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Reducing the digital literacy divide through disruptive innovation

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This review outlines the challenges faced by higher education from the ongoing evolution and penetration of digital technologies throughout many aspects of society. It examines how complex organisational structures can prevent institutions from developing effective means of support for innovation; academics from developing necessary digital literacies and online teaching practices, and students from developing proficiency in contemporary technologically inclusive professional practices. It proposes that academics must look outside of their own institutions for inspiration and support to break this cycle, and explores the potential of informal professional development strategies based upon the notion of disruptive innovation (C. Christensen, n.d.), to help generate systemic change 'from the individual up'.

***Keywords**: Professional development; relational ontology; digital divide; work-practice, information and communication technology; online teaching.*

1. The emergence of the information age

The advent of the Internet and associated communication technologies is overcoming many of the traditional limitations on discourse between geographically dispersed societies. It is also disrupting and challenging many established practices within business, social interaction and education. Socialising, communicating and conducting business online are now accepted as normal practice in many societies or they are rapidly on the increase in others (Australian Bureau of Statistics (ABS), 2011b; Castells, 2011; Fuchs, 2013; Jeffrey & Doron, 2013; Organisation for Economic Co-operation and Development [OECD], 2013; Warschauer, 2003). The Internet is now an

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integral aspect of our global economy, enabling rapid sharing and synthesis of disparate ideas and knowledge. As a result a world-wide, digital workplace has emerged in recent years in many areas of industry (McArthur, McIntyre, & Watson, 2007). This is a trend of such significance to the way modern economies and societies operate that it has been characterised as the third industrial revolution (Greenwood, 1997). Those slow to adapt historical business models to these new disruptive technologies risk losing relevance and value within the changing social context (C. Christensen, 1997; S. Kaplan, 2012; Lucas Jr & Goh, 2009; Naughton, 2010).

The implications of a digitally networked society extend beyond the realm of economics however. Our higher education system is an integral component of the society that surrounds it and plays a critical role in its ongoing development. This rapid social change has placed demands upon traditional institutional operational models, which need to adapt to help academics develop an understanding of how technology is used within current work practices, and how they need to adapt their teaching to reflect this.

Expanding access to digital communication technologies

In Australia general household access to the Internet has dramatically increased from 21% in 2000 to 79% in 2011 (ABS, 2011b, p. 8). In 2011, an average of 32.8% of employees in Australian businesses (79.8% in companies with over 200 employees) were using Internet technologies to work from home or other locations on occasion (ABS, 2011a, p. 14). Australia ranked the thirteenth most connected in terms of household access to broadband and mobile wireless broadband out of thirty-four OECD countries in 2011. This was at 72% penetration, compared with the leading country, Korea, at 97.2% (OECD, 2013).

The rapid penetration of digital communication technologies is exemplified by the expansion of communication using online social networks such as Twitter [www.twitter.com], YouTube [www.youtube.com] and Facebook [Facebook.com], which has an estimated one billion active accounts (Vance, 2012). Similar growth is also now being seen in global online professional networks, such as Linkedin [www.linkedin.com]. Within such professional networking communities, individuals represent themselves in a professional capacity by posting profiles and resumés, connecting with other practitioners, looking for work and joining work related interest groups.

These technologies have become increasingly accepted as a normal part of social interaction in many countries. There is, of course, still a notable inequity in the penetration rates of household Internet technologies in some poorer nations (Chen & Wellman, 2004; Mulligan, 2013). Rates are as low as 1% in countries such as the Democratic Republic of Congo, Liberia, Niger, and Ethiopia (Pejovic et al., 2012). However, as technology becomes cheaper, access to available digital networks, telecommunication technologies and handheld devices rapidly increases (Jeffrey & Doron, 2012; Johnson, Pejovic, Belding, & Stam, 2011; Norris, 2001; Warschauer, 2003). In many cases this has contributed to the improvement of social conditions in developing nations (Jeffrey & Doron, 2013; W. A. Kaplan, 2006; Oyedemi, 2012; West, 2012).

