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Digital Technologies:
Implications for Education Organisations & Settings in the 21st Century

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Abstract

This paper initially investigates the ways in which digital technologies can be used to support learning in education organisations and settings (and change the nature of provision in some instances). The discussion that emerges is based both on contemporary literature and a number of recent research projects in which the author has been directly involved. A transformation in the attitude and behaviour of teachers, it is argued, is required if the possibilities and opportunities offered by digital technologies are to be maximised now and into the future. In reaching this conclusion the paper examines a number of barriers to change and explores relevant theories of learning that should lead to transformative learning whereby teachers cannot imagine a world without maximal use of the digital devices that are now available to all learners for whom they have a responsibility.

[N.B This paper is based on a number of recent publications in which I have been an author and is presented this conference as a work in progress, principally to avoid the possibility of self-plagiarism. I will be re-drafting the paper in due course and submitting for publication. If you wish to cite this paper, therefore, would you please contact me directly: t.male@ioe.ac.uk]

Digital Technologies: Implications for Education Organisations and Settings in the 21st Century

Dr. Trevor Male, UCL Institute of Education

Introduction

The term 'digital technologies' in this paper refers to multi-functional devices with Internet connectivity, particularly those that are handheld and portable. There is now widespread recognition that such equipment presents opportunities to the way in which student learning can be organised. Traxler (2010) suggests everyone typically now owns one, uses one and often has more than one such device. As a consequence it has been argued that the availability of such devices has the potential to change the traditional dynamics and pedagogical patterns of the learning environment (Burden et al, 2012). The combination of more traditional Internet access (fixed location) and personal Internet access (mobile) thus provide the opportunity for educators to explore a number of trends in this new era. The range of possibilities has been classified into two principal areas of provision:

- enhancing student learning through use of appropriate technologies and software applications, or;
- changing the nature of provision to recognize alternative pathways for student achievement and new markets. (Aldhafeeri & Male, 2015: 3).

Whilst recognition will be given to the possibilities for changing provision and enhancing market share (particularly within higher education) this paper will focus mostly on the way in which student learning could be enhanced through the use of digital technologies.

This paper begins with a discussion about the ways in which access to and the nature of the Internet have influenced, even changed the nature of knowledge, before exploring implications for education organisations and settings. Principal concerns arising from this is the role of the teacher and their relationship with the student, with the balance seemingly needing to provide the learner with greater control in a digitally enhanced environment. The key issue arising from such a scenario is the notion of flexible learning which should lead to a revision of teaching and learning strategies. Traditional teacher led environments, it is argued, should move from direction and

control to facilitation and guidance of learners, a process requiring new skills and knowledge. Learning theories in this era now encompass the concept of *connectivism* (Siemens, 2004) which builds upon more traditional (and well understood) approaches of behaviourist, cognitive and constructivist approaches to learning. In such an environment, it is argued, there is a need for collective rather than individual learning leading to a world which depends upon interdependency rather than personal capability. To progress to such environments those responsible for the organisation of learning will need to transform their understanding and provision through developing beyond content to enhance their pedagogical and technological knowledge and capability. This presents a major challenge as demonstrated through theory relating to the adoption of innovations (Rogers, 1962) and recent research in the field (e.g. Male & Burden, 2013; Aldhafeeri & Male, 2015).

The Importance of the Internet to Learning in the 21st Century

In its original form (Web 1.0) the Internet was used by a small elite in a 'delivery and receipt structure' as it only permitted a one-way flow of information and service to the end user (Crook, 2008). This provided limited opportunities for individual or communal knowledge creation and sharing since it required high levels of technical expertise and understanding (Greenhow et al, 2009). These characteristics have fundamental epistemological implications as knowledge was created and validated by a relatively limited number of experts who based their authority and validity on formal evidence-based argumentation (Dede, 2008). Web 1.0 is comparable, therefore, to an encyclopaedia in its library-like structures and procedures and is portrayed as a repository for growing amounts of information and data, generated and authenticated by credentialed authors and experts (Nagy and Bigum, 2007). Users are able to read the content or information in the database (akin to borrowing a volume from a library), but typically were unable to contribute or add to this knowledge repository. In this sense knowledge was created and maintained by a relatively small group of privileged authors (Dede, 2008).

