UNIVERSITY OF LONDON

CENTRE FOR DISTANCE EDUCATION
Research and innovation in flexible and distance teaching and learning

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1.Introduction

About this report

At the start of 2018 the University of London Centre for Distance Education (CDE) commissioned a project to explore the future needs for digital education. This report provides the findings from the study which had the following stated aim:

The CDE Digital Educator Project

To identify significant developments in educational technology and assess risks and opportunities for the educator. This will lead to an assessment of readiness of academics and the needs for skills development to prepare digital educators for the future. What can academics use now to take advantage of future opportunities?

We expect that the project outputs will contribute to ensuring that academics involved in using digital tools to educate distance students, take advantage of emerging opportunities for making effective use of educational technologies that are available now and likely to become available in the medium term (i.e. the next 2-5 years). Whilst the project is focussed on the needs of digital educators currently working within the programmes of University of London Worldwide, we hope that the project findings will be of interest and value to a wider audience.

The project was broken down into four stages each of which builds on preceding stages and explores specific questions. The stages explored are as follows:

Project Stages

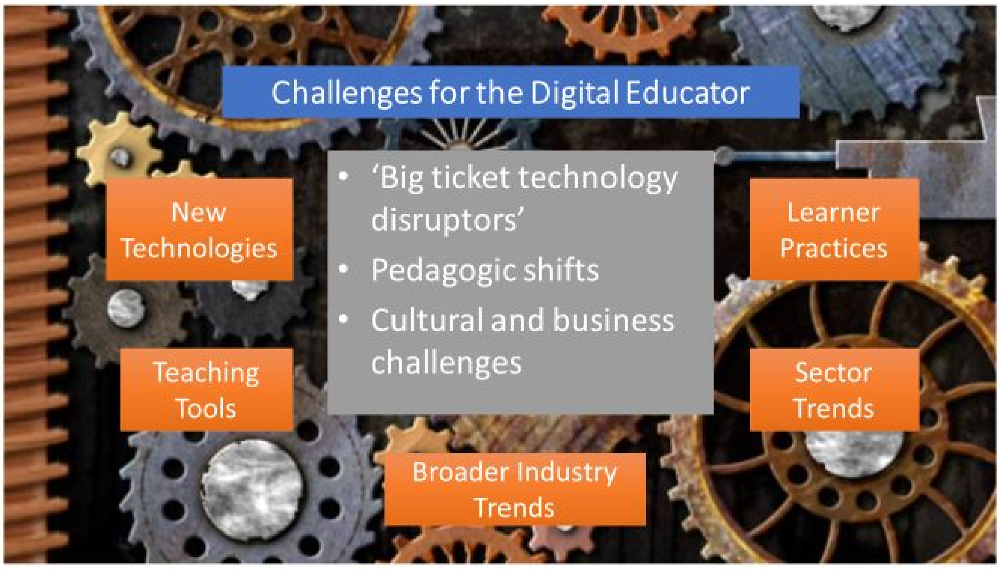
Stage 1: Using available research, we outlined the significant likely developments in Educational Technology within the medium term (2-5 years) for the HE Distance Learning sector. This included identifying and exploring 'big ticket' technology disruptors, pedagogic shifts and cultural and business challenges.

Stage 2: Through interaction with educators, we identified a range of different future scenarios and explored the possible impact of technical and pedagogic innovations on the role of educator, identifying any specific risks and opportunities relevant to the different scenarios.

Stage 3: Focussing on specific technological function and pedagogic innovations we assessed the readiness of current academics involved as digital educators in distance education design and delivery, to adapt to these innovations. This assessment explored awareness, importance attributed to different innovations and willingness to adapt to new changes.

Stage 4: Finally, drawing on the learning from the first three stages, we engaged further with academic stakeholders from within the University of London Member Institutions (MIs), and developed ideas for a potential skills development roadmap for the academics involved in distance education, to ensure that they are prepared to be the digital educators of the future.

The figure below highlights key themes which the project is exploring, and at the centre three major across cutting areas of interest for the 'digital educator project':



Project Stages

The following activities were conducted corresponding to the four stages above:

- A literature review exploring developments in educational technologies
- A workshop making use of foresight approaches to develop potential future scenarios reflecting differing use of technical and pedagogic innovation
- A survey designed to provide insights on current awareness and interest of academics regarding technical and pedagogic innovation
- A stakeholder workshop with academics to provide final discussion and analysis of what has been learned in Stages 1-3 to inform the production of a roadmap for skills development

Report Structure

This report provides sections that summarise the headline findings, providing perspectives from the work conducted.. These align broadly with the four stages of the study identified above, although the final stakeholder workshop focussed on developing technology roadmaps informing skill development.

The final section of the report draws on the perspectives and findings of the four previous sections, to set out ideas for producing skill development roadmaps, which can now be developed in terms of content and piloted with relevant academic groups. The annexes contain separate detailed reports on each of the four major project activities.

2.Perspectives from Literature

As informed by the literature review, five key clusters were felt to be potentially significant to the digital educator of tomorrow:

i) New Technologies – what is their impact in the Higher Education sector?
The rapid growth of consumer technology is shaping both expectations and motivations for adoption of new learning technologies. This growth creates potential for the digital educator to extend learning to new horizons, yet the challenge of how to deliver on this promise is more complex. The current rate of adoption and adaption of technology in the Education sector is variable and generally lagging behind the rate of change of consumer technology. This is due to anchors of existing systems as well as the need for educators, IT specialists, and Institutional leaders to fully engage in the innovation process.

The challenge of choice is a significant factor in rate of adoption, with so many products that informed decision-making becomes difficult. The educator therefore has to decide which new technologies align with their teaching needs, whilst Institutions must develop adoption strategies to support users, investments and anchors of established technologies. More open ecosystems of products are starting to become the norm to support continual experimentation with new approaches and evolution of learning technology Infrastructure.

ii) Teaching Tools – how well are new technologies evolving into teaching interventions?
New learning technologies offer the promise of designing new experiences and opportunities for learning and are both being welcomed and gradually adopted and adapted into teaching practice. Learning Management Systems persist as the core of delivery in many Institutions but are now often seen as *'cumbersome and unwieldy'* and are increasingly perceived as just part of the overall learning technology infrastructure. Additional experimentation with new technologies is widespread in areas as diverse as video to VR, AI and analytics to mobile and social tools for learning. The majority of faculty teaching online have developed pedagogies and skills that have improved effectiveness of their teaching and yet for some there concerns about *'lack of digital competences, and lack of confidence in using digital technologies meaningfully in teaching'*

iii) Learner Habits – are new learner emerging with new technology?
Teaching learners with increasingly diverse modes of engagement for learning is seen as challenging. Some Higher Education Institutions are relatively *'fixed'* in their teaching practices and yet the learner population now contains a *'generational constellation',* some of whom have a culture of *'connectedness'* and have expectations born of *'growing up with Google*'. Digital literacy across the learner population is inconsistent and becoming a potential challenge to consistent engagement with new digital learning technologies.

There is some concern that widespread adoption of devices is fundamentally changing the way we think, remember and therefore learn. Educators are responding by designing digital learning interventions that encourage learners to connect to deeper learning practices. There is, however, some tension between adoption of established and emerging information literacy practices in a digital world and effective learner usage of knowledge sources, management of fake news and acceptance of facts presented. These are all key issues for tomorrow's digital educator.

iv) Higher education sector trends - what trends are shaping the sector?
The rate of adoption of new technologies in higher education is slower than might be expected, but exploration and experimentation with new technologies is widespread. MOOCs are a particular driver of change with now over 100 million registered learners, 800 University partners and 11,000 courses (Shah, 2019). MOOCs are seen as a means of marketing for full courses, developing faculty capability and increasing institutional involvement in digital education, both in terms of full courses and content access.

The value of MOOC certificates remains open to question but the development of new forms of credential and their connection to more flexible learning pathways could create opportunities to open up learning to new groups to address skills shortages in some areas. More broadly, MOOC providers are expanding toward corporate learning and online degrees. The increase in flexible degree options through MOOC partnerships is likely to continue and with the level of VC investment in the sector, the influence and impact of MOOC providers on the future of online education is increasingly significant.

v) Wider learning industry trends – what other insights available from the Learning and development sector?

The combination of new career paths (eg AI), accelerating development of new (often interdisciplinary) knowledge and the rapid obsolescence of existing knowledge creates a strong driver for new models of lifelong learning. The corporate learning sector at present has a strong focus on lifelong learning, supported by delivery of online learning at point of need (eg through *microlearning*). Customisation of learning solutions to corporate needs has increased the adoption of skills-based platforms with the likes of Udemy, Linkedin and Coursera leading the way. Other corporates (such as IBM) have tried to connect smaller learning experiences into badged credentials to address *'critical talent shortages'*.

Corporate learning demands for high learner engagement have seen a progressive side-lining of the Learning Management System in favour of *'Learning Experience Platforms'* to support individual learning, adaptive learning and adoption of xApi to create lifelong personalised learning portfolios.

Key points from the literature review

Overall, the literature review suggests that digital educators of tomorrow will need to continuously

- Develop and evolve digital competence
- Rethink and adapt learning strategies for a digital age
- Transition from a world of memorising knowledge to experiential learning and competency
- Continuously experiment, evaluate, socialise and integrate systems to support ongoing innovation

The future Digital Educator will need to balance knowledge of technology, subject matter, and will be increasingly part of a learning team that experiments and addresses these issues. Higher Education Institutions will need to consider new compensation models to encourage educators and to stimulate improved digital learning innovation in the sector moving forward.

3. Perspectives from the Foresight Workshop

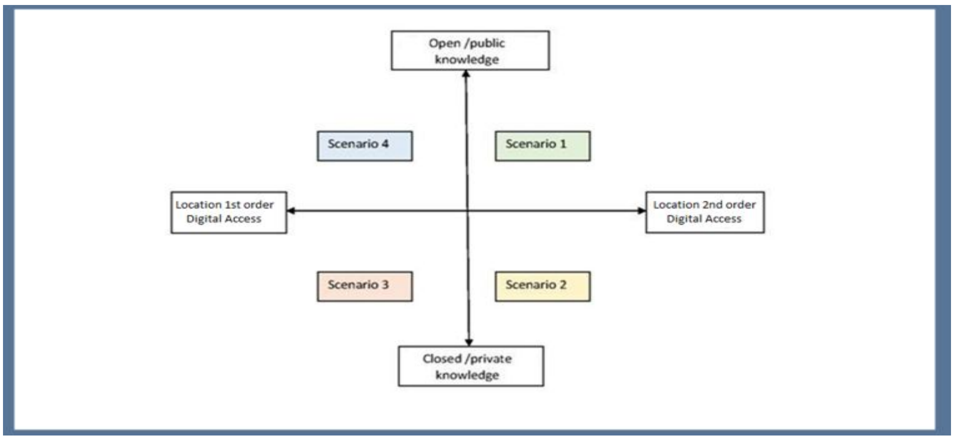
Technology and pedagogy are at the heart of the design and delivery of distance education. The emergence of new technologies is seen as enabler and driver of change, that supports and is ultimately shaped and led by effective pedagogical innovation. Alongside this, the consideration of context, both in terms of student location and teaching/academic institutional context, need to be understood, so that what is designed and delivered is suited to the needs of teachers and students.

To explore this aspect, a workshop was organised with a diverse range of experts with interest in higher education. Foresight tools were used to develop four different scenarios, setting out narratives for quite diverse future contexts. This process involved developing 'drivers of change' and then with reference to these drivers, shaping narratives of how the future could look in the different scenarios.

The table below identifies the main drivers of change identified under different headings. All of these drivers provide important considerations for those involved in strategic planning within Universities, and it is interesting to note which technologies are identified here as major drivers:

SOCIAL	● People living longer driving changing employment and needs to work ● The increasing need for high quality post graduate education to be available to parts of the developing world – demand already outstrips supply in terms of f2f learning ● Increase of digital natives within workforce
TECHNICAL	● Virtual and augmented reality ● Artificial intelligence ● Automation and machine learning (leading to more leisure time) ● More personalisation
ECONOMIC	● Changing skills needed in a digital economy ● Change in economic balance across the globe ● Change in types of jobs
ENVIRONMENT	● Changing job market ● Climate change impacting migration of people from different parts of the world ● International standards e.g. pedagogy ● Less space for physical buildings e.g. in Universities, difficulty in accommodating students in traditional classrooms
POLITICS and GOVERNMENT	● Nationalism, and rise of this in the West ● Developing countries trying to catch up with new trends in education, via creating partnerships with western organisations ● Private businesses have become the world's powerful with governments becoming weaker and less relevant ● Decline of neoliberalism

The process of developing narratives involved the introduction of a grid, where different major variables could be plotted on the two axes. For the purpose of this task the level to which knowledge was open or closed was mapped on the vertical axis and the extent to which people in different locations had poor or excellent digital access (and related competencies) was mapped on the horizontal axis:



The four scenario narratives and their strategic implications are written up in the report contained in Annex B. In brief the HE world as characterised in these different scenarios is identified below:

1	Digital Heaven – Too good to be true? *Open Knowledge* *Great digital access*	● Great digital infrastructure and digital capabilities ● A lot of great open licensed and freely available content ● Abundance of digital gadgetry and mobile technology ● Flexible degree courses ● Widespread use of AI ● Digital educator is a 'knowledge curator'
2	The Rising East and the 'Rock Star Gurus' *Closed Knowledge* *Great digital access*	● BRICS countries lead the way in HE ● Quality education is a private commercial commodity ● HE dominated by a small number of renowned colleges and academics ● Digital educators including academics around the world provide 'back end' support, and their work is allocated by powerful algorithms ● AI and VR widely use
3	The 'Bot'-tom line *Closed Knowledge* *Poor digital access*	● ICT infrastructure has improved but reflects a growing divide with greater inequality than now ● Some free and some premium education ● 'AI bots' support those on the wrong side of the divide, who are people with no control over their data ● Those on the right side of the divide have choices, can get human support and advert free education supported by the latest tools
4	Everything in time (things are gradually opening up and localising *Open Knowledge* *Poor digital access*	● Digital technologies improving and becoming more widely available ● More good quality open educational resources becoming available ● Government and MOOC providers working in partnerships to provide localised platforms ● Digital education is a team based activity ● Emphasis on improving the digital literacy skills of teachers

Whilst different participants could have come up with quite different scenarios and points for consideration, the scenarios usefully draw out some contrasting views of the world where digital educators could be working in roughly ten years' time. The roles of institutions, technology and academics all begin to look quite different, whichever future scenario we anticipate.

Key points from the foresight workshop

The main points that come out from this process of envisioning the future, or rather some possible futures are as follows:

- The need to be aware of very different student context, and of changing institutional models which could support or get in the way of intended digital education outcomes.
- Technology is not neutral, and adoption of different technologies can promote inclusion or exclusion – this can relate to gender, age, location and other factors

- Consideration needs to be given to the role of academics in digital education, and the teams that will be needed to be developed around academic knowledge to promote cutting edge and flexible models of DE that can be relevant in different context. To what extent and in what ways would AI be most useful?
- Strategy needs to be developed to clearly articulate the type of future digital education scenario that University of London World Wide would like to see. Is its niche somewhere close to Scenarios 2 and 3, with some use being made of open licensed content? If so, what are the implications and is this vision widely shared? How would the potential negative aspects of these scenarios be avoided, and how would the technology barriers of students living in Scenario 3 type locations be addressed? What sorts of partnerships would contribute to achieving this vision?