Technology and education

Such rapid adoption and expansion indicates that online networking technologies are an integral part of our social and working lives for many people around the world. The examples discussed within the literature clearly exemplify the increasing trend of a rapid reduction of global technological disparity in a very short amount of time. Technology and society are always evolving, but the rate of change in each is not always comparable, and is rarely in perfect balance. The speed at which digital technologies have infiltrated our society is extremely rapid when compared to other major technological developments in recent history (Castells, 2011; Warschauer, 2003). This rate of technological change often outpaces society's ability to amend its practices to cope with and adapt to the changes at the same pace; causing disruption and imbalance during the period of adaption (C. Christensen, 1997; S. Kaplan, 2012; Lucas Jr & Goh, 2009; Naughton, 2010).

Cultural practices within educational institutions (such as management and procedural policy, curricula, teaching methods, proffered professional and social literacies) continually influence society through academic contributions to research, and as new graduates take their new knowledge and skills into the workforce. Simultaneously, societal practices also shape and inform these different aspects of educational practice—one is inseparable from the other (Vygotsky, 1997). Education is therefore also deeply entangled within the relationship between society and technology.

Existing artefacts relating to teaching practice have been ingrained over many generations of cultural mediation. They have become well-established convention with origins in a society that existed before the recent rapid advances of digital technologies. Slates, chalk, blackboards, books, pens,

calculators and computers have each played their part in the evolution of educational practice. While the function and purpose of such simple technologies were relatively singular, easy to comprehend and easy to adapt into teaching practice (Koehler & Mishra, 2009), rapidly evolving digital devices and networks can be used for a myriad of different purposes. This makes their relationship to trusted and established cultural processes within education not as immediately obvious to many practitioners. As Koehler & Mishra, (2009) argue, "by their very nature, newer digital technologies, which are protean, unstable, and opaque, present new challenges to teachers who are struggling to use more technology in their teaching" (p. 61). Many educators therefore have been slow to recognise the significance of the expansion of digital technologies and respond to the changes that have been happening around them. Goldin & Katz observed that in the race between technological change and education "education ran faster during the first half of the century and technology sprinted ahead of limping education in the last 30 years" (Goldin & Katz, 2009, p. 292).

2. A relational ontology of society, technology and education

Unquestionably the increasing use of digital communications technologies is disrupting, informing and shaping many established personal and professional socialisation and knowledge sharing practices in contemporary society. However, it is important to clarify that these changes in social practice are not simply the result of the development of new technologies. Rather, changes in social behaviour surrounding the increased adoption of digital communication technologies can be considered to greatly influence the continued development of these technologies to better facilitate, perpetuate and improve social exchange. Technology and society are intertwined within what can be described as a *relational ontology* (Orlikowski, 2010). This refers to a lack of defined boundaries between technology and human endeavour in which each element is an integral part of the other. Technology has always informed the development of societal practice, and societal practice has always informed the development of technology.

Trying to evolve established institutional mindsets and pedagogies in keeping with contemporary social and work practices is a complex and troubled process. Yet it is essential to ensure the continued legitimacy and relevance of academic practice. Orlikowski describes a possible theoretical standpoint for such situations called *entanglement in practice*. This entails,

> …a commitment to a relational ontology that undercuts the dualism that has characterised but also limited much of the prior technology research…" (Orlikowski, 2010, p. 128).

In other words, to overcome the perceived dichotomy between technology and organisational culture, those within an organisation must first accept that they are not oppositional elements. From this perspective technological artefacts are not separate entities distinct from epistemological practices. As Orlikowski (2010) conceives it, "technologies have no inherent properties, boundaries or meanings, but are bound up with the specific material-discursive practices that constitute certain phenomena" (p. 135).

While originally contextualised within the framework of management research, the concept of entanglement in practice is equally applicable in many strata of educational practice, whether institutional management, policy and implementation, curriculum development or individual teaching practices. Educational institutions are large and complex. Any change, especially a radical rethink of teaching methodologies at an institutional level, takes time—even if the need for change is clear. However, attempting to reconcile the need for re-examination of the technology and practice ontology within a well-established culture, such as that found within education, has presented significant challenges,. This is especially true in cases where external technologies and related social practice is evolving rapidly, demanding equally rapid change from within.

