rob our children of tomorrow". (Dewey, 1916)

Abstract

Tablet devices have made a huge impact in schools and in 2015 they were predicted to outsell personal computers (Gartner, 2014). 70 per cent of UK schools are estimated to be using tablets (BBC, online) and across Europe, "laptops, tablets and net-books are becoming pervasive" (EU schoolnet, 2014). As these devices become established in schools they both support and develop existing practice (Burden, Hopkins, Male, Martin and Trala, 2012; Baran, 2014), but are also starting to challenge some existing models of thinking and pedagogy (Fullan and Langworth, 2014; Kearney, Schuck, Burden and Aubusson, 2012) and also teachers' attitudes towards learning and teaching (Ertmer, 1999; Burden and Hopkins, 2015). In offering opportunities for learning to become more authentic, personal and collaborative (Kearney et al., 2012) there are opportunities for teachers to start to redesign the ways in which learning is taking place (Puentedura, 2010; McCormick and Scrimshaw, 2001). Traxler defines mobile learning as "an educational process, in which handheld devices or palmtops are the only or dominant used technology tools" (2007: 2) and Kearney et al. (2012) argue that it has the potential to revolutionise the learning process in allowing individuals to determine their own independent paradigms and frameworks of learning. These devices are also sophisticated producers of digital artefacts and children and teachers are capable of being co-producers of learning materials.

Introduction

Technology is not new and, at one point the flint axe was considered to be, literally, the cutting edge. Writing about technology in education is, however, not new but over the last few years there has been a significant change as we have moved into the 'digital or information age'. The children who are currently in our

primary, secondary or high schools will have been born around the turn of the current century - the year of the much hyped, but ultimate damp squib, of the 'Millennium Bug'. These children have encountered the world via a new medium, that of multiple television channels, video games, mobile and smart-phones and tablets; but most of all, and most importantly for their educational change, via a connected world of multi-modal and multi-channel communications. Most of these key communication channels have arise in the last 16 or so years. We have Skype (2003), Android (2003), Facebook (2004), YouTube (2005), Twitter (2006), the iPhone (2007) and the iPad (2010). These technologies have an implication for learning change that will be explored in this paper. As Zeen (2006:9) puts it:

> We are telling you a story, the story of the 'Homo Zappien' to show the potential for change, if we allow ourselves to reconsider practices we consider proven.

Given the prevalence of smartphones, phablets (phone tablets) and tablets across the world it is unlikely that these are going to go away and so the schooling world needs to consider how these devices can best be used in their institutions and to the children and young people within. In this paper two core questions are considered:

(i) How do these digital devices support existing pedagogical approaches?

(ii) How do these digital devices challenge existing pedagogies?

This paper will explore the second of these questions via the "new" pedagogy of Connectivism and how this challenges schooling of the future. Connectivism is a learning theory for the digital age (Siemens, 2005a), a learning theory for those

digital natives (Prensky, 2001) or Homo Zappiens (Zeen and Vrakking, 2006) who are currently in our school system and for whom there was no world before the world-wide-web and for whom there is no media, but social media. Whilst the idea of Prensky's digital native and inter-generational readiness has been challenged (Holton, 2010; Judd and Dalgarno, 2010; Jones, Ramanau, Cross and Healing, 2010) the digital life experiences of those who have been born in the last 15 to 20 years are significantly different. The core differences are the move from technology being static to mobile; from institutional to personal use; and from functional to social applications. So, whilst school age children, by right of their age, seemingly have better understanding or show better utilisation of digital technologies, their ontology will have been, for the majority in the developed West and growingly for the rest of the world, significantly different. These are children whose life experiences are as significantly different from those of their parent's childhoods as those of the first factory worker's children would have been from their agricultural forebears and thus for whom the paradigm shift is as great. Yet the educational experiences of these different sets of children will have been very similar, as the British Primary Minister Tony Blair famously questioned, 'would the children of the 20th century recognise the schoolrooms of the 19th?' (Blair, 2005).

It is this ontological difference that I wish to explore in this paper, asking the question, does growing up in this mobile technology enhanced world potentially challenge the idea we have about learning and the nature of learning and teaching in our schools? Is it possible that the existing pedagogies themselves are made redundant by the technological developments?