There are no clear answers, as there are many future uncertainties, but the foresight exercise highlights that technological and pedagogical innovation can play out in different ways. Part of any skill development training needs to be focussed on raising awareness of these factors. Those involved in strategic planning need to become involved in thinking about these issues at an early stage and providing guidance so that technology supports and enables strategy.

4.Perspectives from the Survey

The survey was conducted to provide further evidence and to examine the future digital landscape of educational technologies in distance learning *(Ethics clearance from King's College London: MRA-18/19-8428)*. It aimed to assess the current readiness of academics employed at UoL Member Institutions (MI) and home institutions of CDE Fellow members, and also to assess risks and opportunities for the digital educator. The findings will allow for the identification of current trends in the use of technologies and pedagogies, strengths and weaknesses, and areas that need to be focused on to effectively take advantage of future educational digital technologies.

Survey participants

Participants were recruited from academics employed at UoL Member Institutions and home institutions of CDE Fellow members involved in distance learning. They were asked to provide demographic information such as: Gender, Age, Academic Position/Role; Discipline affiliation; Geographical locations of their students; Total number of years in teaching.

Forty-eight (n=48) participated in the survey, of which 40% were males and 60% were females. Other demographic classifications were as follows:

- 35% were 45 years old below; 30% were between 46 and 55 years old; and 35% were 56 years old above.
- 73% belong to UoL and MI institutions whilst the rest were from outside.
- 54% were academics and the 46% were non-academics.
- Most respondents were from the UK (96%).
- 39% had been teaching for about 10 years; 21% between 11 to 15 years; 40% has 16 years or more.

Survey Design and data collection

The survey contained statements about digital technology functionalities and pedagogical innovations in distance learning. Each respondent was asked to rate each statement which referenced a specific digital technology functionality or pedagogical innovation in terms of the following:

- perceived level of awareness on the digital technology functionality in distance learning;
- perceived level of awareness on the pedagogical innovation in distance learning;
- perceived level of importance on the digital technology functionality in distance learning;
- perceived level of importance on the pedagogical innovation in distance learning;
- perceived level of relevance on the digital technology functionality in distance learning;
- perceived level of relevance on the pedagogical innovation in distance learning;
- perceived level of willingness to adopt the digital technology functionality in distance learning;
- perceived level of willingness to adopt the pedagogical innovation in distance learning

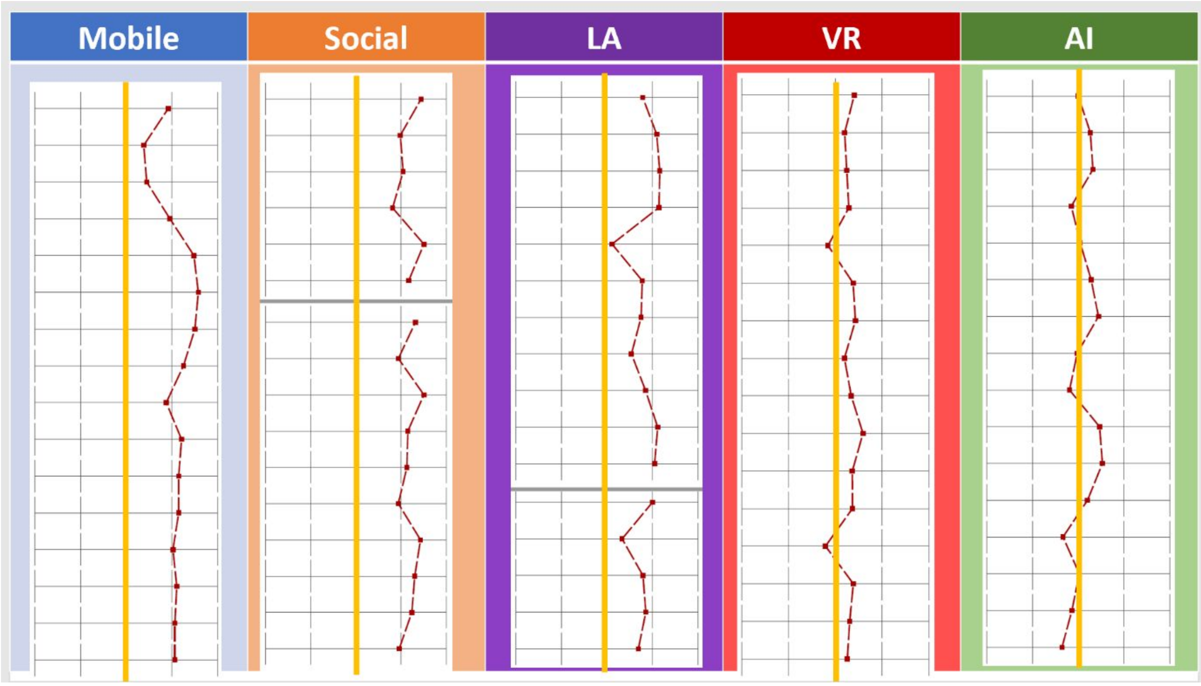
Five technologies and associated pedagogies were considered: mobile devices, social media, learning analytics, virtual reality, and artificial intelligence.

Participants were also asked to give their opinion on two open-ended questions on:

- Perceived threats and opportunities amongst the digital technologies/pedagogical innovations identified.
- Awareness of other digital technologies functionality or pedagogical innovations not specified in the questionnaire

Key Points from Survey Analysis: Summary results

The survey showed that there is a good level of awareness and appreciation of the relevance of mainstream technologies and pedagogies such as mobile devices and social media. Learner analytics is still in its infancy and does not yet have high uptake but there was a moderate level of awareness and perception of opportunities for its potential use. The less mainstream technologies such as artificial intelligence and virtual reality are viewed as being limited in their accessibility to teachers and learners, largely for reasons of cost and suitability of subject areas. These views are largely based on limited awareness and interaction with these technologies and pedagogies, rather than experience of their use.



5. Perspectives from the Stakeholder workshop

The final stakeholder workshop was attended by 15 participants. They were a mix of academics with experience of distance education and distance learning professionals with other roles in supporting distance programmes (primarily learning technologists or similar roles). After a presentation of the results of the project to date, participants were asked to engage in a collaborative activity aimed at identifying roadmaps for the development of a number of technologies relevant to education. Participants were divided into four groups representing different disciplinary areas: Biomedical, Humanities, Professional education, and Mathematics and Technology.

Each group was given a number of cards representing specific learning technologies grouped into the 5 broad technology areas used in the survey:

- Mobile devices
- Social media
- Learning Analytics
- Artificial Intelligence (interpreted primarily as Machine Learning)
- Virtual and Augmented Reality

Groups were asked to place each technology card into one of four levels of acceptance. These levels represented the degree to which a technology was currently used in the discipline and its future prospects. The outcome of this exercise was four, discipline-specific roadmaps which are included in Annex D. These gave a number of broad themes.

Key points from the stakeholder workshop

The levels of acceptance were very consistent with the results of the survey. Mobile Technologies and Social Media are often quite well established, but AI and VR are more emerging, with learning analytics being somewhat in between.

However, there were also important disciplinary differences. Humanities disciplines have much less uptake of a whole range of technologies, while professional education and, perhaps unsurprisingly Mathematics/Technology have made more use. Biomedical education has slightly lower uptake than the latter two domains, but there was considerable enthusiasm for a number of more avant-garde technologies, such as Augmented Reality and AI.

These disciplinary differences reflect different barriers to acceptance. For example, it was felt that humanities academics were less familiar with many of the technologies than other disciplines because they are less likely to use them in research. However, mathematics and technology academics, while very comfortable with technology, are often less familiar with the pedagogical ideas that would help them put these technologies into practice in education.

An important theme of the workshop was that technology itself was not a barrier, but that there were a number of individual and organisational barriers. These include individual lack of familiarity with technology and also organisational factors such as incentive structures that do not reward pedagogical innovation.

Where technological barriers do exist, these tend to be in situations where there have not been sufficient resources to explore and develop new technologies in an educational context.

6. Towards a skills development roadmap

Requirements for a skill development roadmap

The requirements for an academic 'digital educator' skill development roadmap are influenced by four factors:

- i) Major trends in educational technology becoming available and how this can shape design and delivery of distance education
- ii) The context in which students are living and studying, and in particular how this enhances or constrains their access to technology, and ability to respond to innovative pedagogical approaches
- iii) The current awareness, usage and willingness of academics to adapt to using innovative pedagogical models and digital technologies when delivering distance education
- iv) The varied opportunities for using new pedagogical and digital technology enhanced approaches within different subjects, taking account of what technologies and approaches are already being used.

The literature review conducted in the first phase of the project highlighted important emerging trends which are relevant when thinking about areas where skills development is required, and more importantly these trends highlight areas where the University needs a clear strategy, as to which technology trends to follow in the short to medium term.

The foresight workshop that followed, contrasted future scenarios where knowledge may be more closed or open, and where digital technology access may be at basic level or where there may be great digital access (i.e. fast broadband) and students may have excellent digital literacy skills. Our study also highlighted the need for digital education to be developed around teams of experts, including academic leads, so that the full potential for pedagogical and technical innovation to be achieved, without requiring the academic to be an expert on all aspects of different technologies. The concept of the academic and/or librarians as knowledge curators also comes out in the study highlighting the need for both roles to have excellent digital literacy skills.

Whatever skills the academic 'digital educators' may have, the context of the majority of their students, needs to be carefully considered when designing and delivering a distance education course. The situation faced by students for example in Singapore and Malawi is likely to differ significantly for the foreseeable future.

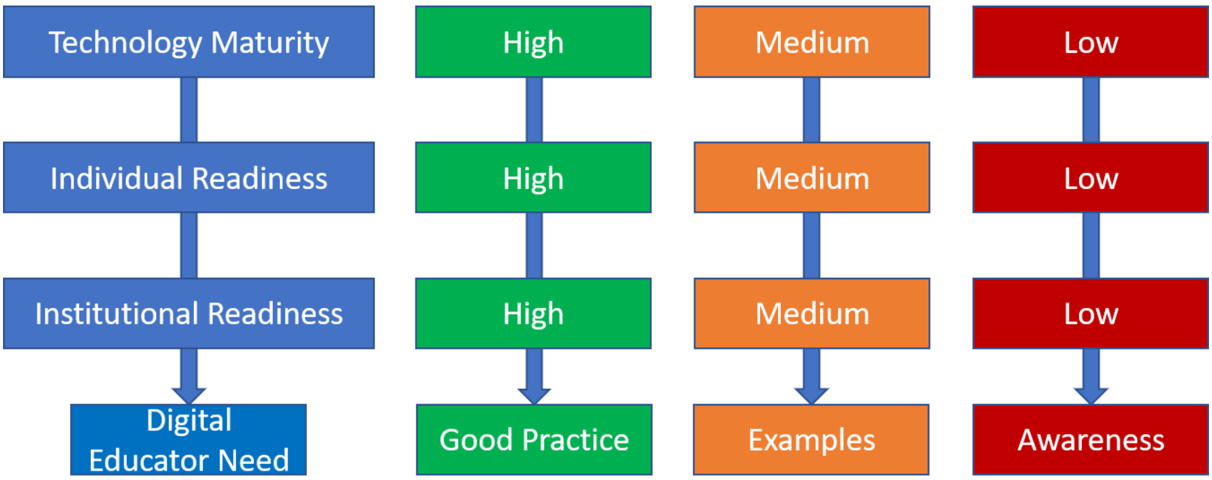
From a skills development perspective, the study highlights that additional guidance is needed for digital educators to support technology adoption. Digital learning remains in a development stage in many institutions, with some educators overwhelmed by choice and perceived complexity of the sector.

The report has highlighted that new technology adoption within the sector is variable and that the most appropriate skills needs for digital educators at a particular point depends on

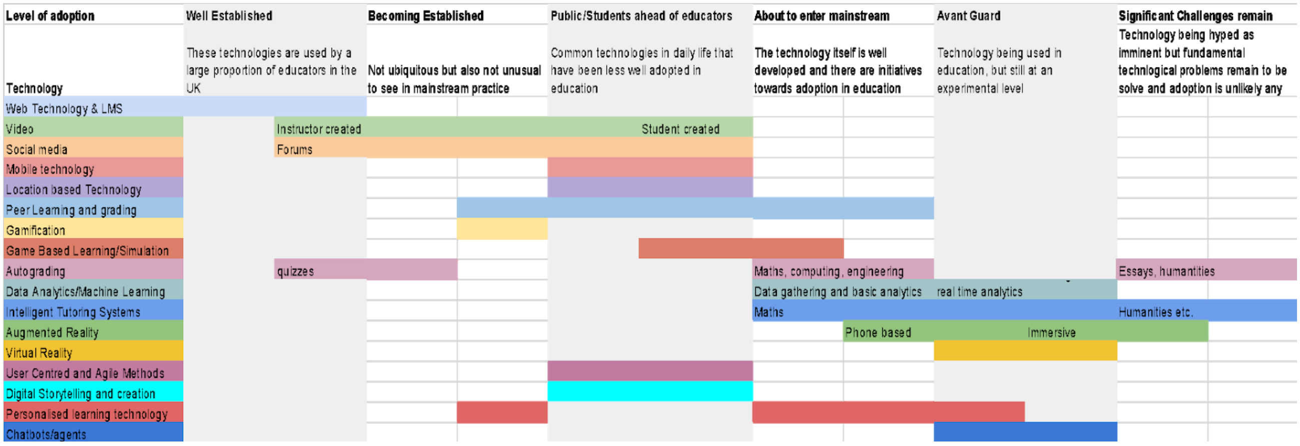
a) Overall technology maturity (is the technology ready for adoption?)
b) Individual readiness (is the educator aware and ready to adopt a given technology?)
c) Institutional readiness (is the Institution willing to support a given technology?)

In evaluating the potential for new technologies, there will always be a range of options and yet limited budget; prioritisation is also required.

The kinds of skills development needed depend to a large extent on the alignment of technology maturity, digital educator readiness and institutional readiness as illustrated below.



The above alignment is extreme and only arises if, for example, an individual educator is both aware and willing to adopt a particular technology based on its appropriateness and readiness for use in a given sector. This may require access to previous examples of successful application in order to build confidence and to communicate this confidence to peers within the Institution to build wider acceptance.



The chart above provides a rough analysis of level of adoption of a range of technologies. It is important to note that even for areas of low technology maturity and readiness (those mainly to the right of this chart), awareness is needed; low technology maturity may still be subject to considerable technology hype.

Awareness raising is therefore needed across the technology portfolio to help digital educators better understand the 'art of the possible' with new solutions and to apply that understanding to their specific sector. For more mature technologies that have been successfully trialled and evaluated in particular institutions, examples of case studies and good practice guidance are also required to facilitate knowledge transfer.

Three clusters of guidance are therefore needed to support digital educators:

- Level 1: Awareness

  This requires building knowledge about particular technologies with a view to encouraging initial small-scale initial evaluations within Institutions. At this level, guidance would help to improve the capability of digital educators to understand new technology-based learning interventions and to evaluate their potential relevance to practice.