Web 1.0 / 2.0 / 3.0 Summary

Crawl	Walk	Run
Web 1.0	Web 2.0	Web 3.0
Mostly Read-Only	Wildly Read-Write	Portable & Personal
Company Focus	Community Focus	Individual Focus
Home Pages	Blogs / Wikis	Lifestreams / Waves
Owning Content	Sharing Content	Consolidating Content
Web Forms	Web Applications	Smart Applications
Directories	Tagging	User Behavior
Page Views	Cost Per Click	User Engagement
Banner Advertising	Interactive Advertising	Behavioral Advertising
Britannica Online	Wikipedia	The Semantic Web
HTML / Portals	XML / RSS	RDF / RDFS / OWL

Figure 1: The Changing Nature of the Internet

Burden (2012) argues that, in contrast to the closed repository metaphor which characterized the early stages of internet use, Web 2.0 is personified as a 'read and write', democratic and highly participatory publishing model and concludes that user participation is the activity which most accurately sets Web 2.0 apart from its predecessor. Where Web 1.0 was essentially a one way 'read only' channel, Web 2.0 embraces 'read-write' along with a host of benefits that enable access to both services and resources and provide opportunities to build learning communities. Additionally, Web 2.0 has moved away from the mainly text-based architecture and has begun the process of fostering social interaction and knowledge representation based on multi-modal representations including images (e.g.Flickr), video (e.g. YouTube), audio (e.g. Podcasts) and combinations of these various media. This is turn has transformed the kind of social interaction possible over the Internet making it feasible to undertake discourse and dialogue without having to rely on text based mediation.

> The online world has redesigned communication in and outside the workplace; anyone can access almost anything about a topic, so [young people] are now accustomed to accessing mutliple open sources of information for solutions. As a result there are more collaborative technologies that have enabled the learning process to evolve from a fixed series of discrete training events into an informal, ongoing experience. Learning can easily occur anytime, anywhere

> and in a variety of formats. (American Society for Training and Development, 2009: 3)

Further developments to technology, particularly in terms of portable devices, has led to the further definition of Web 3.0 which invariably include live streaming in all aspects of life and personalised provision (e.g. behavioural advertising and learning analytics).

Implications for Education Organisations & Settings

Education organisations and settings, however, typically remain organized around spatial and temporal considerations such as buildings, timetables, calendars and internal structures which are designed to classify and manage students (Male & Burden, 2013). New digital technologies, however, offer the potential for different forms of learning and teaching to occur both synchronously and asynchronously. This could be hugely beneficial to students in university education, for example, who could have greater (and more detailed discourse) with both their professors and fellow students in a real-time environment. Additionally asynchronous communication affords learners greater time for consideration and reflection than traditional face-to-face spaces where responses and feedback are expected more immediately (Zieghan, 2001). Digital Internet technologies thus generate new opportunities and challenges for how learners undertake personal research or inquiry in the face of unprecedented access to information and sources of data (Crook, 2008). They provide greater choices for how learners undertake and co-collaborate in an inquiry, but they also raise new challenges around the selection, interrogation and validation of the data they locate. These technologies are a core feature of the 21st Century, therefore, which thus presents the possibility for a fundamental change to education, shifting from passive acquisition of someone else's ideas to active learning experiences that empower people to inquire, critique, create, collaborate, problem solve, and create understanding (Dede & Barb, 2009). With such technologies information is continually being developed, distributed and acquired and has become a paradigm that cannot be ignored within education organisations and settings (Courville, 2011). In the case of higher education Selwyn (2007: 91) makes the case that these digital technologies could allow universities to reinvent themselves, requiring institutions to make a shift "from the representational capabilities of ICTs (i.e., their ability to represent

commoditized informational delivery modes of higher education) to their more expansionist and relational potentials'".

Flexible Learning

Developments in digital technologies have thus allowed for the possibility of m-learning (similar to e-learning, but making use of portable mobile handheld devices such as mobile phones and digital tablets). In exploring the opportunities offered through the combination of more traditional Internet access (fixed location) and personal Internet access (mobile), often referred to as 'pedagogical affordances', a number of trends have been identified which need to be explored, evaluated and possibly adopted by education organisations and settings as they move forward in a new era. The term 'affordances' has recently begun to be used in the context of digital technologies to explain and predict the potential for adapting teaching and learning strategies (Burden & Atkinson, 2008; Conole & Dyke 2004). Tools such as wikis, social networking software (e.g. FaceBook) and aggregator services (sites which bring together artefacts from other places) are identified as the means by which educators might shift the emphasis of their teaching by empowering the student to see themselves as knowledge co-constructors rather than passive recipients of information provided. In an era when knowledge is no longer fixed and is subject to challenge on the very public platform of the Internet students need the skills to explore and synthesize data in order to determine knowledge and construct meaning.