Mobile technologies are a wake-up call for teacher education and for teacher educators. It is likely that the significant majority of those currently providing teacher education or in senior positions in schools have little, or no, experience of using these devices with school aged children and are 'digital immigrants' (Prensky, 2001) or 'digital visitors' (White and Le Cornu, 2011) rather than more sophisticated personal users of the technologies. They are also less likely to be digital producers of materials suitable for use on tablet devices (i.e. apps or e-books) (Felvegi and Matthew, 2012; Glakin et al. 2014).

Technology supporting existing pedagogical structures

At the roots of learning must be the question of epistemology or, what is knowledge? This is an important question as pedagogic thinking has developed from existing paradigmatic positions, which we can divide simply into two epistemological camps those of objectivism and constructivism. Objectivism states that knowledge is there and waiting to be discovered and understood. Bruffee (1999: 151) writes of knowledge up to the time of Descartes when he says:

> […] people tended to believe that the authority of knowledge rested in one place, the mind of God. Most teachers were priests – or priestly. They derived their authority from that they and their students regarded as their godliness, their nearness to the mind of God.

Bruffee (1999) argues that formal knowledge was 'authorized' by the religious authorities and even in those civilisations where there was a wider sense of civic authority, such as the Persians or Athenians, there was still a sense that civic knowledge had a divine origin. This idea of knowledge as being something divine,

precious and the provenance of the knowledgeable has persisted and as he contends:

> one kind of knowledge that traditional college and university education especially values because it is long-lasting is knowledge of the conventions of traditional education itself – professors are not only responsibly for the imparting of knowledge that was imparted to them but the imparting of knowledge as it was imparted to them (Bruffee, 1999: 152-3).

Or as Mathew Arnold (1869:15) put it we must get to know 'the best that has been said and thought in the world'. This idea of cultural capital (Bourdieu, 1973) is that there is a corpus of knowledge that is important and that a didactic method is the most effective way to transmit this. The etymology of didactic is from the Greek word 'didaskin' - to teach in contrast to the Socratic method. The axiom of the didactic method is that of the transmission of knowledge and concepts from the teacher to the student, in the same way that is was transmitted to the teacher when they themselves were a pupil at school, or a student at university. This pedagogy of transmission and knowledge acquisition is in the ascendancy at this time and has powerful political support from recent Secretaries of State in England (Michael Gove and Nicky Morgan) and as such has grown in influence under the current UK government. These supporters appear to draw on the works of Soderstorm and Bjork (2013), with their emphasis on memory retention and testing, on Willingham (2010), with the emphasis on cognitive neuroscience and the nature of transfer between working and long term memory and Hirsch (2006), with his emphasis on cultural capital and knowing. In this pedagogic ontology the job of the teacher or the lecturer is to be the subject or knowledge expert and their role is to transfer this knowledge, as Bruffee explains:

knowledge is a kind of substance contained in and given form by the vessel we call the mind. Professors' mental vessels are full, or almost full; students' mental vessels are less full. The purpose of teaching is to transfer knowledge from the fuller vessels to the less full (1999: 152).

Whilst this may have been the dominant paradigm of that time such ideas have not gone unchallenged. Early on, for example, Rousseau (1762) explored the concept of the child as an active learner, whilst Dewey was strongly critical of the idea of the child as a 'receptacle for knowledge' and of the education system as the 'transmission of facts' describing education rather as a mechanism for social change and explaining that;

> … education is a regulation of the process of coming to share in the social consciousness; and that the adjustment of individual activity on the basis of this social consciousness is the only sure method of social reconstruction (Dewey, 1897: 16).

Much later writers like Paolo Freire were still critiquing this approach, which he called the 'banking model' of education, when he wrote:

> it transforms students into receiving objects. It attempts to control thinking and action, leads men and women to adjust to the world, and inhibits their creative power (Freire, 1970: 77)

Whatever the merits or demerits of an objectivist approach to learning based on memory and testing there is no doubt that is has dominance in current times with the assessment system built around it.   One only has to approach any institution of learning in the summer months, for example, to see rooms full of students retrieving ideas and knowledge from memory in order to satisfy the demands of their relevant examination system.

There is a place for the tablet computer to support this kind of pedagogy, the acquisition of knowledge, but this must be rooted pedagogically and not technically. Over 30 years ago Richard Clark published a definitive study on how it was pedagogy (i.e. the ways and means of teaching) not technology (i.e. the hardware or software) that makes the difference and he later made a further claim that a single media will never influence learning (Clark, 1983 & 1994).