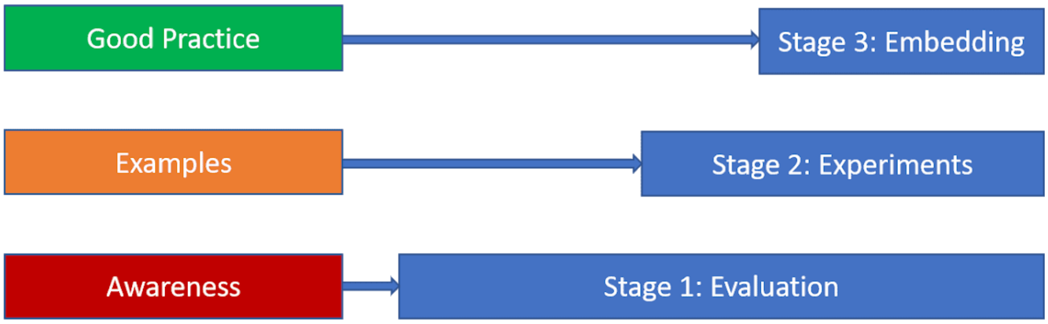
- Level 2: Examples

  This is about reviewing examples of technology application, where a technology has already been successfully applied in some contexts with a view to considering larger scale experiments within Institutions. At this level, guidance would help digital educators to consider the appropriateness of transfer technologies between sectors and institutions.

- Level 3: Application

  This is about understanding good practices in the use of a (now well established) particular technology for learning. At this level, 'good practice guidance' would help digital educators to rapidly adopt and embed new technologies based on the successful experiences of their peers.

The impact of these three clusters of guidance help to support evolution of digital educator practice as illustrated below



Specific skills development needs emerge from multiple sections of this study.

Examples include:

Level 1 - Awareness:

- Introductory guides for emerging technologies :
  - Technologies using Virtual and Augmented reality
  - Technologies using Artificial Intelligence

- Digital literacy for educators – an introduction and glossary
- Partnering with platform providers – the options
- Online credentials

Level 2 - Examples of successful practice:

- New technology examples from practice (eg VR, AI, Analytics)
- New pedagogies for digital educators – an overview of examples
- Engaging diverse audiences with digital
- Measuring impact of digital interventions
- Partnering with platform providers – case studies
- microlearning for learning support

Level 3 - Good practice guidance:

- Evaluating new technologies for the sector – good practices
- Getting the best from your LMS
- Designing experiments and evaluations of new technology
- Pedagogical good practices – designing with digital
- Partnering with platform providers – good practices
- Outsourcing or internal skills development
- Evaluating the value of online credentials
- Outsourcing or internal skills development

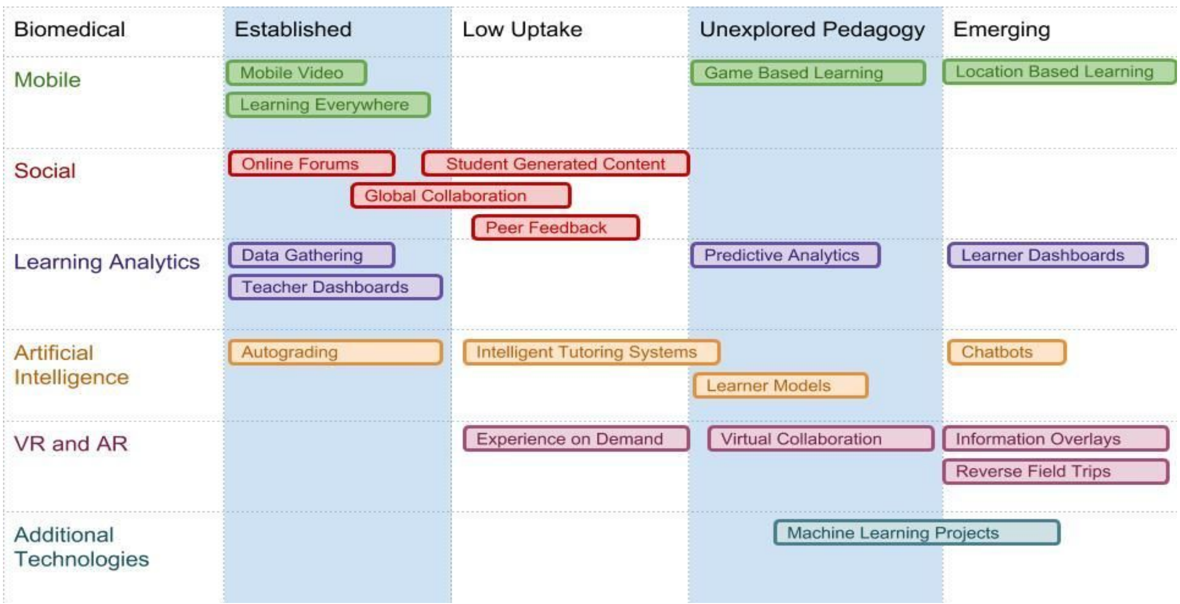
Developing a subject specific skill development roadmap

More detailed needs analysis would be required to design a suitable training programme for academics teaching a particular subject, and in all cases the needs analysis would need to explore some key questions:

- What is the student context? What ICT infrastructure do they currently have or are they likely to have in the next 2-5 years?
- For established technologies what training can be provided to academics to enable them to make better use of what they have?
- Are the established technologies still relevant?
- Where there is low uptake is this because the technology is not considered useful for this subject theme?
- Is low uptake due to lack of awareness or lack of willingness to adapt?
- Where a pedagogic approach is unexplored is this due to lack of perceived relevance to the digital educator and their role?
- Which of the emerging technologies identified offer the greatest potential added value to the teaching and learning experience for this thematic area?

Our final stakeholder workshop highlighted the need for specific skills to be the focus for training in particular sectors. In the biomedical sector, for example (see chart below generated at the workshop), this thematic area mirrors the survey findings in indicating significant existing uptake of mobile technology and social media.

It also indicates there is significant adoption of use of learning analytics and interestingly auto-grading is also viewed as established. It is recommended that training around established areas reviews current practice, draws on good practices and examines how these established technologies can be better and more widely used. Where the established technology is becoming outdated, this should also be identified, and alternative approaches considered.



Beyond use of online forums, there is limited collaboration evident which suggests opportunity for exploring how social media can promote more student engagement in the teaching and learning experience. Low uptake around ‘intelligent tutoring systems’ and ‘Experience on demand’ VR and AR may be due to the lack of willingness to adapt noted in the survey responses.

Given the survey results related to AI and VR/AR and lack of awareness and willingness to adapt, it is suggested that the focus here should be on awareness raising and piloting approaches in relation to unexplored pedagogy and emerging technology/technology.

More detailed training short/medium term training should focus on those related to mobile and learning analytics, i.e. game-based and location based learning and use of predictive analytics and learner dashboards.

We are reluctant to map out a year by year roadmap, but instead link the nature of the proposed training to the levels outlined above (awareness, examples of successful practice and good practice guidance). The roadmap for the biomedical theme, could then be along the following lines.

	Awareness raising and piloting of examples of use	Review of current practices	Training to strengthen and extend use of technology/pedagogic innovation underway	Training on new technology topics
Nature of training	(Levels 1 and 2)	(Level 1)	(Levels 2 and 3)	(Levels 1-3)
Mobile	Raising awareness of mobile content design approaches, and range of useful mobile apps including those that draw on location awareness	Establish current practices of use of mobile video and learning everywhere and how this can be strengthened	Build up potential use of mobile apps for content delivery, chunking of material and voting	Provide training on location based learning and game based learning
Social Media	Focus on the scope for increasing engagement and collaboration through use of different social medial tools (N.B very important per survey responses)	Review use of online forums and how they are being influenced by social media	Develop and introduce training on peer feedback, student/teacher collaboration using social media, and for using student generated content.	Nothing noted as unexplored or emerging, so training focus is on strengthening and improving uptake
Learning Analytics	Raise greater awareness of the potential for predictive analysis and student dashboards. (N.B Personalised learning is	Review current use of teacher dashboards and data gathering	Developing use of learner analytics to embrace teacher and learner needs and enable both to make effective use of available data	Focus on learner dashboards and predictive analysis

	considered important per the survey feedback)			
Artificial Intelligence	Feedback and support using AI features as fairly important in the survey feedback	Review current use of auto-grading and how this could be extended		Commence pilot activities to test use and value of different AI approaches including ● Intelligent tutoring systems ● Learner models ● Chatbots
Virtual Reality & AR	Focus on added value of 3D, haptics, enhancing learning experience of those not in a classroom (all considered fairly important from survey feedback)			Commence pilot activities to test use and value of different VR and AR approaches Based on workshop feedback consider: ● Experience on demand ● Virtual Collaboration ● Information overlays ● Reverse field trips
Additional Technologies	Machine learning projects			

Proposed Next Steps

The above discussion highlights the need for readiness at individual and institutional levels. The suggested steps for road-mapping skills training are as follows:

1) Map out for a specific subject within an MI course portfolio, the current state of technology innovation influencing the pedagogical model. This can be done in a similar way to that produced above for the biomedical theme

2) Translate this into a draft skills training roadmap for the subject that reflects the different levels of individual readiness and technology maturity
3) Provide awareness training for those with budget and decision-making authority within University of London Worldwide and related MIs, regarding the state of maturity and potential of important current and emerging technologies.
4) Modify the training plan in the light of an assessment of the institutional readiness and support (including financial investment), and taking into account the need to reflect the context of the students, and any policies reflecting the values of the institution e.g. regarding access and equity

Through this process a tailored and relevant plan that supports the UoL Worldwide and related MI strategy should emerge. The findings of the different elements of this study will be useful reference material to help scope the plans. We also recognise that some training activities are likely to emerge which are relevant for all subjects.

To test the findings of the study and develop and put in place transformative training that identifies subject specific and overall needs, we propose that the next step would be to have an implementation project that draws on some of the approaches followed in this study. This can have an action research element which draws out the lessons from the next proposed project phase.

We further propose that this implementation project focuses on (i) the Goldsmiths BSc in Computer Science and includes both the digital educators involved in UK and at the teaching centres and (ii) this could be contrasted with a humanities degree course e.g. Psychology.

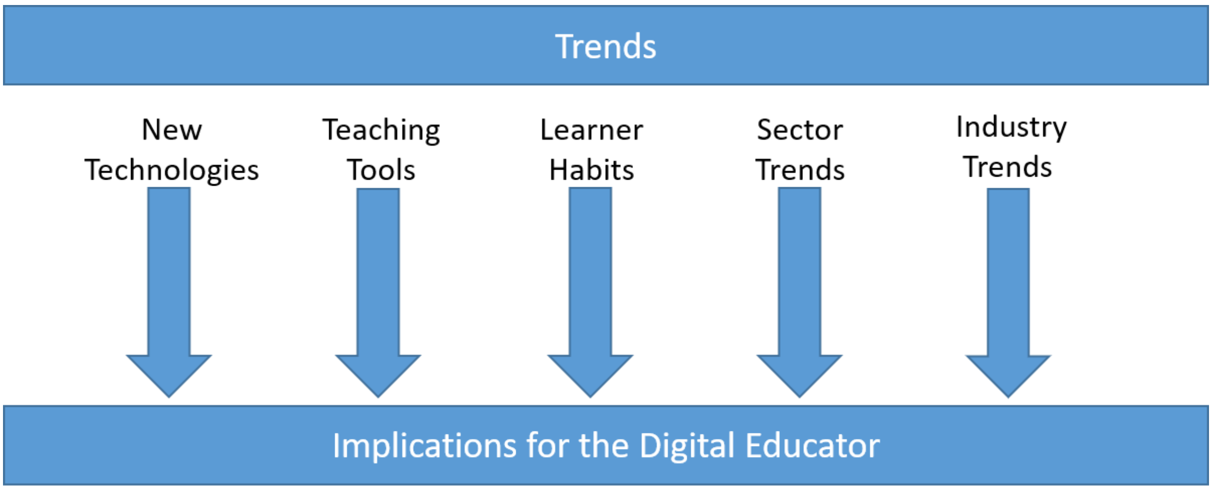
Annex A: Literature review

Assessing Trends That will impact the Digital Educator

The aim of this literature review is to distil key trends that may be significant to the future digital educator. Following an initial review, five key clusters were felt to be potentially significant to the digital educator of tomorrow:

- New Technologies – the impact of their emergence to Higher Education
- Teaching Tools – in particular the adaptation of technology into teaching interventions
- Learner Habits – the emergence of new behaviours connected with technology
- Higher education sector trends - reflecting on trends shaping the sector
- Wider learning industry trends – exploring trends in the wider learning and development sector

Inevitably, there were overlaps between these clusters and the later stages of the Digital Educator project explored how the clusters could combine to inform the needs of the future digital educator as illustrated below.



Findings from each cluster, along with some suggested implications from the literature review for the Digital Educator are illustrated in the following sections.

A1: The Impact of New Technologies on Learning – what is emerging?

Given the accelerating growth of consumer technology, it is important to consider the rate at which such technologies may both be adopted in Education and impact the digital educator.

The evolution of new technology creates significant challenges to learning in the higher education sector. JISC's horizon scanning reports provide some sense of the rapid rate of development and scope of potential impact of new technologies for digital education, pointing in particular to the potential for technologies such as:

- *Blockchain* to provide a source of reliable data access and *'research provenance and reproducibility'* (Hamilton 2017)

- *Cloud computing* to save money improve storage, accelerate development and enable agile development (Hamilton 2015)
- *Data and analytics* to support more effective predictive student analytics (Sclater et al, 2016)
- *Open access systems* to support new knowledge development (Hamilton et al, 2017)
- *Artificial intelligence* for learning support and the generation of new knowledge (Hamilton, 2018)

Several of these potential benefits (in particular cloud computing and open access) are already well recognised in higher education, and the JISC series illustrates the increasing breadth and complexity of technologies that could influence the educators and students of tomorrow.

Gartner's analysis of strategic technology trends highlights a further range of options; the importance of AI, the increased adoption of digital solutions that connect real and virtual worlds and the *'mesh*' of connections and possibilities that arise due to the continuous connection of people, '*things*' and data (Panetta 2017). In a separate report, Plummer et al (2017) highlight the rise of new visual and voice search and the acceleration of bot rather than mobile app interfaces. The challenges of fake news and knowledge as well as the interconnectedness offered by the adoption of internet of things are also recognised as strategic technology issues in the short term whilst Segars (2018) highlights the potential of new technologies to improve access to information (through powerful wireless mesh networks) to share information across devices (through pervasive computing) and to make sense of complexity (through machine learning and artificial intelligence). This potential for connectivity to enhance understanding will offer the potential to extend learning *'far beyond knowing facts or rote learning'.*

Dem-Moore et al (2016) describe disruption due to technology in learning as now '*pervasive'* and connect their predictions of the future to changes in both the demand and supply sides of Education. It is suggested that the rise of microcredentials will lead to the rise of *'modular learning pathways'*, that learning content will increasingly be *'unbundled'* due to increases in adoption of Open Educational Resources and crowdsourcing of content. The extension from unbundling to development of new pathways is also outlined by Reshef (2014) who suggests that effective digital solutions will start to offer *'equal or improved learning outcomes at much reduced cost'*.

The scale of potential growth due to new educational technologies is highlighted by Navitas (2017) whose landscape clusters some 1500 companies into 26 groups and eight interconnected key themes where technologies offer potential for learning:

- *Create* – content and knowledge
- *Manage* – programmes, students
- *Discover* – enrolments, loans
- *Connect* – to learning, to people
- *Experience* – classroom technology, immersive technology (eg Virtual and Augmented reality)
- *Learn* – through open and proprietary courses
- *Credential* – through extension and expansion of existing approaches
- *Advance* – career planning and recruitment

Such a diverse landscape demonstrates both the potential yet also the considerable scale and the challenge of the education technology sector. Given both the complexity of technology systems, the wealth of new technologies and potential opportunities now available to educators, there is a risk of what Schwartz (2006) calls a *'paradox of choice'* with too much choice, too little time and too little confidence to make an informed decision for many. Watson (2001) recognises the challenge of *‘manging expectations of faster innovation’* and the *‘customer expectation gap’* that may result when consumerisation of IT outpaces Institutional adoption and acknowledges that Institutions are likely to face ongoing challenges in both selecting and effectively implementing the right tools at the right time. Deloitte (2017) contrast the recent rate of change in technology with the slower rates of change of individuals, businesses, societies and governments faced with accepting that technology. This model mirrors the challenge of new technologies taking time to be both accepted and adapted in the higher education sector.

