Next Generation e-Learning Systems: Implications and Impacts*

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Most modern education institutions today employ the use of e-learning. One of the reasons for the popularity of online learning systems is that they reduce the need to be physically present in real classrooms. As a result, many institutions have progressed from brick-and-mortar classrooms to digital classrooms, where lecturers and students are often obscure entities in the process of learning and teaching. There are many advantages of learning in a non-traditional classroom context and these include the flexibility of space, time and program options. However, to date, current online learning is arguably unable to completely replace face-to-face teaching. It lacks many human aspects which can only be found in human communication, such as nonverbal communication and spontaneous natural feedback. Nonetheless, innovative triggers of next generation e-learning space are expected to incorporate elements such as affective computing and smart academics, with research and prototypes already well under way. This paper reflects on how academics will remain integral to the use of future e-learning technologies. It introduces new but relatively mature computing technologies, details current research and development in these areas and discusses possible uses for learning and teaching. It then explores the roles and pedagogical implications for academics who intend to use these systems.

Introduction
The advancement of technology and easy availability of the internet through the development of networking, broadband and wireless technology have impacted how teaching and learning take place in our education institution. Interaction with the teachers and peers can now be done remotely and electronically from any location, at any time. Wireless devices such as mobile phones, laptops and tablets are no longer confined to work, social or personal use; they can also be used as tools for teaching and learning. Consistent research and development mean that academics need to keep abreast with the uses of new technologies now possible in universities. This paper discusses some of current and next generation technologies. These technologies include Massive Open Online Courses (MOOCs), image retrieval technologies, Smartlab systems, learning agents, adaptive learning, emotion-based learning and augmented reality. These technologies are selected because they are either current or deemed relatively new, yet still sufficiently mature for educational purposes. The paper then examines the implications of these technologies for learning and teaching.

Current technologies in learning
Current distance learning utilises technology to provide a platform to bridge physical locations and transforms traditional classrooms into virtual environments to reach a larger number of students. Studies by Evans (as cited in Pandey, 2015) show that producing videos for homework, mobile computing, and connecting to the internet at home through personal devices have become the trend. Mobile devices are utilised to regulate learning processes such as researching, reading articles assigned by lecturers and taking photos or videos of assignments.

The popularity of social media platforms such as Twitter and Facebook has also been harnessed by educators to connect and enable students to communicate and work collaboratively with their classmates (Pandey, 2015; Teoh, Pourshe, & Balakrishnan, 2014). While the use of social networks in education is currently in vogue, it is not clear if social media increases student performance, and at least one study finds its use to be counterproductive (Mazer, Murphy, & Simonds, 2007).

A study by Marcus-Quinn and Cleary (2015) shows on-campus and distance-learning students prefer using mobile devices to access learning resources (such as readings, lecture notes and podcasts). Their research also found that students who attend lectures and take notes listen to podcasts with lecture slides and refer to the slides after. Their findings suggest that mobile-learning does not

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replace traditional teaching approaches but supplements traditional teaching and helps enhance personalised learning. They also concluded that more emphasis should be given to creating and providing learning materials that match student needs and expectations.

Recently, MOOCs were touted to be the next big innovation in education. MOOCs advocate an open concept of education by harnessing the power of e-learning and enabling anyone without any pre-qualifications to register for an online course. Citing the success of MOOCs at Stanford University and MIT, many university leaders expressed concerns about the potential threat of MOOCs to traditional universities (Winterford, 2013). However, recent studies show that MOOCs have lost their lustre and are being phased out (Newton, 2015; Stein, 2013). Reports of the low percentage of course completion suggest that MOOCs have a long way to go yet before they can replace traditional university models. Interestingly, a study found that most MOOC users are educators themselves, who enrol to seek more knowledge (Carapezza, 2015). Universities that have adopted MOOCs concluded that they are poor business models, even leading on occasion, to financial losses (Dodd, 2014).