Giving students tablets is not the answer as indicated by Bill Gates, CEO of Microsoft, when he said, *"just giving people devices has a really horrible track record"* (Young, 2012). The combination of mobile devices and well structured teaching does have positive benefits over those of fixed devices, however, as found by Sung and Meyer (2013) when they explored how students learned about how a solar cell works using an on-line learning package. The group using the mobile devices reported stronger ratings on self-reported willingness to continue learning. Hattie's meta-analysis work in this area (Hattie, 2012) indicates that there are positive effect sizes from using technology when allied with good pedagogy and a 2009 meta-study about blended learning (the combination of both face-to-face and remote learning) indicated better results that just the face-to-face learning (Means, Toyama, Murphy, Bakia and Jones, 2009).

The key thing seems to be not to think that you can replace teachers with technology, but to consider how you can use technology to supplement and amplify what the good teacher already does. The affordances of mobile technologies allied with the development of applications software (Apps) allow the 'traditional' objectivist pedagogic approach to be improved by what

McCormick and Scrimshaw (2001) have called ''efficiency' and 'effectiveness' gains and what Puentedura (2010) identified as 'substitution' or 'augmentation'.

Building on such pedagogic roots the teacher can use technology in a variety of ways. The development of digital content, both bespoke by the teachers in the institution and carefully curated from online resources, gives students access to expert knowledge and the digital nature of this means that it is not limited to text and graphics. The availability of this material on the student's device means they have access to this at all times and not just when in the classroom. Furthermore, they are not in competition with other pupils in the classroom for the teacher's attention and they can also pause and even rewind the narrative flow, allowing them time for reflection. In addition, instant feedback from carefully constructed tests using applications, such as Socrative or Quizlet, allow the students to test themselves regularly and this frequent testing benefits long term retention of material (Willingham, 2010) and gives useful data to their teacher. Students can also have access to the storehouse of information that is on-line. This final point has caused some controversy with some considering that it reduces the access to knowledge (Willingham, 2010), but a study by Sparrow discovered that college students remembered information more easily if it was available on-line with the internet acting as a kind of 'external memory' (Sparrow, Liu and Wegner, 2011), an idea I will return to later when exploring the concept of Connectivism more fully. Sparrow et al. also found that students were better at remembering where to find the information than remembering the information.

In contrast to the objectivist view of knowledge, though it is one to which we seem to be returning in England, the more recent view is that of a constructivist epistemology, which holds that knowledge and understanding of the world is constructed via our senses and our perceptions of the world and our interactions with it. Alongside such individualistic interactions is a meaningful dialogue with the communities of knowledgeable peers. In such circumstances knowledge does not have a sense of objective existence, but resides in;

> […the conversation that goes on among the members of a community of knowledgeable peers and in the conversation of mankind. (Bruffee, 1999: 153)

These are the two dominate epistemological positions in education today according to Bates and Poole (2003) who define constructivist epistemologies as those that hold:

> […] that knowledge is essentially subjective in nature, constructed from our own perceptions and usually agreed on by conventions. According to this view, we construct new knowledge rather then simply acquire it via memorization or through the transmission of those who know it to those who did not. (28)

It is in the roots of these two dominant epistemologies that Connectivism has arisen, with the concept building on the ideas of Vygotsky's 'zone of proximal development' (ZPD), which he defined as:

> The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers. (Vygotsky, 1978: 86)

At the core of the idea of the ZPD is that learning develops in a social space, using the mediation of language and the support of what Vygotsky called the 'more significant other' (MSO). In Vygotsky's mind this MSO was a person physically present, but he idea has been extended to include the idea of physical resources as well. Connectivism allows this to be extended even further to include the connected group, or the technology, as this MSO.

Pedagogic thinking has also been influenced by Activity Theory, which seeks to understand human activity as complex phenomena which are socially situated and go beyond the ideas of behaviourism (Engeström, 2001). A key factor of Activity Theory is that it considers an entire system, including teams and organisations, and seeks to explain the actions of the individual within the complex interplay of the system. Thus the motive for activity in the system, which we could think of as learning, is created via the tensions and the contradictions within the system. So, the individual needs to act as part of a system and not individually. Again it is the connected technology, a combination of the people and the technology, that for, in the system. There are also links to Social Learning Theory (Bandura, 1971) in that there is a presupposition that people learn through social contact. There is no assumption that that physical contact has to be either in the same time or place frame, however, but that the technological advances briefly alluded to above mean that this social contact can be both take place anywhere and be asynchronous. Thus we can take the notion of a physically present group that Bandura envisaged and extend this, within the parameters of learning, to the mix of technology and people.