It is known that the rate of adoption of technology can be complex and that common usage is likely to take time to reach widely acceptance (see, for example, Rogers, 1995 or Geroski, 2000). The technology acceptance model of Davis et al (1989) points to factors of *perceived usefulness* and *perceived ease of use* as key to user adoption of new technology whilst the Gartner Hype model and similar frameworks (Steinert, 2010) highlight the expected delay between technology emergence and established practice. Educators play a key role in technology evolution, and Kruger et al (2015) highlight the challenges of continuous technology evolution on adoption, causing educators to *‘view new systems as potentially transient’* and making it *’understandable that they are resistant to invest the time into learning new systems’*.

Abrahams (2010) highlights the need for a critical mass of faculty users to support diffusion and adoption of new technology within higher education institutions, whilst the critical role of networks – both political, social and inter-departmental - is highlighted by Mirriah et al (2012). Redecker and Punie (2017) suggest that the diversity of views toward technology result in different roles being adopted with learning technology in many institutions, from *newcomer* (to technology) through *explorer* to *expert* and *pioneer.* Jaschik and Lederman (2017) recognises the majority of faculty will use *‘new technologies after seeing peers use them effectively*’, a point reinforced by Kreijns et al (2013) who points to the powerful influence of peer usage and adds that increased adoption is also made easier by faculty with a blend of past experience and skills in use of digital learning tools.

Given the combination of accelerating change and inevitable time lag to full adoption, technology implementation is becoming a continuous process rather than a clearly defined project. Some institutions are adopting lean-startup or design thinking principles, with an ethos less *‘specify, procure and deliver’* and closer to a cycle of *‘build’*, *‘measure’* and ‘*learn*’ (Ries, 2011, Müller and Thoring, 2012). Agile techniques also being adopted in academic institutions both for course design (Sharp and Lang, 2018) and with experiments and small trials of new technology seen as key stepping stone to prove concepts prior to full adoption. Johnson et al (2017) point to the value of partnerships, experiments and evolutions in practice in an attempt to keep pace with technology change.

It is unclear which technologies will be adopted into mainstream practice in the short term, but distilling technology trends, Brown et al (2015) provide a common view of the next generation digital learning environment by suggesting it will be characterised by

- *Integration* – although it may be based on an LMS or single system
- *Interoperability* – with adoption of open standards
- *Analytics* – to surface user needs and support options
- *Personalisation* – with the system neither the same for any individual or any institution
- *Collaboration* – as a ‘lead design goal, not an afterthought’
- *Accessibility* – to ensure all learners and instructors are able to participate

Such traits reflect the more open architectures of today's learning providers and point to the flexibility and agility that can result from connecting systems together rather than seeking a single solution.

A1.1 New Technologies and Learning - Implications for the Educator

Distilling the challenge, Green (2017) recognises that significant power rests with the educator,

> *'With so many technologies to choose from, practitioners must decide which of these are most effective to support their learning strategies.'*

Green also recognises the importance of technology '*alignment*', both with learning objective and with other learning interventions; learning technology is but part of the overall learning experience.

Overall, the challenge to educators is both how to assess potential benefits of any new technology and how best to assure return on investment through successful adoption and benefits realisation. Most Institutions will need to assess how best to monitor appropriateness of technology to suit institutional and individual learning needs and will develop adoption strategies aligned to users, investments and the anchors of established technologies.

In conclusion, for technology and implications for learning, the following trends are emerging:

1. Consumer based technology will continue to set high expectations for learning
2. Technology adoption within Educational Institutions is variable, with Institutions experimenting to balance expectations of innovation against investment and learning impact
3. More open learning technology ecosystems are likely to emerge to provide agility of adoption and flexibility of choice
4. Faculty exposure and groups will be key to encourage adoption

A2 Teaching tools and techniques – what are the challenges?

Digital learning is both being welcomed and gradually being adopted and adapted into teaching practice. The digital educator's classroom of the future – whether face to face, blended or online – is likely to be enhanced through technology. Graham et al (2013) recognise that technology is increasingly valued by adult learners both outside the classroom (for flipped classroom delivery, reinforcement and collaboration) and within the synchronous classroom (to maximise engagement and learning).

Technology offers the promise of designing new experiences and opportunities for learning. Proserpio and Gioia (2007) highlight the potential to create connections between content, between people and between domains of knowledge when technology-based learning is effectively applied. Ubell (2017) points out that online environments open up opportunities for reflection, anonymity (which can increase engagement) and analytics (to understand the effectiveness of learning). Conrads et al (2017) suggest, however, that some educators fail to take advantage of technology in learning due to a *'lack of digital competences, and lack of their confidence in using digital technologies meaningfully in teaching'*. More typically, however, Jaschik and Lederman (2017) recognise that the majority of faculty teaching online have developed pedagogies and skills that have improved effectiveness of their teaching.

Educators clearly have to cut through the range of options in order to select what to use and how applied. Kirkwood and Price (2014) highlight that technology can be used to replicate, supplement or transform teaching practice; there is no one size fits all solution. As a result, many educators are experimenting with new technology in order to assess potential for longer term benefit. Examples include:

- Development of more adaptive, more mobile and more collaborative learning management systems (Brown et al, 2015)
- Use of VR and mixed reality both for simulation in high risk environments such as health, offshore and aircraft (Velev and Zlateva, 2017) and to create powerful engagement and immersive experiences (Coppick, 2016)
- Use of mobile devices for immediate access to learning and to access complex content (Briz-Ponce et al, 2017)
- Gamification and game-based engines both to engage technology driven learners and to help develop learning pathways (Lavoué et al, 2018)
- Improvements in virtual teaching practice to help improve leadership and management of virtual teams (Caulat, 2012)
- Use of social tools for improved access to faculty such as Skype for coaching (Rock et al, 2013) and for language practice (Trejos et al, 2018)
- The combination of AI, Machine Learning and Robotics *'when properly used—to extend human capabilities and possibilities of teaching, learning, and research'* (Popenici and Kerr, 2017).

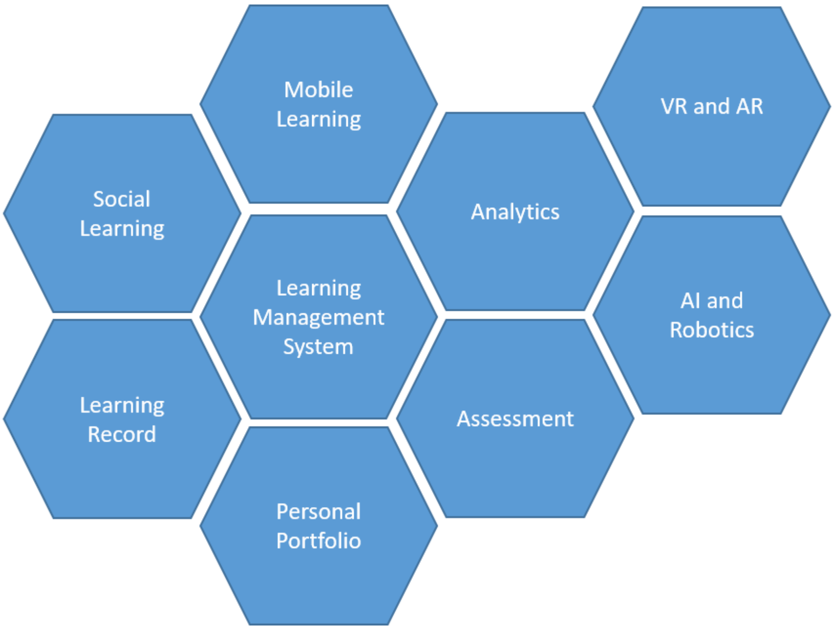
JISC (2009) stress the value of mapping learning goals through to appropriate technologies. Previous experiments (such as Second Life) illustrate the risks of embracing new technology in a time of rapid evolution, but the principle of an educator connecting tools to learning goals remains valid.

The potential for more immersive technologies to create improved cognitive absorption and learner engagement has been highlighted by Chandra et al, 2009, who also point to the strong connection between ease of use and adoption of new tools. Kirkwood and Price (2014) point to positive student attitudes when adopting new technologies, but also highlight that new doesn't always translate to more effective learning. Luckin et al (2012) highlight the opportunity to make better use of tools available for many institutions rather than always looking to the new and novel; novelty does not always translate to pedagogy.

Pacansky-Brock (2017) highlights the value of contextualising technology into teaching (*why is it needed and how is it used?*) and also of communicating expectations to students (*what are the norms, behaviours and desired outcomes?*). Ko et al (2017) recognises that student familiarity with tools and comfort with unfamiliar jargon used within online learning tools have the potential to be barriers to adoption and stresses the value of orientation sessions to ensure success. This engagement stage is seen as critical for both faculty and student to actively commit to engagement with online learning (Pacansy-Brook, 2017). Bolliger and Wassilik (2009) highlight that institutional as well as student engagement is required to create the appropriate learning environment; the complexity and demands of keeping pace with online raise concerns about *'faculty burnout'*.

The critical components of a (fully) online course are identified by Simonson (2017) as '*content, design and instruction'* with technology – whether Virtual Learning Environment or more complex tool – recognised as just a tool for learning delivery. Whilst others argue that collaboration, reflection etc could now also be included as key components, the point remains valid; technology becomes irrelevant and invisible when strong learning is taking place. Against this goal, Kruger et al (2015) report low satisfaction rates with Learning Management Systems and point to many being *'cumbersome and unwieldy'*, causing more work for educators and little benefit to learners. The widely adopted VLEs and Learning Management Systems will, however, continue to contain considerable volumes of data and insight on student activities which, if analysed appropriately, have the potential to provide valuable insights on student pathways and hence improve learning effectiveness (Pardo and Kloos, 2011).

Many Learning Management System implementations have been built with a top-down as opposed to community-based model of learning (Makri et al, 2014) and there are views that the LMS has become outdated and more of a platform for record keeping rather than learning (Bersin 2018). A network of optimised and interconnected learning systems is widely felt to be the most likely future model to offer flexibility for institutions moving forward. It seems likely that the LMS as a discrete system will diffuse toward a more connected model of technologies embracing existing and new technologies as illustrated below.



Student dashboards empowered through technology will continue to be vital tools to guide students through networks of systems and improve motivation and retention as outlined in a study where 27% of first year students changed behaviour just by being made aware of their performance data. (JISC 2017). Collaboration is also valued as a tool for engagement. In-class experiences are known to be enhanced through popular use of audience participations systems (Kaleta and Joosten, 2007) with increased adoption of personal devices rather than separate '*clickers*' seen as beneficial (Katz et al, 2017) although use of such devices for attendance monitoring seems to undermine student attitude toward their effectiveness. Participation techniques are also widely used in the online class to retain engagement and assess knowledge retention, with discussion threads, wikis, blogs and live classrooms now being used to forge collaboration and support learning (Biasutti, 2017, Berry, 2017) as well as challenging learners to learn more deeply (Johnson, 2017). The engagement with such tools is connected to the effectiveness of online learning (Wang, 2017) but the rise of informal networking sites and use of technologies outside the management of Institutions can create challenges of moderation, monitoring and data access and may warrant specific policies on the issue (see, for example, Hopkins et al, 2017).

Live collaboration is increasingly popular through multiple formats, including growth of new forms of collaborative environment seeking to enrich experience through TV quality interaction with Faculty at Harvard and other Business Schools (HBX, 2018, Wylie, 2017, UCISA, 2016).

For synchronous classrooms, access to the internet during class is valued for knowledge access and real-world connectivity during learning (see, for example, Graham et al, 2013) but the use of devices in class has the potential to distract. Carter et al (2017) highlight that deliberate use of digital devices may enhance performance but contrast this to cases where use is optional but unrestricted and where noticeably lower marks were obtained. Percival et al (2009) point to significantly different levels of effectiveness when contrasting students exploring engineering or education and suggest avoidance of Campus-wide policies on the issue.

Improved learning and collaboration technologies make large online synchronous courses now possible, but create significant challenges of design, preparation and learner engagement. The digital educator as increasingly part of a design and development team, embracing digital and instructional designers, media specialists as well as subject matter experts. The costs of digital development and content evolution are also significant; at the University of Texas Austin (Straumsheim, 2013) an introduction to psychology course with the potential to support online groups of up to 10,000 demanded a considerable support resource,

'Between lecturers, audiovisual professionals, teacher's assistants, online mentors and programmers, the number of people associated with teaching one class has ballooned to more than 125'

The potential for technology to undermine learning effectiveness is highlighted by McCoy (2016) who found students spent over 20% of physical class time using devices for non-class purposes. Patterson and Patterson (2017) suggest laptop use in a physical classroom with peers being taught by the same teacher *'directly worsens academic outcomes for students who choose to use them'.* Mueller and Oppenheimer (2014) expressed concerns about shallow processing when using laptops in class, resulting in students *transcribing* rather than *processing* information appropriately to support learning. Spitzer (2014) points to negative impacts on memory from multitasking whilst using laptops in class and also highlights the significant impact of others in class, *'watching two other people multitask in front of you makes you lose 17% of the material presented in the lecture'.* Similar concerns arise with mobile phones, with just presence of the phone sufficient to reduce attention and cognitive processing (Ward et al, 2017). The challenge of learner attention and risks of distraction exist for the distance educator, but are even harder to observe and manage. Szpunar et al (2013) talk of the response to *'mind wandering'* as shorter lectures or interpolated testing but stress that pedagogy and continuous attention to learner engagement are critical broader solutions.

The flipped classroom (in particular using video) is increasingly being adopted both to prepare for more collaborative classroom activities and to prime for investigation of complex themes (see, for example, Dix, 2017). There are many positives and opportunities to use flipped classrooms to engage with large class sizes, enrich learning and set challenges to bring to class (see, for example, Ojalvo and Doyne, 2011). Challenges of adoption and optimisation of the flipped classroom are, however, highlighted by McNally et al (2017) who distinguish those individuals that embrace and indeed prefer the flipped classroom approach (the '*endorsers*') from a group that are largely neutral but chose not to pre-learn (the '*resistors*'). These concerns are echoed by Blair et al (2016) who highlight the value of attendance and commitment in traditional and online (flipped) classes.

Looking to the future, Luckin (cited in Times Higher Education, 2016) suggests the potential of AI to address fundamentals in order to create the opportunity for *'teachers to do the more complicated teaching'*. This connects to Clarke's (1980) rather more extreme comment on Electronic Tutors that *'any teacher that can be replaced by a machine should be'*. Feldman predicts that AI can both relieve administrative burden from faculty and potentially change research as much as teaching due to accelerated information processing techniques (cited in Niven, 2018).

Susskind (2017) connects AI to potential disruption in the legal sector, enabling automation, connectivity and on-demand access to knowledge. The automation of more mechanistic aspects of the law will create demands on the lawyers of tomorrow to remain adaptable and actively maintain knowledge. E-learning approaches will also have to evolve from a focus of delivering knowledge to one that actively engages learners in valuable skills such as advocacy, client management, due diligence and negotiations.