As an example the interactivity of social media provides one way for educators to change educators work with their students. The implication for education organisations and settings, it is reported, could be that:

> Social media enables two way dialogues between students, prospective students, educators, and the institution that are less formal than with other media. As social networks continue to flourish, educators are using them as professional communities of practice, as learning communities, and as a platform to share interesting stories about topics students are studying in class. (NMC, 2014: 8)

Social media thus offer opportunities for students to benefit from their wider learning community in a way that fits with their lifestyle and commitments. Making use of email discussion lists, online forums or discussion groups "can provide a flexible approach

that replicates aspects of social interactions that are valued, though not necessarily achieved, in traditional education" (Gordon, 2014: 14). Such technologies allow for group activities which support collaboration and extend the range of learning opportunities beyond the classroom and even the campus and can be particularly effective for part-time or distance learning.

Opportunities within the learning environment thus extend beyond more effective use of readily available software, and in particular presentations based on PowerPoint or Prezi, and include *networking, collaborative learning and problem-solving*, *flipped classrooms* and the use of *learning analytics* to personalize learning and assessment.

- The interactivity of digital devices with Internet access thus provides the opportunity to change the way educators work with their students and encourage *networking, collaborative learning and problem-solving*. Examples of such behaviours are typically to be found in the less formal environment of social media (e.g. the concept of crowdsourcing), but can be adapted to more formal learning situations. The implication for education organisations and settings, in this case universities, are that:

  > Social media enables two way dialogues between students, prospective students, educators, and the institution that are less formal than with other media. As social networks continue to flourish, educators are using them as professional communities of practice, as learning communities, and as a platform to share interesting stories about topics students are studying in class. (NMC, 2014: 8)

- The concept of the *flipped classroom* is a strategy that reverses the traditional arrangement by delivering content outside of the classroom and moves higher level cognitive activities into the classroom. In a flipped classroom model, students may watch online lectures, collaborate in online discussions, or carry out research at home in order to engage in concepts in the classroom. Thus instead of the teacher being the source of information – "the sage on the stage" – they become the facilitator of learning – "the guide on the side" (King, 1993).