Tablet technologies can support these social constructivist pedagogies Baran's (2014) meta-review of the literature into mobile learning is overwhelmingly positive about the beneficial nature of mobile technologies to learning experiences and Naismith et al. (2004) agree and suggest that mobile devices produce motivating learning experiences. They argue that the devices can be used in "many different settings, giving access to a board range of uses and situated learning activities" (Naismith 2004:7). Kearney et al. (2012) also concur on the use of mobile devices to facilitate situated and authentic learning both in the classroom and outside of it and the use of tablet technologies to support social constructivism is also supported by Pegrum (2009), Pegrum et al (2013), Cochrane and Bateman (2010) and Cochrane, Narayan and Oldfield (2011).

One of the core ideas of the constructivist paradigm is to encourage learners to be 'active constructors of knowledge' (Neiss, 2005) and also to work collaboratively. Tablet technologies support this way of working as Sharples (2001: 7) comments: "the skills of constructing and exploring knowledge, conversing and collaborating with peers, and the ability to control one's own learning are fundamental requirements of effective learning". Tablet technologies can thus be used to support both collaborative and co-operative learning as Naylor and Gibbs (2015) show in a project where English and Science pre-service teachers collaborative to produce eBooks on poetry and marine biology. Again we can see that the technology supports the existing pedagogic ideas, rather than offering new ways of thinking about teaching and learning.

One of the core arguments against the use of technology is the lack of studies, which show significant improvement in educational outcomes, although the general consensus is that there has been a small positive impact when technology is used to support existing pedagogic practices (Higgins et al., 2012; Hattie, 2012; Baran, 2014; OECD, 2015). We may, of course, be looking at the wrong measures if what we are doing is expecting technology to improve test results, especially when most of this technology is banned from the examinations. It could be that whilst technology is very useful for supporting existing pedagogical practices it can only do so far if we are looking at existing models of learning and existing pedagogical practices. It could be, however, that we need a new pedagogy to exploit the potential in these devices.

Connectivism: A pedagogy for the digital age?

Mobile devices have a number of affordances that have been labelled as Personalization, Authenticity and Collaboration (Kearney et al., 2012). These affordances change the relationships between learning, knowledge and experience and the expression of them collectively is central to the idea of connectivism, and provides motivation for the theory's name. The concept of Connectivism was first introduced by George Siemens in 2005 (Siemens, 2005a, 2005b) and later by Steven Downes on his own blog (Downes, 2007), although the idea has been substantially criticqued as well, notably by Verhagen (2006) and Kop and Hill (2009).

Connectivism was put forward by its key proponents in the context of a technological paradigm shift, such as the growing prevalence of mobile devices that demands a new way of thinking about pedagogy. Beetham and Sharpe (2013: 167) refer to this emerging paradigm when they say that, "learning theories need to reflect the technological developments of the time". Siemens (2005a) argues that we have to consider the paradigm shift that has occurred in the last generation of learners as the impact that digital technologies have had in everyday life. This has changed the way that we operate in nearly all aspects of life including the change in the lifetime of knowledge. In particular, Siemens notes that, "One of the most persuasive factors is the shrinking half-life of knowledge" (ibid, p.1) which describes the time span from when knowledge is gained to the time when it is obsolete. In many fields the half-life of knowledge can be measured not in decades or years, but in months, so the idea that knowledge is something that can be transmitted by the professor to the students over generations needs to be seriously challenged. Whilst we could argue that there is still "cultural capital" to be gained from such an approach (Bourdieu, 1973), this is difficult to agree and tends to be a given rather than something which is discussed. Indeed, the nature of research and scholarship and the impact of invention and innovation render the idea of immutable knowledge difficult to reconcile. Gonzales (2004) describes the challenges of this rapidly diminishing knowledge life:

> One of the most persuasive factors is the shrinking half-life of knowledge. The "half-life of knowledge" is the time span from when knowledge is gained to when it becomes obsolete. Half of what is known today was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of

Training and Documentation (ASTD). To combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction.