Therefore, the entanglement of technology in education, and education's entanglement within the rest of society, means many institutions are to some degree hampered by the uncertainty of the short and long-term implications of the rapid development of different technologies and progressive shifts in related social and workplace conventions. As Naughton (2010) explains,

> … one thing we've learned from the history of communications technology is that people tend to overestimate the short-term impact of new technologies — and to underestimate their long-term implications (Naughton, 2010, p.2).

Technological entanglement in practice

The Vygotskyian concept of cultural mediation describes the way in which an individual acts upon and is acted upon by social, historical and cultural factors (Daniels, 2001). As individuals live within a society generation after

generation, certain knowledge and processes become ingrained in the common psyche, giving us a sense of culture; that is, a sense of how we should interact and a frame of reference from which we can give meaning to the construction of new knowledge. In essence, the history and collective experience of our ancestors is passed on through these social artefacts. We use them to advance our own knowledge, subconsciously and consciously building on the experiences of those who have gone before us. They enable us to define who we are as a society, and provide guidance to allow us to function effectively within it. Therefore, we each continue to contribute to these artefacts, leaving our own imprints — our new experiences of social variances — upon them to pass to the next generation. This practice enables successive generations to contribute to and adapt to changes in their social environment over time, to normalise the new or unfamiliar in a way that makes sense in the context of existing social artefacts and convention. This mutually dependent evolutionary cycle of technological and societal symbiosis continually redefines how many aspects of professional and social activity are enacted, constantly changing the fundamental skills required to successfully participate in such contexts.

Higher education is equally susceptible as any other business to losing relevance and value in contemporary society if it does not adapt to changing technological, economic and social practices (C. Christensen, 1997; Davies, 2012; "Not," 2012; Thoma, 2012). Adopting a sustainable technologically-inclusive business model requires an investment not only in technology, but in evolving the practices of many aspects within an entire well-established culture (Stiles & Yorke, 2004). This is a significant undertaking, and many institutions are unable or unwilling to invest so heavily up front in a holistic approach to technological inclusivity that involves restructuring the operational infrastructure of the institution. They assume instead that traditional operational models will continue to provide stable and sustainable revenue (C. Christensen, n.d.). Therefore new initiatives involving technology are often built upon the back of existing administrative and operational structures.

While posing less risk and being easier to implement, the administrative and bureaucratic infrastructure can limit the effective application of technology in core working practices, (Bass, 2012; L. Johnson, S. Adams, & M. Cummins, 2012a; McIntyre, Watson, & Larsen, 2009). The rate of change in many institutions can often be far too slow to facilitate any real lasting systemic change in practice (DiPaola, Dorosh, & Brandt, 2004; Kearns, 2008). There is, as a result, a well-documented history of institutions developing online learning initiatives and training programs that are either short lived or fail to meet expectations from leadership, educator and

student perspectives (Bacsich, 2005; R. Bennett & McIntyre, 2004; Garrett, 2004; Gunn, 2010a; Klopfer, Haas, & Jenkins, 2012; Lentell, 2012). In order to avoid this, from a relational ontology perspective, institutions must acknowledge that building a progressive, technologically-inclusive management strategy relates directly to core business of research and teaching. However, in recent years such acknowledgements have been rare. Rather, many institutions have produced a variety of responses ranging from unfortunate instances of either holding back from engaging with newer technologies, or conversely, engaging in large-scale technology-driven initiatives without first understanding the implications for institutional culture.

3. The isolated development of online teaching

Successful innovations in universities often occur through the devotion of a small number of academics working in isolation. Without institutional support, once the development phase has been completed such innovations can fail to be sustained without the continuing effort of the academics involved, resulting in good practice in online teaching not always being shared with other staff (S. Bennett, Priest, & Macpherson, 1999; Dimitriadis & Goodyear, 2013; McIntyre, 2008). This *isolated development trap* (Stiles & Yorke, 2004, p. 2) can be exacerbated when those who do innovate effective online learning projects, do so with the support of external or competitive funding. Often business cases are not made to institutions by those involved to demonstrate the benefits of continuing to support an online learning initiative; and once funding ceases institutions cannot effectively support their continuation within their existing operational model (Gunn, 2010b; Stepanyan, Littlejohn, & Margaryan, 2013). The resulting difficulty is that institutions are unable to escape short-lived project-based innovation (Lakkala, Lallimo, & Hakkarainen, 2005). Even research centres and support units working within institutions to support technological innovation are often limited by these strategic shortcomings, considerably slowing development of online teaching practices by academics.