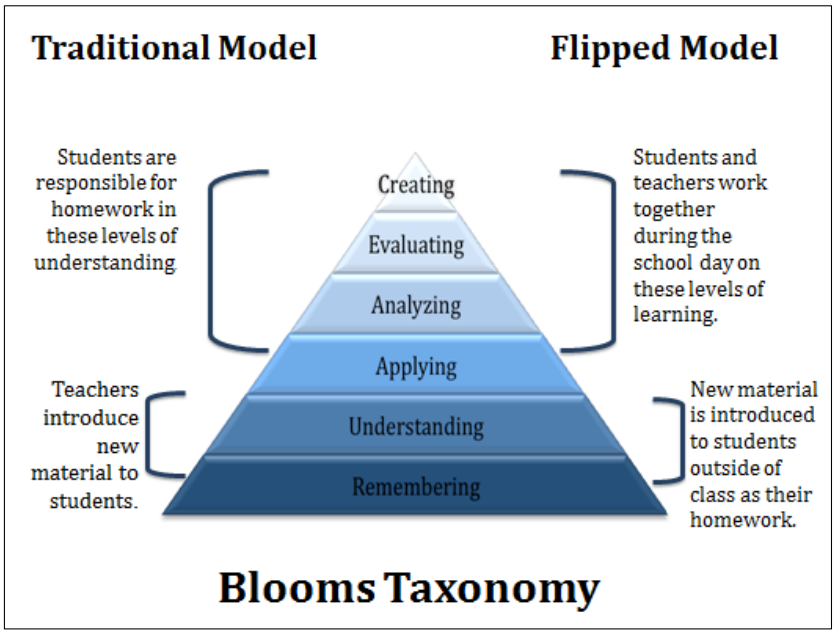

Figure 2: The Flipped Classroom

- *Learning Analytics* can be used to personalize both the learning experience and assessment processes. Students (and staff) typically generate a range of data which can be available to analyse for personal trends in much the same way as the commercial world tracks use of online services in order to be responsive and proactive to consumer needs. This emerging science is discovering ways in which to identify individual learning challenges, to personalize the learning experience of students and enable adaptive pedagogies and practice in order to enhance outcomes. Analytics, they suggest, can "potentially help transform education from a standard one-size-fits-all delivery system into a responsive and flexible framework, crafted to meet the students' academic needs and interests" (NMC, 2014: 38). Using the data it will be possible, therefore, to not only track student engagement with learning and assessment tasks, but also to provide the possibility for intervention and adaptation of such activities where student progress is not as advanced as anticipated. Key features of data driven learning and assessment suggests Gordon (2014) are the potential to match the mode and learning style of students and to provide support for synchronous and asynchronous activities.

Such opportunities provide the student with choice in how, when and where to access learning materials by offering a suitable range: in other words *flexible learning*. Equally the learning process can be managed through personalised assessment processes that recognise individual stages of development. Intelligent systems use information "to provide individual learners with material tailored to their needs in terms of content, learning style and potentially other facets of flexibility" (Gordon, 2014: 10). This leads

him to conclude that, for universities, there are three possible approaches for universities to adopt in the new era.

1. To enhance traditional lecture courses through stand-alone online material;
2. Deliver material electronically with a restricted requirement for real-time (and possibly on site) interaction;
3. Adopt a wholly distance learning approach.

Even the first element suggested here moves the learning experience beyond the immediacy of the face to face interaction and supplements provision that is reliant on a teacher, however skilled they may be in making real time use of presentation software and online materials. By making use of flexible learning opportunities education organisations and settings can enrich the learning opportunities for their students. Further opportunities present themselves to universities through wholly online provision, such as Massive Online Open Courses (MOOCs), but as signalled earlier this will not be explored in this paper. Instead the focus remains on the enhancement of learning and the implications for change.

Learning in a Digital Age

Traditional modes of learning within education organisations and settings tend to be based on teacher led activity where knowledge transfer is supported by extended activities to embed learning. As can be seen from Figure 3 both Behavioural and Cognitive approaches start from the premise of formal presentation (lecture) followed by practice and application which support the consolidation of learning in different ways. In many ways it can be argued that the development of the Internet encourages a constructivist approach based on discovery, scaffolding, personal experience and collaborative learning. Models of learning based on behaviourism, cognitive and constructivist approaches are being overtaken, however, in this emerging digital age by *Connectivism*, an approach first offered by Siemens (2004).

Connectivism defines learning as a continual process which occurs in different settings, including communities of practice, personal networks and work places and allows teachers to shift focus from their textbooks and presentation to the actual student. Knowledge is emphasized by this theory, which stresses the need to help students gather, access, synthesize and publish knowledge in print or in online media.

This knowledge is no longer under the control of experts, but has been distributed and is accessible to average students. In connectivist-based learning, the role of the teacher has changed from that of providing material and presenting lectures to one of helping students create, publish and share knowledge using Internet-based technologies.

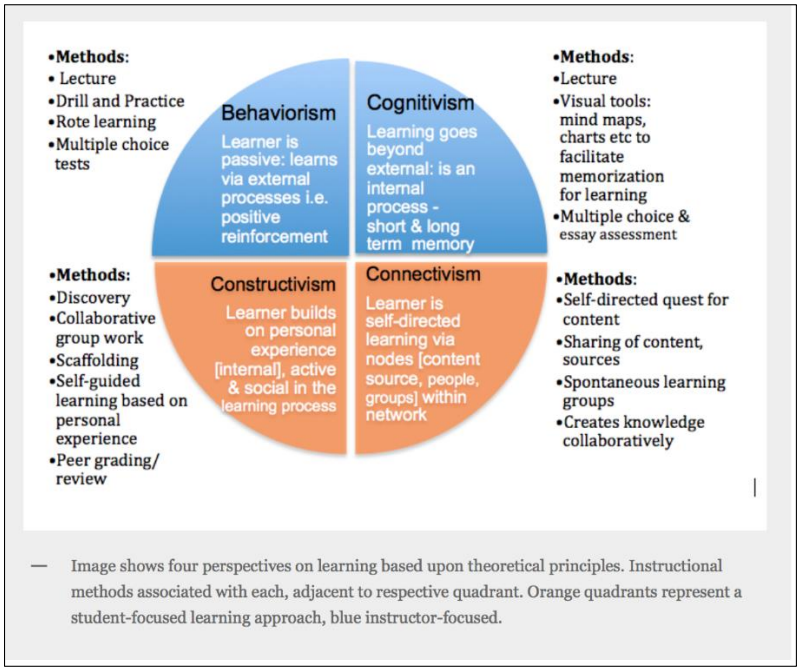

Figure 3: Learning in a Digital Age

The theory of connectivisim is based on the following principles:

1. Learning is a collection of opinions;
2. The learning process consists of connected information nodes or sources;
3. Learning can be stored in computers and non-human objects;
4. Learning occurs when the student's capacity to comprehend knowledge is greater than what the student knows;
5. Learning should help students understand the decision-making process;
6. The availability of timely, accurate and current knowledge is paramount to the success of the learning program. (Siemens, 2004: 5).

Digital technologies support the connectivist learning theory because they provide tools for distributing the vast knowledge in the Internet to students in the classroom. Consequently connectivism suggests giving the learner the control to explore objectives defined by that learner (Giesbrecht, 2007). In order to facilitate the interaction both synchronous and asynchronous tools are essential as extensions of

course environments. With connectivisim, active participation is required by all involved in the learning process and matches the aspirations offered by Confucius: "Tell me, and I will forget; show me, and I will remember; involve me, and I will understand."

Based on the above discourse a model was proposed in regard to student learning in the higher education sector to guide learning beyond self-managed independent learning towards collaborative, interdependent learning (See Figure 4). As Crook (2008) indicates, the learning process in university education requires greater self-management of learning as they progress from entry stage to graduation and on to postgraduate level and, in a digital age, engagement with other students in a collaborative mode. Aldhafeeri & Male (2015) thus argue that student learning potential will not only be enhanced by use of digital technologies that are now readily available, but also foresee the ultimate aim of such education as being the creation of effective learning environments through interdependency, a state often seen as ideal in the world of work where problem solving and creativity are the product of collaboration rather than independent contributions as suggested earlier (Helfand, 2013). Students in such a system would thus be expected to familiarise themselves with the concept or topic of planned learning outcomes and use the time when they meet to explore, discuss and evaluate the ideas. Such an approach encourages cooperation, collaboration and interdependency which tend to be highly valued in the workplace.

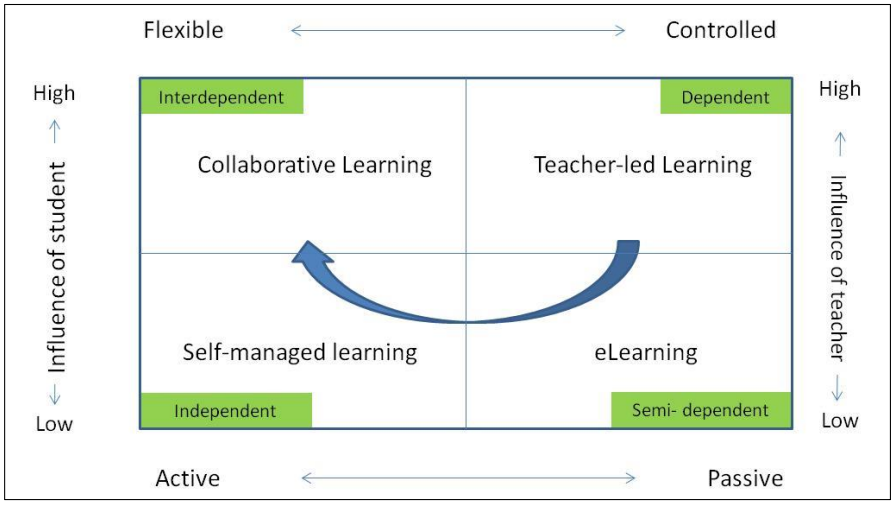

Figure 4 - Learning in a Digital Age
© Aldhafeeri & Male (2012)

Implications for teachers

The main implication for teachers intending to taking appropriate action to extend learning opportunities in the current (and future) era is for an adjustment to the strategy of using digital technologies to extend behavioural and cognitive approaches towards constructivist and connectivist learning. Here the work of Puentedura (2010) is of direct relevance with the *Substitution-Augmentation-Modification-Redefinition* (SAMR) model. Although others have also worked in this field of recognising the potential of technology to not only enhance, but also to transform learning (see McCormick & Scrimshaw, 2001, for example), it is the SAMR model that provides the most effective explanation. As can be seen from Figure 5 the teacher who uses technologies merely to enhance presentation, for example, is substituting that medium without changing their basic strategy. Even with use of tools with greater capability, such as interactive websites, the teacher is till only augmenting the regime of teacher led learning and remains in the enhancement stage recognised by both Puentedura and McCormick & Scrimshaw.