Siemens (2005a) then sets out what he considers will be significant trends in learning that will challenge the existing pedagogic forms of learning and demand that we re-think the nature of learning in our institutions. In particular, he lists these as:

- Learners will move disciplines over the course of their lifetimes
- Informal learning will become more significant – communities of practice and personal networks over more formal settings
- Learning is continual – a lifetime not a 'one off' process
- Technology is re-wiring our brains
- The organisation and the individual are learning organisms
- Many of the processes which humans needed to do can be off-loaded to technology
- Know-how and know-when is being supplemented by know-where

These indicate a need for significant and substantial changes to the way that we currently organize learning both in schooling and in the wider world and will challenge much of the way we consider success or achievement. As seen above there is still significant investment in educational systems in an objectively oriented understanding of knowledge and in the acquisition of a body of knowledge via a transmission model of pedagogy. Siemens argues that objectivism and even the current models of social constructivism, which as we saw above (Bates and Poole, 2003), continue to form the dominant models of learning in education and are predicated on the tenet that learning takes place inside the person. This, he suggests, is either as the reception of agreed existing

knowledge (behaviourist), as the results of internal cognition (cognitivist) or as the result of internal narrative after wider dialogue (social constructivism). There is no consideration that learning may take place outside of the person, that there is a disjunct between the process of learning and that which is being learned and that which is being learned is separated from the process of that learning. This is a lack of authenticity (Kearney, 2012) or the difference between instrumental and relational understanding (Skemp, 1976).

> Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. When knowledge is subject to paucity, the process of assessing worthiness is assumed to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. In today's environment, action is often needed without personal learning – that is, we need to act by drawing information outside of our primary knowledge. The ability to synthesize and recognize connections and patterns is a valuable skill (Bates and Poole, 2003:27)

This demands a double shift in emphasis both away from the idea that learning is about the acquisition of a personal store of knowledge on which the person will be able to draw and recognizing that the quality of knowledge and making connections between aspects of knowledge become more important than the knowledge itself. Consequently, we need to move away from the certainty of knowing into the more chaotic world of connecting and recognize that there is an inter-connectivity and inter-connectedness which the new information age is starting to realise. This is characterised in the phrase "the internet of things" (Burrus, 2014). If adopted this would be a fundamental challenge to the nature of formal education, rooted in a knowing and testing model. We can start to see

this in the ways that our smartphones are linking together databases of the knowledge that is supplied by our friends allowing us to interact with them in a different way and to interact with the databases themselves – try, for example, telling Siri that you would like a pizza – the pedagogic process is in the phrasing of the question not in the memorisation of the information and in drawing on the dynamic and fluidic collective knowledge.

Downes (2007: 77) talks about types of knowledge, reflecting on the historical divide of knowledge into qualitative and quantitative:

> Connective knowledge adds a third major category to this domain, knowledge that could be described as connective. A property of one entity must lead to or become a property of another entity in order for them to be considered connected; the knowledge that results from such connections is connective knowledge.

This kind of knowledge cannot reside in the mind of the individual, but in collective networks. Knowledge is one of connection and the interactions that take place because of the connection – a chaotic rather than a systematic existence. This is emergent knowledge, which is the product of both the starting conditions and also the interactions that take place within networks. This idea of emergence is not new and is seen as "a process whereby larger entities, patterns and regularities arise through interactions among smaller or simpler entities that themselves do not exhibit such properties" (OECD, 2015). These properties are seen in science (especially in biological systems, but also in weather and fundamental particles) in philosophy (in the principle of etiology) and in art (where the creation of the product is more than the collection of the parts).

Science has embraced this idea of connectedness and chaos where the individual nodes of knowledge are less important than wider relationships. This is akin to Heisenberg's Uncertainty Principle where chaotic patterns have been embraced by weather scientists and particle physicists alike in what is commonly known as the 'butterfly effect', when small causes can have momentous effects. Gleick (1987:8) states that "this analogy highlights a real challenge that of sensitive dependence on initial conditions". From this we can see that this can also be reflected in the learning world in the way in which groups or communities of learning on-line form, grow, evolve and then break-up in ever changing patterns what Rocha (1988:3) defines as the "spontaneous formation of well-organised structures, patterns or behaviours from random initial conditions". Downes (2007) gives the analogy here of the political party where he says,

> The political party is a distributed entity. What is important to note is that it is more than merely a collection of associated or even similar people. A group of people, even if they all hold the same beliefs, and even if they all know each other, does not constitute a political party. Nor is it a question of quantity ... is the set of connections between its members, the existence of which is often manifest and recognized with special documents and legal standing"

In the same way we can consider the school or the learning environment, which has been defined as the collection of people, artifacts, records or buildings, but is in fact more that this as it is the network of connections between these things that form the entity that we might call the school.