Academics are not encouraged to explore or engage in online teaching

The differences between face-to-face and online learning spaces are significant enough that unique pedagogical approaches are required for effective teaching online (Baran, Correia, & Thompson, 2011; Casanova, Moreira, & Costa, 2011; Goodyear, Salmon, Spector, Steeples, & Tickner,

2001; Koehler & Mishra, 2009; McFarlane, 2011; Salmon, 2004). Developing effective online teaching practices can initially take significant time and effort (Keengwe & Kidd, 2010), particularly for those academics unfamiliar with the practice. Those who do wish to try to develop their capabilities often spend extra time doing so on top of existing workloads (Herrington, 2006; Lakkala et al., 2005; Mills, Yanes, & Casebeer, 2009). This is a burden that many educators regard as outside of what is, or should be, expected of them (Huber & An, 2012; McIntyre et al., 2009; K. Watson & McIntyre, 2012). This is despite many institutions considering online teaching to be a part of an academic's normal duties (Kim & Bonk, 2006). In fact, a recent Australian study of higher education institutions found that,

> most Australian universities do not have centralised procedures or guidelines for allocating academic workload which take into account the specific activities associated with online or blended learning (Tynan, Ryan, Hinton, & Lamont Mills, 2012, p. 5).

This means that even academics who may be interested in developing new online pedagogic skills are often deterred, because proper investment of time and training to develop the capability in staff isn't acknowledged or compensated (Bolliger & Wasilik, 2009; Mills et al., 2009), nor seen by many institutions as necessary for their core business (McIntyre et al., 2009).

Technology before pedagogy

In the early years of online learning many institutions rushed to address the fact they had fallen behind contemporary societal practice by investing quickly and heavily in digital technology (DiPaola et al., 2004; McIntyre, 2008; D. M. Watson, 2001). Believing technology was a non-disruptive addendum to existing cultural process, many institutions often neglected to consider its entanglement within organisational culture, pedagogy, or the broader implications of its relevance to external social and professional practices (Orlikowski, 2010). An institution having the resources or infrastructure to officially support any customised use of technology, or a large selection of alternate technological platforms, is often an unrealistic prospect. This can result in tightly controlled centralised information technology strategies and infrastructure out of managerial necessity. Such circumstances can severely restrict the availability of the resources, flexibility and support that can afford academics the opportunity for experimentation or innovation. This results in a technology-driven "one size fits all" approach that may not be appropriate for different disciplinary contexts or teaching scenarios (Uys & Gunn, 2012). Despite being manageable from an institutional or

administrative perspective, this approach can have the unfortunate consequence of systemising teaching, subjugating tailored pedagogical approaches because they don't always align with the functionality of the software being used (R. Bennett & McIntyre, 2004). The unsuitability and high learning curve of this approach has resulted in tension, resistance and fear within academics, and the dissatisfaction of students.

Fear and resistance amongst academics

The legacy of such complications is that online learning can still often be perceived as a poor quality, money saving, automated and "lazy" approach to teaching in higher education (McIntyre, 2008). Over the years this has resulted in some academics feeling resistant to adopting unfamiliar teaching approaches; fear of criticism by peers; uncertain about being replaced by technology; and insecure about their role as a teacher (Bozarth, 2006; Ertmer, Addison, Lane, Ross, & Woods, 1999; McIntyre, 2008; McIntyre et al., 2009; Rabak & Cleveland-Innes, 2006). When reasons such as these prevent academics from changing their teaching practices, it can result in them being blamed for being inept at integrating technology into their teaching practice (Dimitriadis & Goodyear, 2013). However, Facer argues "…this myth presents a profoundly anti-progressive account of education history, one that does little justice to the dynamism of educators, educational activists and their capacity to act as a force of change in the world" (Facer, 2011, p. 7).