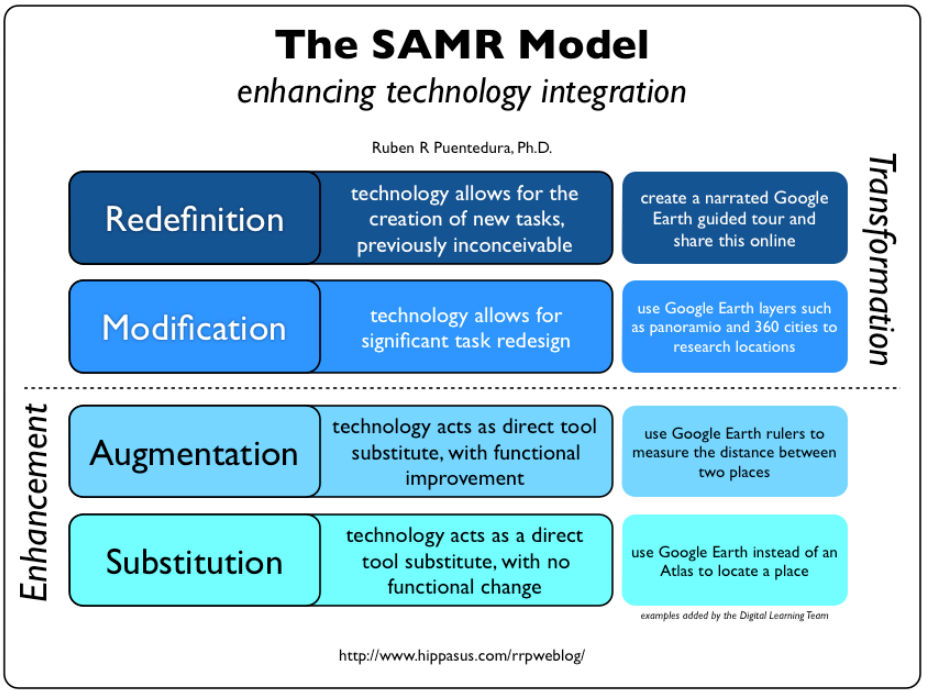

Figure 5 – the SAMR Model (Puentedura, 2010)

It is only when teachers look for significant changes in the task, such as the flipped classroom, or the learning outcomes, that they move into the transformation stage of

the model where modification and redefinition come to the forefront of their planning and delivery of the student learning experience. In order for this to happen, however, there needs to be a transformation in teacher expectation and capability.

Changing Teacher Behaviour

Sadly, however, we have seen and continue to witness that teachers remain fairly conservative in their style and willingness to change. In projects in which I was engaged within the last three years a key factor delaying transformation was caused by systemic and individual reluctance to embrace the full capability of digital technologies. Those barriers to change resulted, we argued in a review of those projects, that for many students the current situation is 'Access Denied' (Male & Burden, 2013: 2). A number of factors were identified as facilities related (e.g. inadequate consistent access to online services), but the major restraints emanated from issues relating to e-Safety and to teacher attitudes. The ogre of e-Safety was often manifested by introducing firewalls and regulations that prevented or discouraged student use of digital technology, especially in the formal face to face learning environment. Education systems, organisations and settings seemed paralysed by the possibility that (a) students would not use devices appropriately and (b) that the threats to the young people's online safety. It was a situation that was changeable, in our view, and one that related to behavioural rather than technological issues. The best descriptive parallel to what we considered to be conservative behaviour was to imagine if the word 'pencil' was to be substituted for 'device' (e.g. how would I know what they were doing with the pencil when I was not watching them?)