Siemens (2005a) argues that is it in the networks that learning takes place and that this is an ever-shifting process. It is in these networks that learning will take

place more and more, rather than in the more formal networks of school or university and thus he defines Connectivism as,:

> The integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual.

Because of this chaotic nature of networks and the rapidly evolving nature of knowledge, too rapid for the traditional knowledge transfer artifacts or systems, Siemens (2005a) has developed the following core principles of Connectivism:

- Learning and knowledge rests in diversity of opinions;
- Learning is a process of connecting specialized nodes or information sources;
- Learning may reside in non-human appliances;
- Capacity to know is more critical than what is currently known;
- Nurturing and maintaining connections is needed to facilitate continual learning;
- Ability to see connections between fields, ideas and concepts is a core skill;
- Currency is a core intent;
- Decision making is a learning process.

These principles address the concerns of learning in a technologically rich, networked and always-connected age, according to both Siemens and Downes. We may not be able to operationalise these principles because of technological limitation and also we are no doubt restricted because the majority of those in position to affect change will have been successful under the dominant pedagogies and see no reason to change. Outside of formal learning (schools

and universities), however, we can see how these open chaotic learning networks are beginning to change the dominant landscapes. We see this in the media where the mainstream news channels are being challenged by blogging and tweeting (e.g. the 2015 UK election was called the "social media election" - BBC, 2015), in personal knowledge where information is shared and collective and in the developing design of learning environments. This can be seen in our personal lives, for example, where we have transferred the learning task of remembering telephone numbers to being reliant on our contacts list; the ability to do multiplication and division to our calculators and the worry of where we are to our online GPS application. Siemens and Downes have both argued that this is a positive direction of travel, but recognise they are fighting a dominant conservative embedded pedagogy and are not without their critics. They argue, however, that this idea is not a panacea, but a step into the light. As Siemens (2005b) comments

> When attempting to move away from established approaches, a period of confusion and disorientation ensues. Many in education are beginning to venture into this transitory stage. We are moving from formal, rigid learning into an environment of informal, connection-based, network-creating learning.

Criticisms and challenges

The idea of Connectivism has garnered more interest in the online community than in more traditional literature and perhaps this is indicative of the process (although later we will explore if this lack of interest in traditional literature is, in of itself, significant). Kerr (2007a), for example, says that there are two purposes for the development of a new theory: it replaces older theories that have become inferior or it builds on older theories without discarding them. The critics of

Connectivism ask a number of questions the first of which is, is it a new theory? Gredler (2005:12) refers to a number of elements that must exist for a theory to be well constructed:

> Clear assumptions and beliefs about the object of the theory should be highlighted; key terms should be clearly defined; there should be a developmental process, where principles are derived from assumptions; and it should entail an explanation of underlying psychological dynamics of events related to learning.

Kop and Hill (2008) argue that Connectivism does not, at this time and in Gredler's (2005) terms, fulfill the requirements for a learning theory. They do argue that the core of the theory, the concept of distributed knowledge (Downes, 2007), offers a real challenge to existing, more established learning theories and builds on the idea of social constructivism. Connectivism seems to be more concerned, say Kop and Hill, with the outcomes of the process rather than the events related to learning. Verhagen (2006) also argues in a similar fashion and states that Connectivism is more of a pedagogical view, rather than a learning theory. He says (2006:2) that:

> A theory should explain phenomena and those explanations should be verifiable. The information presented here is not sufficiently specific and coherent to allow any comments on that aspect. The principles are not sufficiently linked to the arguments and examples to develop an idea of how the theory could function in practice"

Verhagen further argues that there is no clear idea about the identity of Connectivism and that there is more of a focus on the processes of how it plays out in practice – what connectivists do – than providing an underlying reason as to why they do these things. He continues that the core processes are not new

and as such do not constitute a new idea and that people have always worked in this manner. He concludes that whilst there may be acceleration of these effects because of new technology this does not constitute a new way of thinking about learning and subsumes the eight principles of Connectivism into four key categories:

- Educational Aims (capacity to know and ability to know);
- Premises (diversity of opinions and currency);
- Learning processes (nodal connections and decision making as a process);
- Learning may reside in non-human appliances.