A2.1 Teaching Tools and Techniques - Implications for the Educator

In terms of teaching tools and techniques, the following trends are emerging:

- Educators are somewhat overwhelmed and need to be better supported in their use of digital technologies
- Widespread experimentation is likely to continue and knowledge sharing of what works would be useful for educators
- Structured LMS's are likely to become more open to support a learning 'ecosystem'
- The selection and use of teaching tools will increasingly be for learning effectiveness rather than 'newness' – pedagogy will be more important than novelty
- Whilst digital technology is evolving, it is less clear how quickly digital learning is evolving in practice?

A3. Learner preferences and practices – what do learners need?

Given the changing nature of the learner in a digital world, it is important to consider whether learning habits, practices and effectiveness are evolving.

The challenges of teaching a generation of learners who have *'grown up with Google'* is well documented, creating a challenge of engagement to educators seeking to teach learners with strong digital literacy and with preferences for '*experiential learning*', '*interactivity*', and '*immediacy'* (Skiba et al, 2006). Millennials are recognised as *'adaptable'* but some (such as Arum and Roksa, 2011) question both the quality of student reasoning that is developing in a digital world and the quality of evidence evaluation that is applied (McGrew et al, 2018). Jaschik and Lederman (2017) echo the point, identifying emerging concerns at lack of understanding of plagiarism in undergraduate students. Selwyn (2003) recognises the initial contrast between 'fixed' teaching institutions and the emerging always-on culture of *'connectedness'* of mobile learner access. This trend presents a challenge to the alignment of educator preference and learner need. There are contrasting views as to whether institutions or learners should change, with some students suggesting teaching practices are *'from the last century'* (Blumenstyk, 2017). Proserpio and Gioia (2007) talk of the need to address this by aligning *'teaching and learning styles'* to optimise both learning impact and student performance.

The rise in smartphone use provides an opportunity for the digital educator to exploit positive opportunities for continuous connection to information and continuous connectedness between participants but such benefits also have an unknown psychological cost (Pearson and Hussain, 2017). There is a fine line between increased smartphone and internet use and addiction (Lopez-Fernandez et al, 2014) and some evidence that increased technology use is starting to change the way young learners think (Taylor 2012). There is some evidence (Carr, 2010) that widespread adoption of devices is fundamentally changing the way we think, remember and therefore learn. Others highlight that, after an event, there is growing evidence that learners are able to recall *where* to access information but not necessarily the information itself (Sparrow et al, 2011). The suggestion is that, to some extent, parts of memory are being outsourced, *'The Internet has become a primary form of external or transactive memory, where information is stored collectively outside ourselves'.*

Spitzer (2014) suggests that, as a result, the reduced cognitive load when using technology could lead to reduced ability of learners to build appropriate connections between concepts.

There is some evidence that consumer experiences are resulting in learners becoming more impatient and more demanding of technology with greater expectations of delivery, despite the reality of Institutional anchors and procedures inhibiting rate of adoption. Dzuiban et al (2013) highlight the challenge of responding to the ever-changing nature of student expectations and *'voice'* in higher education, suggesting that established assessment methods in particular will be increasingly challenged by evolving student perceptions of learning experience. Newman and Beetham (2017) suggest that students are generally positive about learning technology experiences but they expect Institutions to continuously improve technologies and address the quality of learning experience.

Brooks et al (2016) recommend ensuring online learning interventions are appropriately incentivised and embedded in wider learning activities. This connection is particularly important to avoid learners seeking to *game* the system if confident, resulting in *'superficial as opposed to deep learning, if any learning at all'.* For learners, both perceived usefulness and perceived ease of use are essential to facilitating adoption and acceptance of new technology (Davis, 1989). Agarwal et al (2000) highlight that user belief in the effectiveness of a system is a key factor in encouraging adoption, whilst from an Institutional perspective, Luckin et al (2012) point to cost, complexity and (online) safety of technologies as potential barriers to adoption.

Once using technology for learning, effective learner usage of knowledge sources, management of fake news and acceptance of facts presented may also be an issue for tomorrow's digital educator. Back et al (2016) found that students valued learning management systems to access curricular content and timetables but open sources including Wikipedia were popular as a source of knowledge acquisition. Rodgers (2018) highlights the emerging tension between established and emerging information literacy practices in a digital world and recognises the challenges presented by socially curated or rapidly generated computer-based information that appears credible to students. Wisely, the suggestion is to

'prefer primary sources, seek multiple sources, look past advocacy, question motives for reporting, and look for reasons why disagreements may exist among diverse sources.'

To complicate matters, the learner population is increasingly diverse, made up of what Howe and Strauss (2007) call *'a generational constellation'*, creating a variety of teaching and learning preferences both within learner groups and between educator and the student population. This also creates a challenge to digital design in seeking to find the dominant preference of a given learner group. Karakas et al (2015) suggest such difficulties may be managed through learning design and selection of appropriate tools and techniques, with the digital educator addressing lack of concentration through use of reflective spaces, lack of engagement through creative spaces and lack of socialisation through collaborative spaces.

The inconsistency of Digital skills across the learner population is a potential challenge to engagement with new digital learning technologies.

Kluzer and Priego (2018) estimate that 44% of the EU population have insufficient digital skills, and map out 21 competences necessary to be digitally competent (mapped to 8 proficiency levels). Both JISC (2017) and Redecker et al (2017) have distilled digital competencies into specific digital competencies for Educators. Digital literacy is seen by Sohelia and Singh (2015) as a key factor in reducing barriers to learning technology adoption, and several Institutions (see, for example, JISC, 2014, Sheppard and Nephin, 2014) have developed digital literacy tools and guidance to enhance digital skills and competencies of faculty. Sharpe and Beetham's pyramid model of digital literacy (2010) identifies levels of literacy from digital access (still a problem in many parts of the world) to skills, effective digital practice and identity. JISC (2014) suggest seven elements of digital literacy:

- *Learning skills* – ability to both study and learn in formal and informal digital environments
- *Digital scholarship* – ability to participate in practices (academic / professional / research) that relies on digital
- *Information literacy* – effective information access, evaluation, management and sharing practices
- *Media literacy* – ability to engage with content in multiple formats
- *Communications and collaboration* – ability to participate in digital networks
- *Career and identity management* – ability to manage reputation and identity online
- *ICT literacy* – ability to use and adapt systems and services to needs

For students, Woods and Oradini (2013) suggest the vast majority of students consider themselves digitally literate but recognise the importance of embedding digital skills development into the curriculum to aid employability. French (2014) recognises the value of basic IT skills – Excel, Email, Social Media – being *'as much a key functional skill as numeracy and literacy'* but bemoans that *'too many young people leave education without the basic digital skills'.* Rowlands et al (2008) stress the risks of assuming the Google generation will have acquired appropriate digital learning skills; books are still valued but habits of plagiarism, poor information search techniques and reduced library usage were recognised as challenges to future educators. Schech et al (2017) recognise the ability to work (digitally) in a digital world as an important enabler of *'getting work done'* and also highlight the opportunity to use digital collaboration tools whilst learning to build appropriate life skills for employment. For digital educators, the implication is that understanding effective use and appropriate behaviours with digital tools is becoming a key skill in the digital world.

The variation in use of technology – both within a group and across the globe – creates a considerable challenge to aligning solutions with needs for the digital educator. Although in some studies (see, for example Li et al, 2018) the learning styles of students are felt to be significant in learning effectiveness, Husmann et al (2018) and many others disagree with their use in education with little evidence that studying according to supposed preferred learning style leads to better outcomes. Learning styles have been used as a frame for structuring learning design in some cases as illustrated by Wessel et al (1999) but Willingham et al (2015) highlight the lack of success in finding an agreed model to characterise student learning preferences. The value of considering both difference and common ground in students is likely to endure in considering the future of learning, with the need to connect any preferred style to digital learning preference and competence complicating the analysis still further. Course design is key with Johnson et al (2017) suggesting the planning of

'experiences that cultivate a genuine curiosity in students so they are excited to explore subjects further'.

The rise of data analytics and resultant personalisation technologies offers promise to provide a strong bridge between learner needs and educators (Bienkowsk et al, 2012) with profiling as an important first step toward adaptivity (albeit with parallel privacy and data protection issues). To support personalisation of learning, Drysdale (2013) points to increasing research focus on student outcomes, highlighting the need to address both student engagement and motivation when carrying out learning design, whilst Boelens et al (2017) suggest attention is needed in fostering an affective learning climate that builds student confidence, engagement and outcomes.

The digital educator will, however, need to preserve the distinction between personalisation and ease of learning. To avoid the '*illusion of knowing*', Brown et al (2014) point to the value of enhancing assessment and feedback through frequent low stakes testing to help embed knowledge and skills. Brown et al also stress that deeper and longer lasting learning is stimulated when effort is required, so they highlight the need both to design in '*desirable difficulties*' and to connect concepts to a range of contexts in order to embed learning.

Such techniques demand continuous and effective feedback techniques, and JISC (2015) highlight exploration of new approaches to provide both feedback and feed-forward (constructive guidance on how to improve). Audio and video feedback are recognised as providing a more engaging and valued form of feedback. Smith et al (2017) also stress the importance of connecting appropriate assessment techniques with effective feedback, highlighting the use of technologies such as screencasting to provide richer form of feedback on summative assessment as it '*offers the opportunity for richer, more dialogue-driven comment'.* They also highlight the value of e-portfolios to provide greater visibility of student progress, a point reinforced by Karakas et al (2015) who highlight the value of a reflective portfolio to seed longer term learning.

A3.1 Learner Preferences and Practices - Implications for the Educator

In conclusion, for learner preferences and habits, the following trends are emerging:

- Learner habits are evolving rapidly, creating an increasing challenge to educators of 'understanding the modern learner'
- The value of testing, data analytics and learning pathways are likely to increase to support enhanced engagement and learning
- The importance of digital literacy is likely to see demands for enhanced digital skills development in higher education from both learner and potential employer

A4. Higher Education Sector Trends – What is changing?

For all the promises of learning technology, the rate of adoption in higher education has been slower than many would have expected. Kirkwood and Price (2014) suggest that to date

'The potential of technology to transform teaching and learning practices does not appear to have achieved substantial uptake, as the majority of studies focused on reproducing or reinforcing existing practices.'

Educational technology developments are regarded as important by institutional leaders, with Jaschik et al's (2018) survey of provosts and chief academic officers suggested 8 in 10 were expecting to expand online offerings over the next year. Quite how institutions will decide to do this is a far more complex matter.

MOOC partnerships and investments continue to grow, with Business and Management and Computer Science subjects leading the way by volume (The Economist, 2017). The rise of the MOOC creates both opportunity and threat, fee and free channels, but has both allowed more faculty to voluntarily engage with online learning and provide access to quality learning in an age of overload. Headlines on the perceived high dropout rate of MOOCs overlook the voluntary and low stakes nature of engagement as well as those browsing MOOCs for knowledge on subjects of transient interest (Liyanagunawardena et al, 2014). Learners may well not be interested in a full course and there is evidence that a large group use MOOCs as a resource for reference – a form of digital textbook. Parkinson and Chew (2016) recognise that the brand association with major academic Institutions creates a badge of quality

'Content becomes readily available to students much in the same way Google and Wikipedia provides, yet with the branded goods providing some reassurance of their quality and reliability'

Siemens (2015) points out MOOCs are a potential stepping stone to other courses in the higher education sector and that they also help institutions to evolve new practices as they open the door to *'new ways of thinking and operationalizing innovations in education'.* Howarth et al (2016) also point to the potential value of MOOCs as a marketing technique, providing a *'taster'* for more detailed study. This progression is not assured given the widely recognised *'funnel effect'* in low fee or free MOOCs with a large drop in numbers from registration to completion (Clow, 2013). Steffens (2015) is less convinced of the learning impact of MOOCs, observing that '*MOOCs have spread at a breath-taking pace in the last few years, although it is far from clear to what extent they are based on principles from learning theories and really support learning'.* The different pedagogical approaches that may be required for 'at scale' as opposed to 'on campus' courses could lead to differing participant experiences (Stacey 2013). Howarth et al (2016) suggest such differences may limit the effectiveness of MOOCs for marketing purposes moving forward.

Hollands and Tirthali (2014) highlight that many initial MOOCs fell short of expectations. In particular:

- Increasing access to education – many MOOC participants are already well educated and a relatively small percentage engaged fully with the course
- Building and maintaining brand – isolating and measuring impact is challenging
- Reducing costs or increasing revenues – many early stage MOOCs required considerable investments in time and money

They also observed the value in MOOCs allowing institutions to experiment:

'with various types of blended or hybrid delivery models on-campus, and in efforts to help struggling students find low-risk options to build skills that allow them to test out of developmental education courses'

MOOCs have continued to evolve and are now a key part of the digital education space. Shah (2018 and 2019) highlights the significant growth of the MOOC space:

- Over 81m learners at the start of 2018 rising to over 101m in 2019
- Over 800 University partners in 2018 rising to over 900 in 2019
- 9400 courses in 2018 rising to over 11000 in 2019
- Over 500 MOOC based credentials in 20178 rising to over 600 in 2018 – from nanodegrees, microdegrees, micromasters to professional certificates and specialisations
- Online (MOOC based) degrees rising from 15 in 2018 to 45 in 2019

Revenues for MOOC providers have continued to rise with edX introducing a new paywall and Coursera achieving $140m in 2018 (Shah, 2019).

Kim (2017) recognises that, whilst the educator / learner relationship is hard to scale, good MOOCs have now matured beyond just content delivery to create both learning communities and a pathway toward traditional and new credentialing opportunities. MOOCs are increasingly accepted as a space to experiment, market and commercialise and Howarth et al (2017) suggest that the likelihood of MOOC participants transitioning to further enrolment is enhanced when they have both been satisfied with the MOOC experience yet feel that the final award falls short of their educational ambitions.

The companies associated with MOOCs continue to grow and evolve. Shah (April, 2018) suggests that increasing success has allowed MOOC providers to move upstream toward corporate learning and online degrees. In parallel, partnerships have been established (Coursera now have over 1000 corporate partners) and revenues have started to grow significantly (Udacity exceeded $70m in 2017 up from $25m in 2016). With such investments and accelerating power, their influence and impact on the future of online education is likely to become increasingly significant.

Van Valkenburg observes that MOOCs are starting to be offered as part of for credit options in major universities with the option of learning online but still gaining credit at the individual's host institution. Coursera, meanwhile, continue to grow their portfolio of fully online masters and most recently Bachelors programmes with a global range of university partners (Lunden, 2018).

When MOOCs are used for certificates of completion or other awards, the wider issue of credentialing needs to connect to issues of industry and academic relevance and recognition. The Economist (2017) points out that

'people are much more likely to invest in training if it confers a qualification that others will recognise'.

The use of open digital badges for positive reinforcement of learning accelerated after 2011 when Mozilla, with funding from the MacArthur Foundation, developed a way to recognise learning '*wherever it was happening*' (Mozilla, 2017). Mozilla also pioneered the concept of the 'Backpack' to allow individuals to own a portfolio of their own achievements and to selectively share evidence of credentials with others online. The Open badges specification is currently being managed by the IMS Global Learning consortium, who are now also seeking to develop a *'comprehensive learner record'* (to create a complete student picture of learning) and a '*Competencies and Academic Standards Exchange'* standard (IMS Global, 2018). This need for a trilogy of a comprehensive personal record, appropriate standard and means of showcasing to interested parties is likely to emerge as a challenge to awarding institutions over the next decade as alternative forms of MOOC credential start to emerge.

The value of any new form of credential needs to move beyond practicality to widespread acceptance, understanding and use of appropriate standards (Carey and Stefaniak, 2018). The issue of quality and trust is significant (Finkelstein et al, 2013) whilst the interface between less formal forms of credential and higher education credit remains challenging. Buban (2017) suggests

'Challenges remain for students who seek to bring alternative forms of learning to their higher education experience.