In a more recent work, however, it was the attitude of teachers that caused most delay to the use of technologies to transform learning (Aldhafeeri & Male, 2015). The research that informed this finding was carried out in Kuwait, a country with extremely high level of personal wealth. Here we can see physical evidence of what Traxler (2010) suggests in that digital devices are ubiquitous. The survey we undertook in May 2013 showed academic staff and students to be extremely well equipped with personal mobile digital devices and generally considering themselves to be competent users of such equipment and associated software applications. Nevertheless there was little evidence to suggest use of digital technologies to enhance student learning

other than a claim by academic staff that they employed presentation software extensively in their teaching (a claim challenged by students). The use of portable digital devices, particularly mobile phones, rather appeared to be actively discouraged in taught sessions and there was no suggestion of the use of learning analytics or the flipped classroom. Social media, it appears, is used precisely for the purpose of socializing and not to support student learning. Finally, although there was the suggestion of the use of hybrid learning this was seen to be mainly the use of VLE as a repository for teaching materials with no evidence of interactive tasking.

The principle that teachers are conservative and slow to adapt to change matches the work of Rogers (1962) who investigated the diffusion of innovations. As can be seen from Figure 6 the proportion of the population that are innovators and early adopters is very low, typically at just 16 per cent. It is these people are the pioneers who, in the case of making effective use of digital technologies, will be those who change their approach to embrace the potential of radical change.

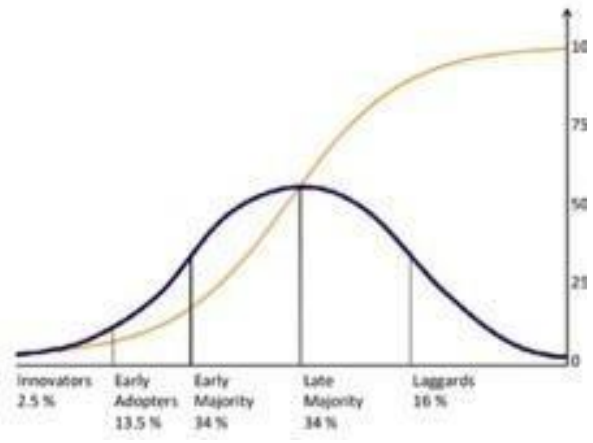

Figure 6: The diffusion of innovations with successive groups of users adopting the new technology. The second line shows when the innovation reach saturation level (Adapted from Rogers, 1962).

Without the necessary impetus or incentives, therefore, the majority of the population only change once the innovation is inevitable. This makes the current situation of laggards seemingly driving the speed of innovation adoption with digital technologies somewhat puzzling as the personal ownership and use of devices is now almost universal. It seems that for digital technologies to become common in use by teachers to transform learning they personally have to pass through a 'transformation horizon' whereby they can no longer see their work as not being dependent on personal

devices (Burden, 2012). The metamorphosis recognised in this instance was based on the theory of *Transformational Learning*, initially developed by Mezirow (1975).

Transformative Learning

Mezirow's theory of transformational learning explains how and why some individuals are able to examine their existing assumptions and ways of seeing the world in order to reconcile them with new approaches or paradigms brought about by a significant shock or disorientating dilemma. From his original investigation into the way in which his wife (and other women) re-entered education later in life he developed a hierarchical typology which predicted the stages they might pass through before experiencing a full perspective transformation. These begin with a disorientating dilemma and include:

1. Disorientating dilemmas followed by series of phases:
2. Self-examination,
3. Critical assessment of assumptions,
4. Recognition that others have shared similar transformations,
5. Exploration of new roles or actions,
6. Development of a plan for action,
7. Acquisition of knowledge and skills for implementing the plan,
8. Try out of the plan,
9. Development of competence and self-confidence in new roles and responsibilities
10. Reintegration into life on the basis of new perspectives.

(Mezirow & Associates, 2000: 22)

Mezirow explained how some adults achieved a 'meaning perspective transformation' in which they questioned and altered their fundamental assumptions before reintegrating them (Stage 10) into completely different ways of seeing the World. Mezirow summarized this as:

> ...the process by which we transform our taken for granted frames of reference (meaning perspectives, habits of mind, mind sets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action. (Mezirow & Associates, 2000: 8-9)

According to Mezirow since most adults hold that the World is largely predictable, what happens once they anticipate will occur again. Over time, and usually in an unconscious and uncritical manner, this expectation shapes assumptions and beliefs which begin to coalesce as clusters of meaning schemes or frames of reference (Mezirow & Associates, 2000). It is only when something unforeseen occurs to interrupt this cycle that adults can, under certain circumstances, be encouraged to questions their existing frames of reference. This occurs, in Mezirow's interpretation of Transformative Learning, through a mainly rational process of self-critical reflection and discourse when individuals begin to realize their previous assumptions and meanings do not explain the unexpected new experience. Transformative learning occurs when this critical process enables the individual to consider new alternatives and develop new frames of reference (Canton & Roy, 2003).