Educators primarily need to understand why it is important to embrace new technologies, and when considering their use, to place considerations of pedagogy and curriculum before those of technology to develop truly effective online learning initiatives (McIntyre, 2008; Schnackenberg, Luik, Nisan, & Servant, 2001). Yet even if an academic is open and willing to expand their teaching practice, without a supportive infrastructure in place to help them understand the reasons why technology should be considered; how it can enhance and is relevant to the learning experience for students; and how it can benefit their teaching practice, these reactions are unlikely to abate quickly.

4. The growing digital literacy divide in education

Up until very recently, access to technology was seen as the primary social separator between the digitally advantaged and disadvantaged. This is commonly referred to as the *digital divide*, a concept that explores how this lack of access to technology within different socioeconomic groups has

increasingly disadvantaged and hindered people from participating as a fully participatory member of contemporary society (Black & Akinson, 2007; Chen & Wellman, 2004; Mulligan, 2013; Norris, 2001; Warschauer, 2003). A lack of participation is conceived as limiting individuals' potential to improve their lives, and widening the gap between the haves and the have-nots (Wresch, 1996). However, the rapidly increasing availability of digital communication technologies means that the issue is increasingly less about access to technology, and more about one's ability to use it to effectively participate within the relational ontology of personal, professional and educational practices. As digital technology use continues to become ever more ubiquitous, the definition of digital divide will increasingly shift from the have and the have-nots to the *cans and the can-nots*.

This *digital literacy divide* can be defined as a lack of knowledge of how to effectively use digital technologies for valued social economic and political practices. The development of digital literacy knowledge and attitudes (Sonck, Kuiper, & de Haan, 2012) is becoming critically important for current students,

> …the personal and social importance of skills of critical information consumption, infotention (managed media attention), ethical collaborative research and networked coproduction of knowledge, digital citizenship, and network know-how is magnified multifold by digital media and networked publics (Rheingold, 2012, p. 53).

Goodyear et al. argue that the jobs most university graduates are employed for require knowledge-work, "… adding value to a product or service through the application of knowledge" (Goodyear, Ellis, Brew, & Sachs, 2007). Recent years have seen a, "…change in the relative demand for more educated workers, which has been driven largely by skill-biased technological change" (Goldin & Katz, 2009, p. 294). Not only do graduating students need to be top of their respective fields to be competitive in the contemporary globalised workplace, they must also be experts in using information technology, collaborating and working with others, being flexible and having the ability to continually analyse and adapt to the world in which they find themselves (Goodyear & Zenios, 2007). This places great emphasis upon the higher education system to ensure that graduates develop *epistemic fluency* (Goodyear & Zenios, 2007) in these knowledge management and analysis skills. In addition, they must be literate in the use of the digital technologies and related emergent societal conventions and practices that have made them necessary.

Contemporary students possess a wide range of technological skill levels, but they are often lower than might be expected of a generation that Prensky (2001a) once dubbed as technologically self-sufficient *digital natives*. The digital native concept has since been heavily disputed (S. Bennett et al., 2008; Selwyn, 2009; Thomas, 2011), and even Prensky himself has since recanted, or at least redefined the term,

> …it seemed clearer and clearer to me that being a digital native is not, at its core, about capabilities, or even knowledge, regarding all things digital. No matter who you are, all those things have to be learned in some way" (Prensky, 2011, p. 17).

This means that now more than ever, students are expecting academics to help them develop the digital literacies they need (Hall, Nix, & Baker, 2012). If, as Rheingold (2012) suggests, essential digital literacy skills are too complex or sophisticated to be learned by rote, then this has significant implications for how educational institutions define their graduate attributes and curricula, and especially for how academics need to evolve their individual teaching practices to support their students in achieving them. However, this presents a significant problem if many academics do not understand how to do so, or even why they should.