It is evident that current technologies such as social media, virtual learning platforms and mobile-learning have changed the process of teaching and learning at university level while others such as MOOCs have had less impact overall. The success and failure of these technologies imply that it is important they are harnessed effectively for teaching and learning. While it is not possible to discuss every type of technology currently being studied, this paper introduces some current research in future e-learning technologies and demonstrates how educators could benefit from them by discussing their strengths, weaknesses and suitability for adoption in university education.

Future technology trends in learning

Image retrieval technology

Unlike simple text search and retrieval, image search and retrieval is more complicated but necessary and constantly being improved. Images provide visuals that not only enhance learning but contain crucial information in fields such as medical, ecology and archival studies. For example, ecology students can take photos of fireflies during field-work to match them with images retrieved from a database to access associated information (Chen et al. as cited in Wang & Zhang, 2015). Complex algorithms have also been developed to empower computers to recognise images precisely so that they can be ‘intelligently’ classified correctly (Deng, Berg, Li & Fei-Fei, 2010; Li & Fei-Fei, 2010). Image retrieval technology in education has shown significant results in improving student learning and enhancing students’ engagement in, and retention of, learning content. However, it currently has weaknesses regarding costs and usability, due to the smaller screen sizes of mobile devices (Wang & Zhang, 2015).

Smartlab system

Despite the many advantages of e-learning, distance-learning science students who need the benefits of hands-on experience in laboratory environments may have difficulties doing so online. Both online and advanced learning laboratories that incorporate simulations will be useful in such scenarios in future. Advances in haptic technologies, for example, have made it possible for medical students to experience tactile sensations during simulated surgeries (Panait et al., 2009). Haptic technology can be used by educators to provide medical, nursing, health and many other realistic lab environments. Hands-on experiences in such Smartlabs are essential, as they help develop students’ transferable professional skills for when they join the workforce (Yin, 2015). Advances in imaging have also enabled 3D images that can be rotated or moved in lab situations. The successful experimental use of such Smartlabs have been reported for medical and health students (Geiger & Kikinis, 1995; Sorensen, Mosgaard, & Trier, 2009), archaeology students (Van Gool, Pollefeys, Proesmans, & Zalesny, 2002) and engineering and architectural students (Boland, Lytinen, & Yoo, 2007).

Learning agents

During the last two decades, researchers have looked at the development of virtual personal tutors, also known as learning agents. Advances in natural language technologies evidenced by the popularity of virtual assistants such as Siri (for Apple devices) and Cortana (for Windows 10) highlight the need for people to have natural, seamless communication with devices. While these mobile assistive technologies may seem new, such technologies have been researched extensively for a few decades without much success. One such example is Microsoft Agent, an assistive agent in the form of an animated character called Clippit. Users reportedly found it annoying and intrusive once the novelty faded (Rudman & Zajicek, 2006). Learning agents are thought to be a technology that can replicate personal tutors. It is believed that students identify such agents as learning companions that help them learn more efficiently (Baylor, 2000). Some of these agents work quietly behind the scenes and are made up of complex
algorithms which subtly provide advice and support to students (Ishaya & Wood, 2005; Murano, 2001), while others can take the virtual form of a character (Alepis & Virvou, 2011; Mao & Li, 2010). Research by Kim, Baylor, and Shen (2007) found that positive interaction with such learning agents can improve student self-efficacy, recall and overall learning.

The literature above shows that while the use of learning agents has yet to show any real promise in major e-learning sites, they are sound technologies for educators to explore. Users can learn to accept mobile assistive technologies if they are implemented on mobile phones and smart devices carefully.

**Adaptive learning**

Adaptive e-learning refers to the learning systems that dynamically adapt online learning activities to the abilities of individual students. The technology customises content and provides feedback to individuals. For example, AdeLE uses a real-time eye tracking tool to collate information on learners’ gaze such as fixation, blink rate, duration of gaze, and gaze position to assess learning behaviours. This information serves as an indicator of the student’s attention level, stress, fatigue or lack of motivation, enabling adaptation of the learning content to the individual (Pivec et al., 2005). Similarly, another system called the Adaptive Learning Module customises lecture content by evaluating gaze data regarding the duration a learner’s gaze fixes on certain content and the shift of gaze from one area to another area of the page. A minimum requirement must be met before a learner can continue to the next page. A specific image that is not viewed by the learner for a required amount of time will appear as a pop-up in the centre of the screen for some time before the learner can continue to view the following content (Schmidt, Wassermann, & Zimmermann, 2014).