In a small-scale case study of teachers in a UK secondary school (Burden, 2012) it was demonstrated that some reached a point along the continuum where their perspectives and meaning structures were irrevocably altered, to a point at which they could no longer conceptualize their previous ways of teaching and organising learning and fully embraced this new world of learning.

> … the affordances of [digital technologies] and the processes of transformation are inextricably linked with teachers moving towards and through an imaginary boundary which is referred to by the title of the 'Transformation Horizon', based on the principle of a Black Hole where the term the Event Horizon is used to signify a point beyond which there is no return. In this case the Transformation Horizon is used to denote a point at which the individual's meaning schemes and perspectives are irrevocably transformed. (Burden, 2012: 291)

Exposure to personal digital equipment was a first step in this process of transformation, followed by a willingness to collaborate and share ideas, resources and practices. Fundamental to this transformation process was the recognition that teaching was not just about content knowledge, but was also about pedagogical and technological understanding and capability in this digital age. This combination of knowledge and skills is demonstrated in the TPACK model (Koehler & Mishra, 2009) – see Figure 7. As can be seen, the effective teacher in a digital age is one who has Technological, Pedagogical and Content Knowledge and Skills.

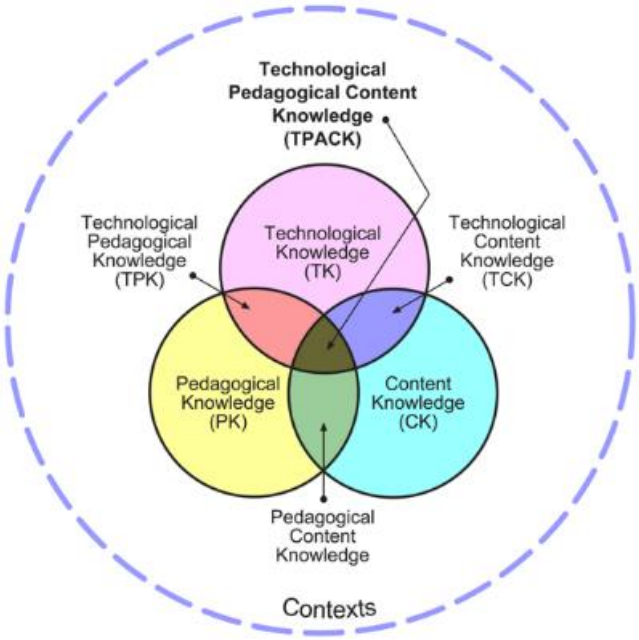

Figure 7 – The TPACK Model (Koehler & Mishra, 2009)

Conclusion

The conclusion to be reached is that there is still ineffective use of available digital technologies in education organisations and settings which seems to be more to do with attitude rather than lack of opportunities and skills. In the study undertaken in Kuwait University the only two lines of defence offered by students for academic staff not engaging more fully with digital technologies to support learning were that the amount of lecture time available militated against the complexity of using multiple platforms for investigating knowledge and, secondly, that too few teaching spaces had permanent Internet access (Aldhafeeri & Male, 2015). Whilst these can be deemed as valid reasons in terms of fixed or portable computer equipment these are not excuses for failing to take advantage of the capability to utilise the potential of personal mobile devices with Internet access. Whist it is clear that the university and its academic staff have recognised and realised the potential of online learning, most obviously through the use of VLEs, there was too little substantive evidence of digital technologies being used adequately or effectively in the taught learning environment.

This research within the Kuwait University appears to mirror, therefore, the current situation that seemingly permeates all phases of education globally in that the technology exists, as does the capability to use it, but the willingness to exploit

personal mobile digital devices and associated software applications is limited. The source of such limitation is typically based around intransigence of teaching staff to adapt their practice, a response often disguised through concerns about student safety and the validity of data sources when using the Internet (see, for example, Male & Burden, 2013). It is time to move on.

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