'Constructing a degree with a combination of transfer credit, prior learning, and other types of courses……is something of a puzzle'

There is some evidence of polarisation between skills based '*badges*' and more academic '*credit*', but only limited evidence as yet that employers are as yet showing any significant signs of favouring the former for anything beyond basic skills and competencies. Mischewski (2017), however, suggests that the development of new forms of credential and their connection to more flexible learning paths could create opportunities to open up learning to new groups to address skills shortages in some areas.

The emergence of Blockchain technology offers scope for improved costs of data management as well as to develop new models of trusted exchange between employer, student and academic institution (Grech and Camilleri, 2017). MIT have recognised the potential of the Blockchain to create a secure digital route to access certificates and other credentials that could be both trusted by institutions but with records carefully owned, curated and shared by individuals. Their response has been to create an open framework based around the concept of 'Blockcerts' as a means of receiving and sharing appropriately validated records (Schmidt, 2015). In the UK, Wolff university claim to be creating the world's first Blockchain university, using the technology both as a secure means of academic record and to facilitate high quality interactions between student and teacher based around the tutorial system.

Learning online more widely accepted with a large global survey pointing to over three quarters of younger learners taking an online course (Yu and Hu, 2018). As online continues to scale, the assessment of quality in digital teaching and learning will become more important evolving those benchmarking and assessment frameworks that already exist (see, for example, the EFMD EOCCS model or SLOAN C – now OLC – pillars as outlined in Moore, J, 2005). Adoption and wider exploration of such benchmarking frameworks is likely to intensify as institutions look to optimise and continuously improve their use of digital learning.

A4.1 Higher Education Sector Trends - Implications for the Educator

In conclusion, for Higher Education trends

- *MOOC providers are likely to be catalysts for ongoing innovation and change*
- *Degree partnerships and new forms of credential are likely to emerge to provide flexibility for tomorrow's learner*
- *The influence and impact of MOOC providers on online education will be significant and may need to be monitored*

A5. Wider Learning Industry Trends

Higher education Institutions exist in an increasingly complex global environment, with new players and practices emerging rapidly. There is increasing recognition that the companies of tomorrow will demand new skills and new roles in response to accelerating change. The World Economic Forum (2017) point out that

> *35% of the skills demanded for jobs across industries will change by 2020, at least 1 in 4 workers in OECD countries is already reporting a skills mismatch with regards to the skills demanded by their current jobs*

Rahschutlte (2018) points out that knowledge shelf life is limited and that the rapid evolution of knowledge signals a need for situational analysis, rapid but effective decision making and, most critically, continuous learning. Arbesman (2012) highlights that whilst some principles of knowledge remain static, others will change often, creating risks for those seeking to make decisions based on outdated information. The consequence of rapid knowledge growth, obsolescence and Industry change is discussed by Saracco (2016) who questions the very concept of a 'job' (let alone a job for life) due to the rapid evolution of work.

The accelerating development of new (often interdisciplinary) knowledge combined with the rapid obsolescence of existing knowledge creates a strong driver for new models of lifelong learning. It has long been recognised that professionals risk knowledge obsolescence due to a combination of accelerating growth of new knowledge and the *'potential deterioration of previously held expertise'* (Rothman and Perrucci 1971).

Lifelong learning is also increasingly important due to our longer lifetimes. If, as Gratton and Scott (2017) and Van Dongen et al (2018) suggest, one consequence of people starting to live longer is likely to be longer working lives which may be expected to go through more varied and complex stages. Individuals will need to prepare and cope with transitions and learning needs will need to adapt and flex to support these demands, addressing the needs of new generations of learners and encouraging collaboration and knowledge transfer. As Van Dongen suggests,

'*those charged with organizational development will need to take a close look at how individuals learn at different stages of their life and design their development programs accordingly'*

Skiba (2017) notes the difficulties for digital educators are twofold

- *'As faculty, we are constantly updating courses, trying to stay one step ahead of our students'*
- In addition, however, *'we are expected to manage knowledge related to teaching-learning, educational technologies, and devices that are accelerating at warp speed'*.

Towards Maturity (2018) recognise that digital learning adoption in the corporate space is being held back due to a lack of awareness as to what technology can bring to the learning agenda, but point to a six-point plan for success in practice:

- Define needs
- Understand learners
- Connect to context
- Build capability
- Ensure engagement
- Demonstrate value

Given the need to continuously refresh knowledge in the corporate environment, Bersin (2018) talks about the need to learn *in the flow of work* and similarly, Karakas et al (2015) recognise that '*learning is not confined to the spatial and temporal boundaries of the classroom in the digital age'* and talk of the need to create

'learning at the speed of life'

Learners in the rapidly moving world are challenged, overwhelmed and yet demanding and impatient in their demands for untethered on-demand learning (Tauber and Wang, 2014). It is important to respond to this need with a blend of access and challenge, as Spitzer (2014) suggests,

'The more effort you have to take, the better the learning outcome'

The corporate learning industry is focusing on the attractive promise of nanolearning, learning at point of need and microlearning (Eades, 2014). From a digital educator perspective, such approaches may create a tension between the ease of learning the basics in the shallows as opposed to the professional need to understand more complex or multidisciplinary issues at depth. Spitzer (2016) questions the value and impact of knowledge on demand whilst Carr (2010) warns of the need to avoid and challenge shallow learning, and yet adoption of skills based platforms is widespread with the likes of Udemy, LinkedIn and Coursera leading the way (Chen 2018) and corporates such as IBM have tried to connect smaller learning experiences into badged credentials to address *'critical talent shortages'* (IBM, 2017).

The MOOC and corporate online learning sectors are not short of proposed solutions in the B2B corporate learning space with Coursera, EdX, Futurelearn and others exploring how best to adapt existing courses to corporate needs (Shah, 2018). New providers and new approaches are also being explored, with large corporates not afraid to be lead partner with colleges and technology providers to shape products to their needs (see, for example, Boeing, 2018) and with partnership models collecting class and workplace learning also popular (Kinash et al, 2016).

The complex nature of the corporate space blending content, collaboration and time specific context is overwhelming to busy learners and is creating demands for new forms of integrated technology platform. New, more immersive environments are being explored for simulations (Velev and Zlateva, 2017) and Chandra et al (2009) highlight the value of learner '*trust and familiarity' as well as 'perceived playfulness'* (specifically for virtual worlds) as ways of using immersive learning environments to build *'cognitive absorption'* – a state of *'deep involvement'.* More generally, Bersin (2018 – ii) talks of the progressive side-lining of the learning management system and emergence of '*Learning experience platforms'* that will provide a highly personalised experience to connect personal needs to appropriate learning pathways. Adaptive learning technologies are also likely to be in demand with the emergence and progressive acceptance of xApi leading to the possibility of personalised portfolios that can connect to corporate learning systems and Educational accreditations (Betts, 2018). The potential to map learner progress against perceived level of engagement in order to highlight the need for appropriate support interventions is currently people based, but the potential to adopt machine learning based tools is also being considered.

The combination of knowledge obsolescence, knowledge development, changing nature of learners and growth of machines makes it difficult to predict what knowledge will be valued and what modes of education will most be valued in future (Saracco, 2018) but it remains important to know *'how to ask the right question and whom to ask'*, a goal the digital educator will continually keep in mind in learning design. AI and '*expert*' systems can go some way toward mobilising knowledge at the right time for such complex problems, as illustrated by the successful use in treatment of depression in Germany (Berger et al, 2017).

A5.1 Learning Industry Trends - Implications for the Educator

In conclusion, for Learning Industry trends:

- Lifelong learning and knowledge access will be increasingly required to support corporate and individual learners
- Knowledge decay and development will both accelerate
- Microlearning and similar trends will accelerate, ironically at the same time as more complex global challenges will emerge
- The partnership of man, machine and learning will need to be considered

A6. Design skills for the digital educator – what are the implications for educators?

Distilling the five themes together, the challenges to educators for new programme design and delivery skills in parallel to the evolution of digital learning have been recognised for some time (see, for example, Salmon, 2000 and 2004 or Proserpio and Gioia, 2007). Salmon's five phases of online learning activity (*access and motivation, online socialisation, information exchange, knowledge construction and development*) highlighted the need for educators to support and then engage students through these stages with use of appropriate techniques (from initial familiarity with technology through management and moderation of discussion threads to group identity, knowledge transfer and reflection). The methods and tools to enable these stages, however, are evolving rapidly.

Mishra and Koehler's TPCK model (2006) suggested that educators would need to develop technology, content and pedagogical knowledge. The model also highlights that the content (*what is taught*) and pedagogy (*how it is taught*) informs the appropriateness of any technology used. Moore (2005) highlights the need to consider the five pillars of learning effectiveness, cost effectiveness, accessibility, faculty satisfaction and student satisfaction to achieve good quality online learning.

Picciano (2017) highlights the continued challenge of defining blended learning, recognising that the nature of the blend can vary from supporting learning through to a transformational learning activity. Picciano (2009) notes the confusion that can result and highlights the value of '*blending with pedagogical purpose*', stressing that educators need to think of objectives prior to selection and use of technology from the vast range of options available.

Adams Becker et al (2017) highlights the need for development of:

- Designs that blend formal and informal learning to enhance engagement
- Student digital literacy skills to prepare for the workplace
- Improved routes to access learning and learner retention
- Management of knowledge obsolescence – both in terms of teaching practice and long-term learner effectiveness
- Faculty support for *'technology and pedagogy discovery'* to ensure ongoing learning impact

They also recognise that these challenges are complex; the first of these may be solvable to some extent over the next 2 years but all are part of an ongoing process of change in the higher education sector.

Skiba 2017 notes the need for Universities to support *'faculty experimentation, programmer and instructional design support, and faculty and administration problem solving'* and also recognises the re-emergence of collaborative learning focusing on *'placing the learner at the center, emphasizing interaction, working in groups, and developing solutions to real challenges'*

Looking to the future it is likely that educators will be faced with the dilemma of how best to fulfil more roles than they can optimise. Watanabe-Crockett (2018) highlights the need for educators to develop deep understanding of technology in terms of its teaching potential, but also stresses a need for educators to be sensitive to learners' online safety, digital literacy, and both global and digital culture when teaching online. Kezar, A (2016) recognises that there is increasing pressure for faculty roles to evolve, moving beyond teaching and research to also adopt new techniques, compete with for profit institutions and (potentially) adopt new forms of contract. Jaschik and Lederman (2017) suggest that there is still some debate (and variation) in Institutional support for teaching online, and question as to whether institutions compensate fairly for online course development. Open discussion and debate on appropriate compensation models is needed, as is support for the innovative digital educator. As Skiba (2017) points out some early innovators seeking to embrace digital pedagogies ended up being

> *'fearful of getting terrible course evaluations because they were challenging the status quo'.*

Redecker and Punie (2017) stress the need for a process of continuous exploration, evaluation and adoption of learning technologies in order to blend technology and effective learning practice and propose six stages for adoption of new technologies: *Awareness, exploration, integration, expertise, leadership* and *innovation*. Embedded within this framework is the pivotal process of socialising new technology within the peer group in order to achieve widespread acceptance. JISC (2009) highlight the value of learning activity design, a process of considering the most effective combination of activities, technologies, people (learners, peers, tutors facilitators etc) and learning outcomes.

The future role of technology providers and other partners needs to be carefully considered. Morriss and Stommel (2017) stress the importance of assessing whether tools say what they say they do, but also actively researching terms of service, considering data issues and impact on learning in order to avoid *'damage by working directly at odds with our pedagogies'*.

Redecker and Punie (2017) highlight a wealth of different competencies that will be required for the educator to support the learners and learning designs of tomorrow. Their EU 'DigiCompEdu' framework outlines 22 educator-specific digital competences are organised into 6 areas. Subject specific and base digital competencies will be key enablers for educators, with key pedagogic competencies relating to:

- Selection, creation and management of digital assets
- Design of a blend of appropriate teaching, collaborative and solitary learning experiences
- Empowerment of all learners through accessibility, personalisation and engagement tools
- Assessment on a foundation of strong analytics to provide personal feedback and planning

The EU framework highlights the value of connection between Educator professional competencies, Educator pedagogic competencies and Learner competencies.

JISC (2014) also point to key elements of digital literacy:

- *Learning skills* – ability to both study and learn in formal and informal digital environments
- *Digital scholarship* – ability to participate in practices (academic / professional / research) that relies on digital
- *Information literacy* – effective information access, evaluation, management and sharing practices
- *Media literacy* – ability to engage with content in multiple formats
- *Communications and collaboration* – ability to participate in digital networks
- *Career and identity management* – ability to manage reputation and identity online
- *ICT literacy* – ability to use and adapt systems and services to needs

New faculty roles and critical competencies are likely to emerge, and support for faculty transition and development will be required. McKenney and Mor (2015) describe the increasing recognition of teaching as a *'design science'*, calling on the blend of educational design, analytics and inquiry for effective results. Jaschik et al 2018 highlight the need for teaching and development of faculty to (mostly US based) senior leaders, with 94% of institutions offering some form of professional development for faculty members on teaching with technology, 87% on use of assessment systems and 60% on how best to evaluate the effectiveness of digital tools. Conrads et al (2017) recognise the importance of *'supporting teachers and strengthening their capacity to meaningfully integrate digital technologies into education'* as a key priority in digital education policies. Europe-wide policies have evolved from infrastructure and innovation foci to recognise the role of educators in exploring, adopting and adapting learning technologies to learning objectives.

At a base level, the learning professional's familiarity with digital communication and delivery will need to increase. Applying this knowledge to selection, develop and manage digital resources will also be a key enabler prior to mobilising the power of technology to deliver meaningful teaching and assessment. Digital tools may be expected to facilitate a more learner centric future, particularly with the potential to adapt learning pathways to personal needs and interests. Ultimately, however, the digital educator of tomorrow will need to juggle a complex mix of technology evolution, institutional adoption, learner habit, teaching practice and learning effectiveness to lead change.

The digital educator will need to

- Continuously evolve digital competence and continuously rethinking of how to learn in a digital age
- Shift from a world of memorising knowledge to experiential learning and competency
- Continuously experiment, evaluate, socialise and integrate systems to support ongoing innovation

For Institutions, new compensation models will be required to embrace appropriate incentives and support for digital learning innovation.

Looking to the future, the longer-term emergence of AI and teaching machines could lead us to a world of far greater change. The emergence and influence of technology platform providers is also likely to be significant

'If we reach a point where the agenda of universities is set by a handful of techlords, as well as the control over their information and the ethos of universities, higher education is looking ahead a very different age' (Popenici and Kerr, 2017).

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Annex B: Digital Educator Foresight workshop

As part of the Digital Educator project, University of London CDE hosted a workshop at Senate House June 26th 2018 to explore the future of role of the digital educator. The workshop sought to engage a wider group of stakeholders with diverse perspectives and deliver outputs from the workshop that would be of interest and relevant to a wider group. Participants with wide ranging and relevant professional expertise, were drawn from among CDE fellows, University of London Worldwide and Colleges of the University of London, University of East London, JISC and consultants with expertise in distance education and international development.

The workshop programme was framed around use of foresight methodologies which helped us in a participatory manner to generate drivers of change and narratives for possible future scenarios, The foresight tools used for the workshop, represent a 'lite' version of the full foresight process[1], which normally runs over a longer period, with follow-up workshops which explore a potential preferred scenario, and work back using a more extensive range of tools to develop strategic approaches and policy recommendations.

In the next section of this report the outputs of interactive group discussions, which produced drivers of change and four different potential scenarios are summarised. At the workshop participants also briefly considered timelines for major events which could contribute to their scenario arising, and suggested strategies that would enhance positive aspects of their scenario or reduce negative aspects. These scenarios are briefly documented and developed in this report.