Those working in the academe of specific disciplines or professions have the responsibility of passing relevant knowledge and process within the field to a new generation, thus giving the educational experience an authentic connection to work practice. Therefore, if the use of technology has become integrated within the practice of a particular discipline, an academic has a responsibility to their students to ensure that the content, knowledge and skills they teach about the topic, align with current work practices. As Goodyear et al. (2007) argue, "knowing how tasks are carried out by experienced knowledge workers is a prerequisite for helping students learn how to carry out such tasks" (p. 57). This does not mean that academics have to abandon their existing pedagogic practices, and it does not mean they should always use digital technology. However, academics should have a fluent understanding of digital literacies in relation to the practices of the workplaces they are preparing students for.

The *NMC Horizon report: 2012 higher education edition* (L Johnson et al., 2012a), and The Technology Outlook for Australian Tertiary Education 2012-2017: An NMC Horizon Report Regional Analysis (L. Johnson et al., 2012b) are comprehensive studies detailing technological trends in society and the implications of this technology for education, both current and future. These reports stress the urgent need for higher education to

recognise the importance of digital technologies and their essential role in the education process. They also highlight the fact that, "most academics are not using new and compelling technologies for learning and teaching…" (L. Johnson et al., 2012, p. 19). It is this digital literacy divide amongst educators that is of prime concern when considered in the context of educating future generations to be fully participating citizens in a digitally networked world.

5. Reducing the digital literacy divide

The extent of the digital literacy divide many academics find themselves within can, through repeated cultural mediation of ingrained practices, be perpetuated and exacerbated. If academics do not possess the necessary digital literacies to engage with technology in ways that can meaningfully extend their existing teaching practices to make them more relevant to authentic work practices within their field, then they need to develop these literacies—or risk becoming increasingly ineffective within the educational process.

However, as discussed above, the reasons for this digital literacy divide emerging amongst academics in recent years are many and complex: the fast rate of technological change; the inability for large institutions to respond quickly enough in adapting their organisational infrastructures; the failure to properly acknowledge the importance of technological entanglement in core business practice; technology led online initiatives that fail to enable a meaningful translation of existing individual knowledge and teaching practices; lack of support for academics in the development of online learning initiatives; and the lack of recognition of the work required by academics to develop the digital literacies and online teaching competencies.

It follows therefore, that some form of professional development is an important element in helping to restore balance in the relationship between technology and education. The *NMC Horizon Report* acknowledges that institutionalised professional development built around technological platforms is ineffective in building digital literacy capacity; but that some academics are finding effective support in other forms of professional development or informal learning (L Johnson et al., 2012).

The importance of an individualistic approach

Formalised professional development strategies can often be designed to address the broader strategic needs of an organisation, and are not necessarily capable of dealing with the incredibly diverse circumstances or

requirements of individual academics. The potential key to creating lasting epistemic change is to help academics understand the relevance of technology to their own existing pedagogic practices, in the context of the authentic workplace practices of their field (Koehler & Mishra, 2009). In addition, given that the aim of professional development is to promote real change in practice, it is important to acknowledge the pragmatics and shortcomings of different teaching practices, the unique strengths and weaknesses of individuals, and to account for these in the design of any support system. Dimitriadis & Goodyear argue,

> We think it is time to change tack to approach design with the strengths and limitations of real teachers in mind... In short, we want to open up new perspectives on the conception of design for learning that take seriously the uncertainties and complexities of real-world learning environments (Dimitriadis & Goodyear, 2013, p. 1).

If higher education institutions are currently unable to change their approaches to staff development to provide this level of individualised, customisable support, an alternate strategy is to try to help academics assume responsibility for developing their own effective online teaching practices on a more individual basis.

The potential of disruptive innovation to spark systemic change

Bass (2012) notes that contemporary digital technologies have created increased opportunities for educational practitioners to draw upon sources of support outside of their immediate institutional and professional contexts,

> a growing appreciation for the porous boundaries between the classroom and life experience, along with the power of social learning, authentic audiences, and integrative contexts, has created not only promising changes in learning but also disruptive moments in teaching (Bass, 2012, p. 23).