While the examples above use ‘intelligent’ adaptive learning approach to e-learning, adaptive learning does not need to be intelligent. Instead, it can be interface-based or content-based (Burgos, Tattersall & Koper, 2006). Although this approach is simpler, it requires proper planning because it is time-consuming and involves more work in course design and development due to the need to develop multiple levels of the same content or topic.

**Emotion-based learning**

Some researchers claim that the online learning environment lacks the nonverbal or non-text feedback available in a real classroom environment (Beard, Clegg, & Smith, 2007; Teoh & Ng, 2014). Current online systems do not possess the capability to know if a student feels confused, bored or engaged in the lessons. To detect these responses, technology from emotion recognition research has been integrated into e-learning systems. Emotion recognition technologies can range from simple text-based emoticons, voice recognition, biosensors and facial recognition, to gesture recognition (Teoh & Ng, 2014). For example, an e-learning system may use laptop cameras to detect and monitor facial expressions to determine a student’s emotions during an online lesson. When it detects negative emotions, the system will intervene. If the student appears bored or confused, the system may display a message to prompt them to access more information or replay previous sections of the lecture. Research in this area is ongoing (Hwang & Yang, 2009; Kapoor, Mota, & Picard, 2001; Teoh & Ng, 2014; Wells, 2013), and the development of emotion-based learning technologies is seen as a step closer to a more ‘natural’ virtual learning environment.

Some of the challenges in this area include the development of more accurate, inexpensive and convenient ways to identify student emotions, and to integrate and implement such systems in online learning. Furthermore, these systems are complex and challenging to create. Nevertheless, enthusiastic educators could develop lessons by integrating simple emotion-based systems to monitor a student’s engagement and provide simple actions in the event a negative emotion is selected (Teoh & Ng, 2014).

**Augmented reality**

Virtual reality environments (VREs) refer to online platforms that enable users to experience situations simulated from the real world. Users in systems such as Second Life, VisCube and Oculus Rift take on the role of virtual avatars and experience different situations in the virtual worlds (Saxena, 2015). In education, VREs are used in simulated training to develop specific skills. For example, Grantcharov et al. (2004) report significant improvement in surgeons’ psychomotor skills in performing laparoscopic cholecystectomy after using VREs. Farra, Miller, Timm and Schafer (2013) report positive outcomes in disaster training among nursing students through 3-D virtual reality simulation (VRS). VRS is cost-effective as it provides the flexibility of simulating a variety of situations and scenarios. Also, VRS is accessible, as students can undergo the simulations repeatedly to reinforce and retain knowledge and skills. In short, virtual reality environments can improve conceptual understanding in learning (Hedberg, Harper & Dalgarno, 2002). However, the transfer of actual knowledge from VREs to the real world and
the extent of learning improvement need to be explored in depth for this technology to sustain its usability in future education.

While the creation of such worlds will require some expertise, educators may consider harnessing existing platforms such as Second Life to build virtual worlds for use in their courses. As with other education technologies, educators need to consider and justify the pedagogy, cost and time of using such technology to the purported learning advantage and benefits in the long run (Dickey, 2003).

Discussion and reflections: Impact of future technologies

Educators have traditionally rejected and challenged education technologies, with responses ranging from reluctant acceptance to wholehearted adoption. When television was introduced in the classroom, some teachers resisted and were worried they may be replaced. While television seemed to be able to reach and deliver learning packages to a large number of students, it was soon apparent it could not replace the role of a teacher as it lacks the interaction and spontaneity of a real life teacher (Freeman, 1967).