Note that a small amount of further work has been carried out by the report author, and with input gratefully received from participants to develop the scenario narratives. The report concludes by highlighting some key areas for future consideration.

B1 Foresight Workshop Summary Report

The workshop commenced with a brief presentation by Jon Gregson highlighting the purpose of the event, which is not about trying to predict change, but to explore different perspectives and consider different scenarios which digital educators may face in the future.

To set the context, the rapid pace of change in relation to exponential growth in use of digital technologies was emphasised. Each of the participants identified some headline topics that they felt were important considerations for the future of digital education, and Tony Sheehan presented early findings from the literature review. These inputs provided a helpful initial context for the discussions which followed.

B1.1 Drivers of Change

Participants were then divided into four groups, for the first main activity, and the groups commenced by reflecting on drivers of change that are likely to influence the future over the next fifteen years. The drivers of change were then classified using the five 'STEEP' headings:

[1] School of international futures, www.soif.org
Foresight Scenario Planning Guidance 2009, Government Office for Science

Social - Technical – Economic – Environment - Politics

Participants were invited to vote on the drivers they considered to be the most significant in each category, i.e. in terms of potential high level of impact or uncertainty.

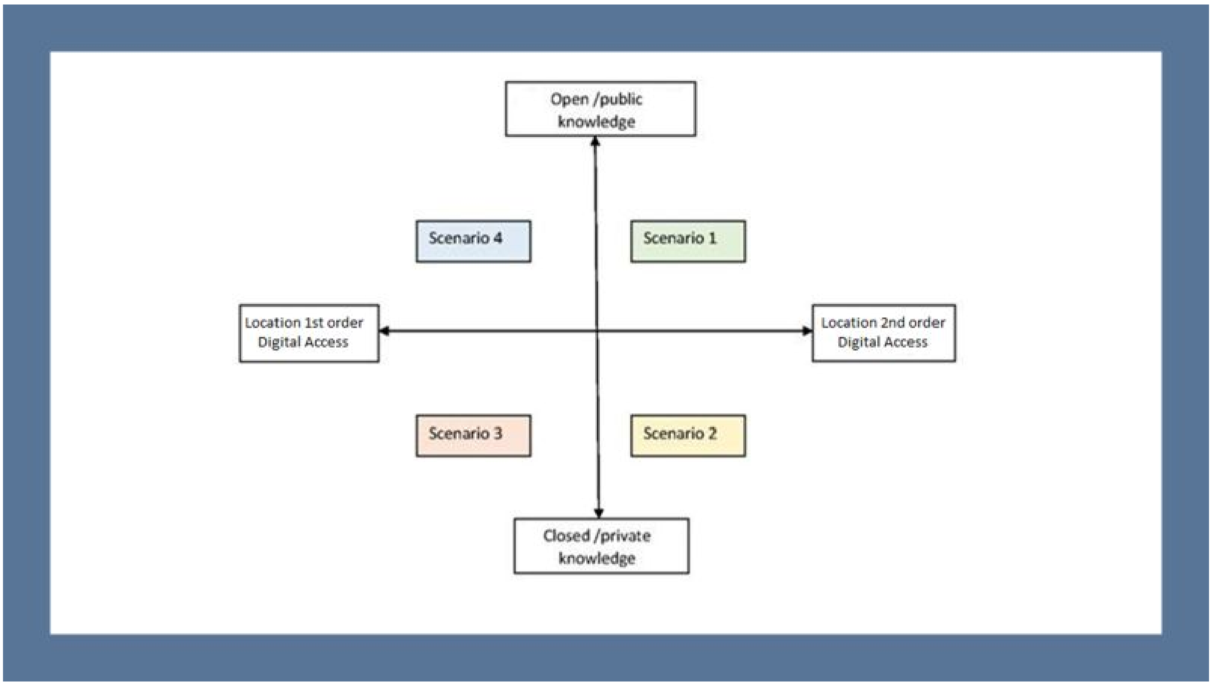
The table below shows the drivers of change for each of the STEEP headings that rated highest in the voting exercise.

SOCIAL	● People living longer driving changing employment and needs to work ● The increasing need for high quality post graduate education to be available to parts of the developing world – demand already outstrips supply in terms of f2f learning ● Increase of digital natives within workforce
TECHNICAL	● Virtual and augmented reality ● Artificial intelligence ● Automation and machine learning (leading to more leisure time) ● More personalisation
ECONOMIC	● Changing skills needed in a digital economy ● Change in economic balance across the globe ● Change in types of jobs
ENVIRONMENT	● Changing job market ● Climate change impacting migration of people from different parts of the world ● International standards e.g. pedagogy ● Less space for physical buildings e.g. in Universities, difficulty in accommodating students in traditional classrooms
POLITICS and GOVERNMENT	● Nationalism, and rise of this in the West ● Developing countries trying to catch up with new trends in education, via creating partnerships with western organisations ● Private businesses have become the worlds' powerful with governments becoming weaker and less relevant ● Decline of neoliberalism

B1.2 Developing Scenario Narratives

Following the identification of key drivers of change, the participants were now invited (in groups) to develop different scenarios expressed as narratives or stories describing how the future might look in 2028.

The '4-quadrant method' for developing contrasting scenarios was selected as the tool for developing four scenario narratives. This requires selection of two axes drawing on drivers of change that have high levels of uncertainty. The variables for the two axes illustrated below were proposed by the workshop facilitators.



As shown in the diagram the axes selected represented the following variables:

- **Horizontal**: Location was used as an alternative geographical descriptor to 'developing' and 'developed' country' differentiators as it was noted that in most countries digital access is now uneven, with some of the population having 2nd order digital access i.e. fast affordable services and skills and income to enable effective use of many online services, and others struggling (whether or not they have a mobile phone) to get or afford basic access and lacking skills or literacy to make effective use of digital technology they can access. Students with digital access could be anywhere on this range.

- **Vertical**: This axis contrasts the nature of intellectual property, which can be a free publicly available good, or owned by private individuals or private sector organisations under copyright or patent legislation. In the latter case knowledge is only accessed at a price determined by the market. Creative commons licences provide a range of licences which are closer to the centre where ownership is protected in different ways, but users can have free access and some rights to change and adapt materials.

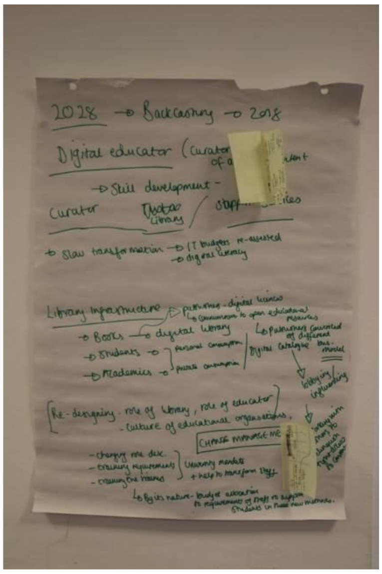
With reference to the drivers of change, and the inputs reflecting diverse perspectives from earlier discussions, the four groups of participants developed potential narratives for each of the quadrants, which are introduced below.

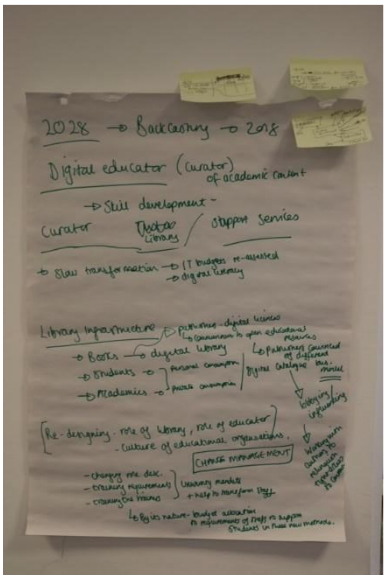
B2 The Four Scenarios

Participant groups took slightly differing approaches to developing their scenario narrative, and due to time constraints, there was variation in terms of how developed the narratives had become. Nevertheless, valuable insights were generated, and in this report these narratives have (to an extent) been further developed based on the workshop material, with the help of some of the workshop participants. Every effort has been made to stay true to the ideas generated at the workshop, though group participants may well have diverging views on how well this has been done!

Scenario One – Open/Public Knowledge with location characterised by 2nd Order Digital Access

Title: Digital Heaven - too good to be true?





It’s surprisingly difficult to distinguish people in this 2018 scenario, as we all have such good access to technology, knowledge and education. A lot of divisions and inequities have dis-appeared, and most people have a great range of choice - somehow the anticipated dominance of major private sector tech companies and oppressive regimes hasn’t materialised, but they still carry significant influence. Perhaps, some of this change started in the 2016 USA elections and the uproar that started going back to the Cambridge Analytica scandal. Wikileaks and advocates for a more free, transparent and open world somehow garnered a lot of support, despite a temporary rise in Nationalist / protectionist regimes that started to wane around 2023.

So, what is life like for us in this unlikely digital heaven? Well maybe not everyone inhabits this place yet (and some don't even like it!) but it's hard to see beyond our situation (even if it maybe a bubble).

We now have open access to content that is available to support all kinds of education - degree courses, CPD, and subjects of personal interest, and importantly we all benefit from affordable high-performance technology with a great infrastructure that is open and fast and where broadband is freely available, and high speed mobile technology is embedded in a range of innovations and gadgets that can support learning.

These days we benefit from a lot of innovation in relation to technology and pedagogy. Here are just some that come to mind:

- There is multi-platform curation of course content though 'plug-ins' and application programme interfaces (APIs)
- AI, Machine learning, AR and VR have been gradually introduced and really enhance the nature and speed of feedback and student support
- We have increasing access to open source content that even feeds into closed degree (more expensive) course content making even the high-end courses more affordable
- As students we can switch between platforms accessing dynamic course content that branches off to specific content on other University VLEs
- Course content is in effect 'MOOC-like' and provided as definitive chunks of learning in a particular area. There is no need for hard copies of learning materials to be provided by Universities or commercial partners who may be driving the way education is conducted
- Student communication tools are dynamic and respond to student behaviour. Students can instantly talk to one another, even across language barriers, through a range of communication tools accessed through APIs
- The role of the librarian has changed a lot. Librarians have great ICT and curation skills and play a significant expert role with others in conducting educational activity, and in creating packages of content rather than designing new programmes. They help to shape and define what the content of the course is rather than being restricted by licences. They also provide guidance in how these services are accessed and have improved the provision of information and digital literacy to anyone who need it.
- There is a range of payment options that make accessing education flexible and accessible. These range from pay as you go (modular approaches), to subscription models
- The student experience is increasingly influenced (some would say governed) by metrics which track student behaviour, satisfaction, confidence and achievement. This data informs University strategy, and course content is being dynamically improved and enhanced to respond to student metrics

Digital educators see their role as curators of academic content. To reach this point over the last 10 years there has been a strong focus on change management, requiring changing role description and the re-designing role of library, educator, and culture of educational organisations to enable them to become more open and equipped in terms of digital literary. This at times slow transformation has been helped by a reassessment of IT budgets, and a commitment to skills development for digital educators/curator, library and support services. The change process has benefitted from budget commitment and a clear sense of training needs, met through a training of trainers approach, and high level mandate to transform staff in the new methods needed to support students.

The library environment and infrastructure has also developed. Digital literacy needs are being met, and digital licences provide rapid connection to OERs and catalogues from different publishers who operate a range of business models. This process is more seamless these days, but one drawback is that publishers remain powerful and so there is an ongoing need to lobby and influence and work closely with others to get them to relinquish tightly controlled access to content ranging from published articles, books, datasets to those that are in the processing of research including research tools, methods, lab notes and instruments/equipment.

Comments on the role of Digital educator and Universities:

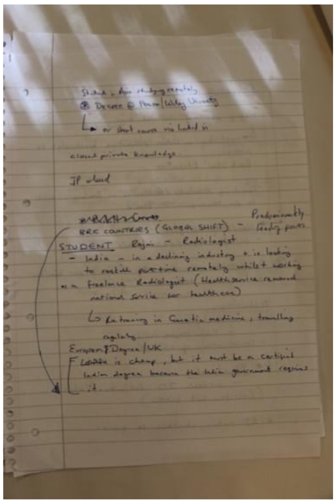
In this scenario upskilling is required to raise digital education to a very high level and this permeates across all roles, that digital educators undertake. Universities become experts in curatorial aspects and need the ability to deliver rather than create. They focus on platforms, and how content is delivered, shared, used and reused. The challenge is to develop the style of learning to a global audience in order to get to this point where participation is frictionless from all sides of the platform (producers and consumers).

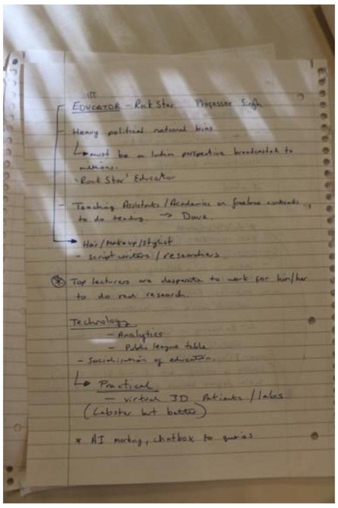
Note: If all new knowledge is open licenced, where is the Universities' or author's value?

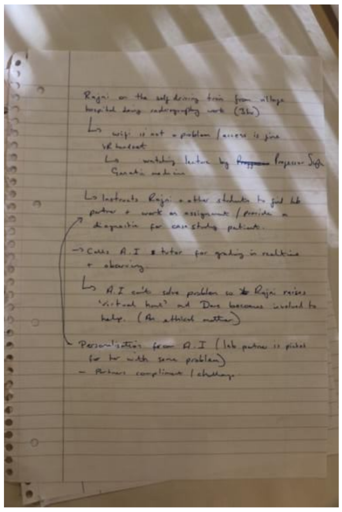
Scenario Two – Closed/Private Knowledge with location characterised by 2nd Order Digital Access

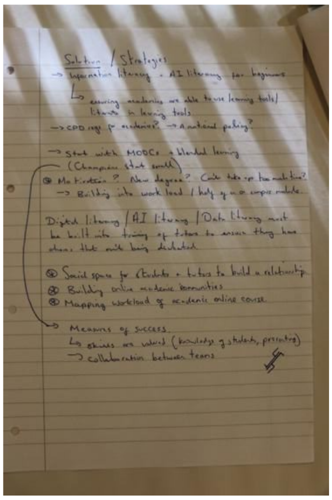
Title: The Rising East and 'Rock star' Gurus

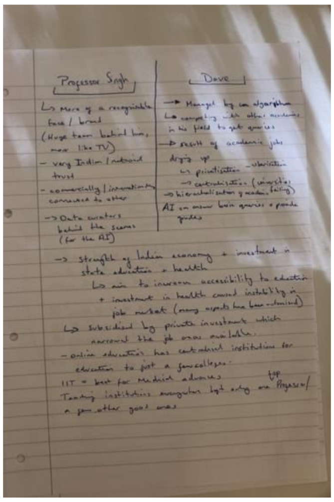
We envisioned an imaginary future in 2028 where the economic advancements of the BRIC (Brazil, Russia, India, China) countries and the over nationalisation and privatisation of the western world has seen countries such as India become predominant global leaders in distance learning and the UK as a sort of aid to this success.