Breaking away from established institutional internal infrastructures in order to seek support from a variety of other sources, has the potential to creative a state of disruptive innovation in educational practice. Harvard Business School Professor Clayton Christensen defined disruptive innovation as, "… a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors" (C. Christensen, n.d.). Christensen states that disruptive innovations typically

don't meet existing customers' needs as well as currently available products or services, but that a whole new type of customer base is often generated, sometimes eventually usurping the original dominant model. Christensen cites the example of the mainframe computer business being disrupted and eventually largely replaced by the PC market (C. M. Christensen, Baumann, Ruggles, & Sadtler, 2006). This is reflective of the higher education market. Fully online learning may not meet the needs of full time face-to-face students for example, but globalisation has created a new and large market of time poor or geographically distanced students wanting flexible online options in their study. Christensen goes further to explain that, "Because implementing a simpler, less expensive, more accessible product or service could sabotage their current offerings, it's almost impossible for them to disrupt themselves. Therefore, the catalytic innovations that will bring new benefits to the most people are likely to come from outside the ranks of the established players" (C. M. Christensen et al., 2006, p. 96). Even though Christensen is not speaking specifically about education, this insight offers a clear explanation of why large and established educational institutions find it so difficult to radically and holistically revolutionise their business models. It also explains why lasting change that can maximise the potential of technologically inclusive practices in education for all involved must— initially at least— come from outside of these institutions.

The problems inherent in the structures of higher education institutions will eventually be reconciled at the top of the operational hierarchy if enough individual academics develop effective digital literacy knowledge and practices. Academics have the power to affect change from their individual practice up, supported by a more "grassroots" approach to professional development. Once it has gained enough momentum, this approach can, "… create systemic social change through scaling and replication" (C. M. Christensen et al., 2006, p. 96). Therefore academics wishing to reduce the digital literacy gap would find benefit in circumventing the prohibitive complexities of entrenched large-scale operational structures, and connecting directly with communities or arefacts that best showcase the experiences of other academics that are engaged in similar pursuits.

6. Open and informal professional development

Engaging with informal learning via open resources or networks such as OER (Open Educational Resources), online forums, or even MOOCs (Massive Open Online Courses) that are created by other academics gives a unique opportunity for sharing heuristic knowledge gained from personal experience more broadly. Developing this type of knowledge about

technology's relationship to teaching and professional practices is essential in establishing lasting change. It, however, is not reliant upon existing knowledge, but is constructed by doing, and is personal for each individual as it is based upon his or her own unique experiences and disposition (Eraut, 2000). As Wenger, (2011) suggests, by engaging with resources created by others, "they develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems—in short a shared practice" (p. 2).

Academics can simply choose to benefit from the shared knowledge of others, or contribute to a larger discourse—based upon their available time and inclination. In addition, such initiatives do not have to be based upon personal communication. Resources or other artefacts conceived from an experiential design philosophy that document strategy or insight from a more individual and pedagogically based perspective, can also be invaluable in helping academics building digital literacy capacity relatable to their own situations. Exposure and participation in such initiatives, where the epistemological infrastructure is oriented to encourage pedagogically-driven, collective knowledge building, greatly improves the effectiveness of professional development initiatives, the motivation of academics, and the sustained uptake of online teaching practices (Gold, 2001; Gullett & Bedi, 2007; Laurillard, 2002, 2012; McIntyre, 2008; Paavola, Lipponen, & Hakkarainen, 2002; Scrimshaw, 2004).

There are examples of groups of academics adopting more small-scale, community-based, pedagogy-focused staff training initiatives, with good levels of success (R. Bennett & McIntyre, 2004; Gold, 2001; Lakkala et al., 2005; Markauskaite, Goodwin, Reid, & Reimann, 2006; McIntyre, 2008; McIntyre et al., 2009; Pearson, 2003). This illustrates the feasibility of a more personalised approach to professional development that tries to address the imbalance between technology and education by promoting instances of disruptive innovation within established practices. One such example specifically designed to address the previously discussed complexities and issues created by adopting online teaching practices is the Learning to Teach Online project (LTTO). The project is described as,

> a free professional development resource designed to help teachers from any discipline, whether experienced in online teaching or not, gain a working understanding of successful online teaching pedagogies that they can apply in their own unique teaching situations" (McIntyre, 2011, p. 1).

The following section will explore the features of the LTTO in greater detail as an example of a disruptive professional development innovation.