The dismal failure of MOOCs is also evidence that large e-learning implementations will never replace brick-and-mortar institutions (Stein, 2013). In short, technologies will never be able to replace the role of educators completely but only support the learning process. However, it is important that educators harness education technologies effectively so that their students can have the best possible learning experience. The effective use of technology can only be achieved if academics keep abreast with technological advances and understand their limitations and strengths.

One of the major challenges to academics is the need to acquire new skills and knowledge continuously, and attend professional development and training programs to keep up with the rapid progress in technology. Pursuing new knowledge and expertise can be difficult for many academics who are pressed for time and those who are not computer savvy. There are, however, some techniques that could help such academics. First, it is important to prioritise the technologies that could be useful for classroom teaching and learning. Palloff and Pratt (as cited in Quinsee & Hurst, 2005) emphasise acquiring basic knowledge and skills in computer-mediated conferencing, using online discussion tools, learning material development, monitoring and managing online information and assessment options. We also advocate that educators experiment and experience new future technologies. For example, academics can experience first-hand being in a virtual world in Second Life. Alternatively, academics can also immerse themselves in digital games to experience the draws and exhilaration of playing with multiple players. These experiences will provide insights to understand better how to capitalise on advanced online technologies for learning purposes. Another method to learn about new technologies is to keep abreast with such developments through like-minded communities of practice that exist in universities, national organisations and online (Gray, 2004). An example of such a community is the Society for Learning Analytics Research (SOLAR) where educators explore how to apply best research and practice in learning analytics.

The next challenge of future technology is its impact on academic workload. Preparing materials and providing support for online learning are often more time consuming than traditional face-to-face learning (Alexander, 2001). Academics will be pressured with the increased demand on their time to teach and to take on other responsibilities such as research. Some universities have experimented with the reduction of teaching workload to accommodate time spent developing digital content and learning new technologies. Educators can also work in teams and use a divide-and-conquer approach when developing new online learning projects. In the same manner, education technology projects could also be investigated and studied for research purposes regarding conceptual development, implementation, usability, impact and effectiveness. As technology becomes more advanced and complicated, it is evident that educators will need to work in collaboration with information technology and multimedia professionals. Academics will also require a new form of work system where they contribute knowledge and pedagogical expertise while information technology professionals deliver the final output, much like the association between architects and engineers (Torrisi-Steele & Davis, 2000).

Pedagogical considerations are essential when evaluating education technologies. Pedagogy approaches should ideally be student-centred, interactive, and mimic the natural learning environment. Pelz (2010) and Bronack et al. (2008) recommend that online learning systems should emphasise interactivity, presence and enable students to do most of the work. It is also important to note there is no one best pedagogical approach to online learning. It depends on needs, expected outcomes and other underlying factors. Like any other classroom initiatives, the success of education technology lies in careful pedagogical
approaches and methodologies. For example, technologies such as adaptive and emotion-based learning will suit educators who intend to cater to individual learning styles (McLoughlin & Lee, 2010). On the other hand, Bronack (2008) proposed a Presence Pedagogy based on social constructivist theory that emphasises co-constructing knowledge through collaborative learning, suggesting that VREs may be more suitable for collaborative learning. Learning agents can be utilised to achieve educational objectives in the affective domain. For example, Lane and Johnson (2008) programmed an agent to overreact to taboo cultural inputs such as foul language, to teach cultural values. In short, education technologies need to be considered carefully to ensure that implementations are in line with pedagogical fundamentals.

**Conclusion**

This paper has introduced some future learning technologies and discussed the impacts on, and implications for, educators. While there are many new and exciting learning technologies being developed and introduced in the horizon, it is important that educators prepare themselves to evaluate such technologies and harness the best for their needs. As with any professionals, academics need to learn new skills to keep their knowledge up-to-date to capitalise on these technologies. By immersing themselves as users of the technologies, academics can have the benefit of the user perspective and experience before they decide how to employ these technologies in teaching. Certainly there are challenges but with the correct mindset and support from institutional leaders, new generation e-learning systems can be rewarding for the students, institutions and educators.

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