He argues that the first of these are existing ideas that have been re-worked in connectivist terminology and says that, "the arguments in the article consist of posing questions regarding the influence of technology and chaos and network theory on learning, followed by listing some characteristics and properties of these developments" (2006: 3). He goes on to argue that a theory should explain phenomena and the explanations should be verifiable (similar to Gredler's arguments) and that the ideas presented in Siemens (and later by Downes) do not fulfil these requirements. He then goes on to explore Siemen's idea that 'learning may reside in non-human appliances" and argues that this appears to have a, "special significance for Siemens" (p.4) and that, "he returns several times to this subject to argue shortcomings of existing learning theories" (p.4). Verhagen concluded that this is *"a remarkable definition because learning is not defined as a process but as a result" (p.4). Consequently, he dismisses the idea of connectivism as simply the removal of trivial processes of processing to a

machine-based algorithm, although he does go on to say that Siemens is probably thinking of more complex systems than these and had a vision where:

> Information technology is everywhere, so learning will soon take place in a continuous interaction with information systems and in which the learner consciously decides which cognitive tasks he undertakes himself and which ones he delegates to a software system. And in such a way that he integrates the knowledge stored within the system with the knowledge he has in his brain into a single whole which the learner considers to be his own knowledge" (p.5)

So What?

The big idea at the heart of Connectivism is that we can delegate some of the cognitive functions of the individual to the technology and in doing this we allow access to wider cognitive developments and better learning. If we were to accept this definition, then we would have to start to seriously rethink the nature of the educative process as the idea of a system predicated on the learning of the individual. This presumption, which is at the heart of most current educational systems, becomes harder to justify.

Does this make Connnectivism a new learning theory or an extension of social constructivism? How does this link with the ideas of communities of practice (Lave and Wenger, 1991) and dialogic communication? Perhaps the current most enthusiastic exponent of this is Sugata Mitra whose work on Self-Organised Learning Systems (SOLE) (Dolan, Leat, Smith, Mitra, Todd and Wall, 2013) and his *School in the Cloud* project (Mitra 2014) takes this idea of distributed cognition and use it to challenge the existing structural ideas of both learning and schools in their geographic and temporal boundaries.

Conclusion

Whilst Downes and Siemens see the on-line environment and the social media space as indicative of the changes that are taking place they do not suggest that Connectivism is limited to the on-line environment. Rather the on-line environment has allowed the possibility for networks to connect to each other in a more complex and inter-related way and consequently has been important for the development of Connectivism. In connectivist learning the networks are those between the internal (individual) and the external (collective) environments and it is in the inter-actions between these networks that learning takes place.

There is little doubt that these new technologies have increased the ability for us to communicate, converse and collaborate and, as Kerr (2007b: online) reminds us: "good educators have always recognised the importance of such things". What has changed is the scalability caused by the development of technology and this might have led to Connectivism as an emergent property of this scale, whilst the scaling itself is not the innovation.

What does this all mean for the learner and the school systems? As stated in the introduction to this paper these changes are very recent and most of these have only really started to happen in the lifetimes of current young students. So there is a significant disjunction between the learning experience of the students in the system and those who are teaching in, leading and controlling the system. Those outside formal education systems are having to rapidly adapt to a changing world and understand what this means for the production and consumption of

knowledge, including news, film, music and learning. New information is being produced without the checks and balances that might have previously existed and being distributed without these checks, causing disquiet to the institutions who seek to regulate these new mechanisms with systems invented for regulating the old.

My experience across many schools in a number of countries is that most schools are still operating on a 1:1:30:60 model (Hopkins, 2014). This is one teacher with a group of about 30 children for about 60 minutes working towards an externally set examination, or in places where this is not so it tends to be because finances or structures mitigate against this (e.g. in Sub-Saharan Africa). The acquisition of "set of knowledges" which is then assessed in a predominant individualistically way, with recall of memory still being the predominant model. This is a model that made sense when it was devised as a means of mass education for a country in the process of industrialisation, but an educational process which makes less sense now, especially as the technology becomes personal and mobile.

Currently schools and other places of formal education do not look significantly different those of a hundred years ago, so will they look in the next century? At the moment it seems that the educational conservatives are holding sway, but as those who are children of this time will become those who are managing things that may need to change in the future. It may be a development of Connectivism that gives us the learning framework to operationalise those changes.

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