Learning to Teach Online (LTTO)

LTTO represents part of the author's own work in trying to redress the digital literacy divide in higher education, using principles of disruptive innovation and rhizomic dissemination (McIntyre, 2012). It is a freely available[1] OER, accessible via several different online channels including OER databases, existing online communities of practice, social media and YouTube and iTunes U. Content of LTTO is comprised of a series of pedagogically-focused videos and associated PDF documents categorised into different issues relevant to the adoption of online teaching practices in higher education. The resource draws upon the practical experiences of 53 university leaders, educators and academic support staff dealing with the realities of adapting online teaching practices, in addition to interviews with14 students. Those involved represented 18 disciplines from 18 institutions in Australia, the UK and Switzerland (McIntyre, 2012, p. 495).

LTTO was conceived as a means of trying to help one aspect of the technological and educational connection cope with the surge in development of the other. It was intended as a balancing agent but there is, of course, an inherent "Catch 22" with the use of disruptive and informal online professional development. In order for academics to access the various online resources and networks of information, a certain level of digital literacy is required. Therefore, those educators with little or no inclination or ability to use digital technologies find it more difficult to directly benefit from this course of action. Herein lies a significant and continuing challenge in building digital literacy capacity— if an academic does not have a basic level of technical proficiency, it cannot be assumed they will even engage with online professional development or informal learning content.

The author is currently engaged in research to examine the extent of the spread and impact of LTTO. Large numbers of educators in different disciplines, sectors and countries all around the world have engaged—and continue to engage—with this open professional development resource (McIntyre, 2012). This would suggest that disruptive innovation within institutions via external open professional development is occurring and is likely to occur more frequently in the future. Most significantly, data from online statistical engines related to the sharing and embedding of content are revealing that a large number of educational institutions are actually

referring to or actively integrating the resource into their existing practices. A recent analysis found:

- 153 links to the project on institutional websites from 19 different countries as part of their learning and teaching support for staff.
- 133 instances of resources embedded in postgraduate or professional development programs in higher education, K-12, vocational and private education sectors from 23 different countries.

Interviews are currently being conducting with a number of the directors of such programs across several institutions. The aim of these interviews is to determine why they chose to integrate an external disruptive professional development resource into institutionally-based programs. While it is too early to draw any final conclusions from the research, many interviewees refer to the pedagogically-focused, modular design, and the authenticity and reliability of the heuristic knowledge shared by other academics as an obvious motivation for inclusion. Such integration of an external professional development resource (with content often representing disciplines different to the context in which it was embedded) into institutional frameworks is indicative of the progressive process of disruptive innovation, gradually changing the more dominant and entrenched model of operation.

LTTO's integration in face-to-face programs is a disruptive innovation that helps those academics without digital literacy proficiency to engage with external online professional development resources. As a stepping-stone that helps them to bridge a conceptual gap between two realms, it has the potential to offer the best of both worlds. By participating in a face-to-face program with colleagues, academics can receive enough technical support to learn how to access external online networks and resources. At the same time, using these external disruptive innovations can bring new insights and opportunities for helping them build digital literacy capacity relevant to their own existing teaching practice, from an individual perspective. It is, however, too premature in the current research process to draw any informed conclusions of the resource's influence upon the development of digital literacy within individual academics in these institutions. Yet, the extent of use and sharing of the resource, along with recognition in the form of awards and positive reviews indicate that academics value such as approach enough to share with colleagues, and that the strategy is gaining momentum. Research into these effects will continue.

7. Conclusion

Many educators who find their teaching practice affected by the digital literacy divide need help in accelerating the rate of their adaption to the use of technology in teaching. Only by bridging the divide can they play a real role in the positive social reproduction of effective knowledge-work practices. Approaches to professional development that are designed around the principles of disruptive innovation have the potential to help gradually redress the imbalance between the rate of development of technological and cultural practices within the complex, relational ontology of higher education. This relationship, however, will always be in flux. Education's capacity to adapt will come from building greater digital literacy capacity among academics to enable them to contribute to reshaping educational practices and structures in ways that are congruent with emergent work and social practices.

8. Note

1. tinyurl.com/lttoproject

9. References

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