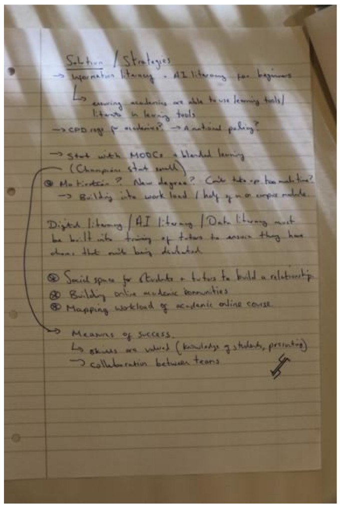












Due to the weakening in value of the British degree, Indian practitioners and professionals require potential job candidates to have degrees from a certified Indian institution.

Rajni is a freelance radiologist in Mumbai working in several hospitals in the Mumbai City District. With the boost of the Indian economy and the recent heavy investment in state education and health, Rajni is no longer required to work full time in the radiology department at one hospital. To keep her job in medicine, Rajni has decided to retrain and embarks on a degree course in Genetic Medicine through the Indian Institute of Technology. She works full time and due to her long travelling schedule tends to study and complete elements of her course on the train. The growth and demand in retraining has led to an increasing need for online education and due to heavy nationalisation, this has subsequently lead to institutions being centralised to just a few ‘renowned’ colleges.

The centralisation of institutions has also led to people putting their trust and faith into a select few academics. In the growing age of YouTube and Instagram stars/influencers, Professor Singh has become the ‘David Attenborough’ of Genetic Medicine and therefore all the main lectures at IIT are given by him. He is the ‘recognisable brand’ for genetic medicine and has a huge team of people working behind him (writing the scripts, teaching assistants preparing the programme, researchers, camera crew, cosmetic details such as hair/makeup).

Top lecturers and academics are desperate to work for his team to do the latest research in that field.

The course is taught online through a series of lectures, interactive quizzes and practice test questions, and VR headset (virtual 3D) patient/lab sessions. Students are assigned a lab partner for each assignment which is determined by their grades, personality type and where they are on the student ‘league table’ (for example, a struggling student may be assigned with a stronger student to help them improve their grades). All the grading and marking is completed by Artificial Intelligence (AI) and there is an automated chat bot system to answer general student queries.

Unbeknownst to students such as Rajni, when she asks the system a question that requires a sensitive or personable answer, she is immediately put through to an academic specialist in the field of genetic medicine who then works with her to help answer any complex queries or concerns.

This is where Research Assistant Dave comes in…Dave works a remote nightshift in South West London with several universities across Asia on their online degree programmes. He answers complex student queries and monitors student lab sessions from numerous computer monitors at home. After nationalisation in the UK and the privatisation of the higher education sector (and medicine), many European academics saw value in becoming freelance/self-employed and chose to provide their academic services remotely to renowned universities in other parts of the world.

Dave's workload is managed by an algorithm and he is competing with other academics in his field to be sent through as many queries as possible. Here we see the 'uberisation' of academia, whereby academics are paid per student for each query that they successfully solve. Luckily for Dave, he is very knowledgeable and good at his job. His new work/balance lifestyle ensures he can take his kids to school in the morning and complete a bit of research on the side before working through the evenings.

So let's now imagine Rajni on the intercity train back to the suburbs of Mumbai after a day spent doing radiography work. Wifi is not a problem, and she has enough power to access the virtual lab via her VR headset.

After watching a lecture by Professor Singh, Rajni is instructed to go to the virtual lab with Riya, her lab partner, to work on an ongoing assignment and provide a diagnosis.

Rajni is provided with some personal information regarding the 'patient' and raises here virtual 'hand' to ask the AI system a question (who is in the meantime is providing her with real time grading and observation).

The AI cannot answer the query and Rajni is therefore immediately directed to Dave who steps in to help. Rajni and her lab partner are pleased with the help Dave has provided and at the end of the lab session provide him with a 5-star rating, which automatically bumps him up the queue for further student queries.

Desirable strategies

If this scenario is the world we envisage, then

- Ensuring that academics have 'information and AI literacy' when it comes to distance learning. There is transparency in the AI algorithms that are used.
- Ensuring that academics are already becoming familiar with online learning tools and are confident in using and understanding these tools.
- Start this process with MOOCs + blended learning (should CPD regs for academics be a national policy?)
- Online platforms should provide a social space for students and tutors to build relationships and trust.
- Academic workloads should be mapped online
- Measures of success should be identified through skills (knowledge of students)
- Teams within academic institutions across departments should collaborate and share knowledge (academics in sciences and B&M working with those in social sciences and humanities)

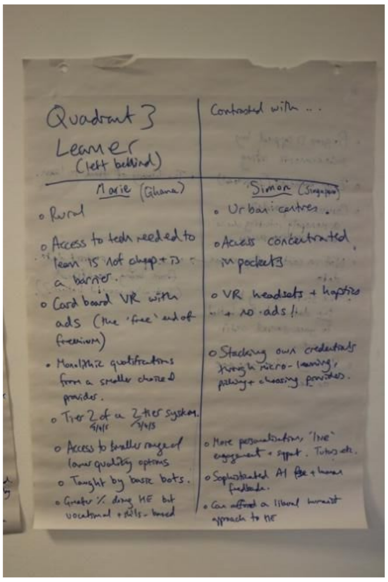
Comments on the role of Digital educator and Universities:

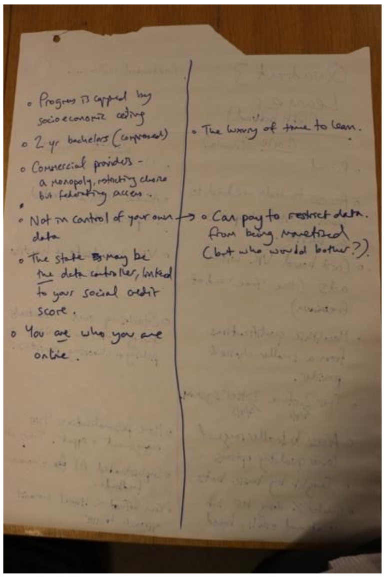
Academic careers will still be needed in this scenario so 'don't build structures/ways of working that damage the profession'!

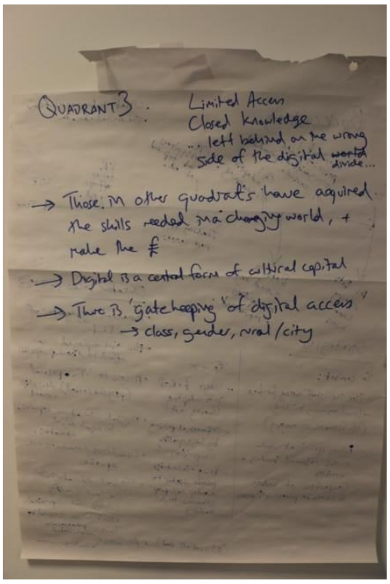
Technology provides sophisticated data analytics to mediate between students and tutors, to make the best use of tutors/academic's time. It remains important to retain student/tutor relationships that are personal. VR provides a (sophisticated) simulation, that could be important in online education, but it is expensive

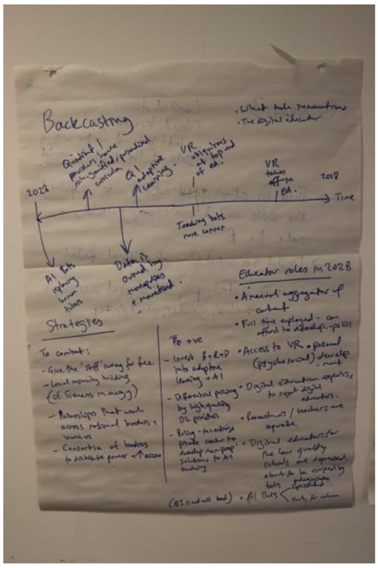
Scenario Three – Closed/Private Knowledge with location characterised by 1st Order Digital Access

Title: The 'Bot'tom Line









This scenario is characterised by inequity. Let's explore some of the characters.

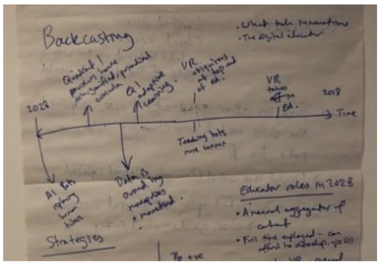
Firstly, meet Marie in Ghana. She lives in a rural community, her access to technology is not cheap and this is a major barrier, but she has a need to learn. The way she accesses online learning is at the 'free end of the freemium business model' so she is constantly bombarded with customised highly targeted adverts. She has access to card based virtual reality and can choose from a monolithic range of qualifications offered by a very small choice of providers. There is also access to a much smaller range of lower quality options ‘taught by basic bots’. Most students in her position are engaged in Higher education but where the focus is on vocational skills

Contrast Marie with Simon in Singapore. He lives in an urban centre where the best digital access is concentrated in pockets. He can access online education using VR headsets and haptics and he doesn’t have to be disturbed by any adverts. Over time he is stacking his own credentials through micro-learning, and carefully picking and choosing providers. His learning context is personalised, with live engagement and even additional support through human tutors. His learning experience is enhanced by sophisticated AI and human feedback, and he can afford to take a liberal humanist approach to HE.

Simon has the luxury of time to learn and can pay to restrict his data from being monetised (but in practice he is unlikely to bother).

By contrast Marie is left behind on the wrong end of the digital divide and her progress is capped by a socio-economic ceiling. She is on a 2-year compressed bachelor’s degree course. Commercial providers have a monopoly but are restricting choices and federating access. She has no control of her own data, and in effect you are defined by what the data says about you and what you are capable of ‘online’. The state may be the data controller, and despite progressing her education, the online data is used to generate a ‘social credit score’ which constrains what jobs you are qualified for.

In this 2028 scenario there is gatekeeping of digital access, which divides people by class, gender, rural/city. Digital has become a central focus of ‘cultural capital’. Those who are digitally empowered are those who have acquired the skills needed in a changing world and who make the £s!



This all started to happen in 2020 when VR took off in education. By 2023, teaching bots were becoming more common, and VR was by now ubiquitous at top (expensive/elite) end of education. By 2028 the AI bots had more or less replaced most human tutors, and data had become owned and monetised by monopolies. The winners in this scenario has rich gamified personalised curricula and impressive systems that support adaptive learning.

By 2028, research and teaching roles are separate, and the ‘digital educator’ role has become that of a manual aggregator of content. Digital educators for the low-quality schools are by now very depressed and about to be usurped by ‘bots’ but looking at the positives AI bots are not all bad – they are pedagogically sophisticated and can handle high volumes of work/students. Full time employed ‘digital educators’ can afford to develop and upskill, and an important role has emerged for ‘Digital education experts’ to support digital educators. Access to VR is supporting personal psychosocial development.

Desirable strategies

If this scenario is the world we envisage, then there are clearly some negatives to try to combat and this could be done by:

- Giving educational resources away for free, e.g. open educational resources
- Local capacity development cf Siemens in energy
- Developing partnerships that work across national borders and barriers related to location
- Supporting consortia bodies to distribute power and increase access

There are also strategies to support positive outcomes in this scenario:

- Invest R&D into adaptive learning and AI
- Support differential pricing models for high quality DE providers to promote access
- Policy incentivisation to private sector to produce non-proprietary solutions to AI teaching

Comments on the role of Digital educator and Universities:

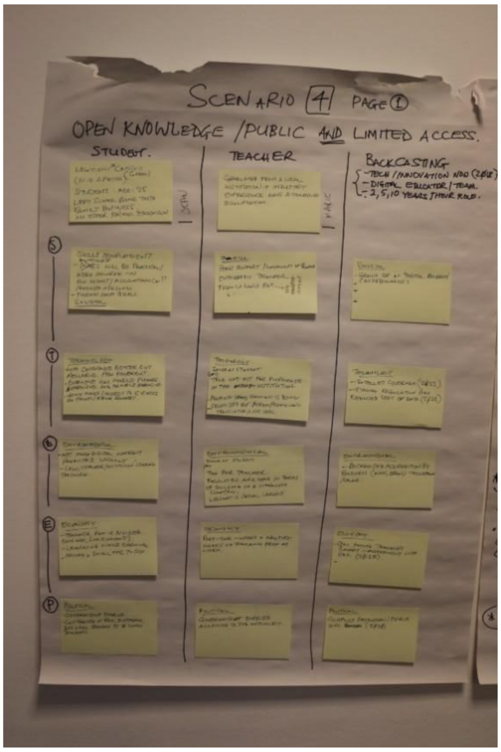
At the low end, digital educators are manual aggregators of content, whilst at the high end there is a need for personal development, and a role for experts. So, there is a spectrum of roles. This is the current situation for much of the world today. There is an ongoing role for responsible providers to maintain high quality and affordable education.

This suggests there is a need to find effective ways of facilitating learning without lots of contact. This requires collaboration and a learning environment that scales and doesn't require a lot of tutor input. Consider use of VR to grow provision and access and invest in adaptive learning approaches.

Scenario Four – Open/Public Knowledge with location characterised by 1st Order Digital Access

Title: Everything in time

(Things are gradually opening up and localising!)



Jean is a student aged 25 who lives in Kinshasa, the capital of the Democratic Republic of the Congo. She left school with no formal education to go into the family business. Many of her friends have qualifications so she has decided to take an online course produced in DRC which provides a practical introduction to Financial Management and accountancy.

The wi-fi coverage is better than it used to be, so is quite reliable these days and there are far fewer power-cuts than in the past. These days everyone has a mobile phone, but these are expensive and data for mobile remains expensive. Phones and eBook readers are also being used to access MOOCs and e-books. Local teachers and institutions are leading the course that Jean is taking but there is not much digital content produced locally. Pay for teaching is mixed with some reasonably well paid and others not. Most people are also in a situation where they also have to learn while they are earning, and when they study they need to pay a small fee to the Government

The Government itself is quite stable and they have contracted the 'Edz' platform who provide MOOC courses with the local teaching by DRC teachers. The teachers graduated from a local institution and have some industry experience and a teaching qualification.

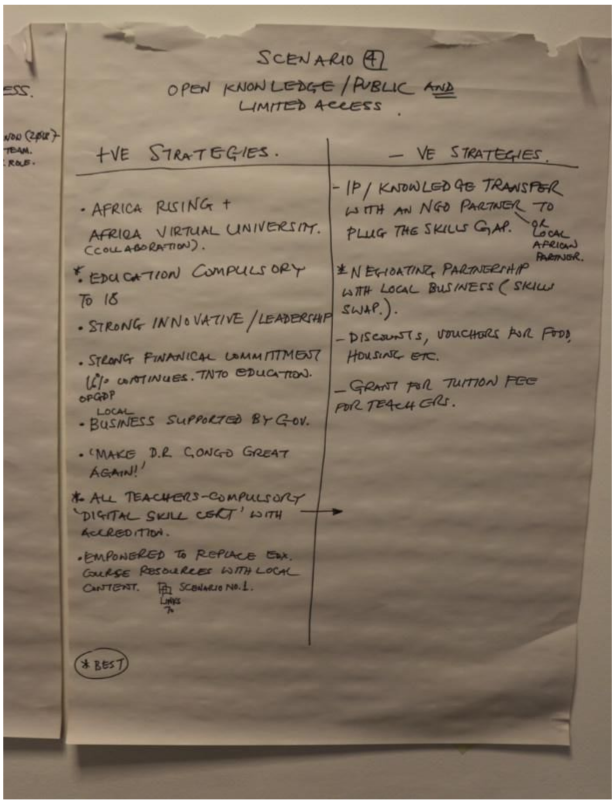
Jean benefits from some peer support from fellow students, as do the teachers who are enthusiastic and take part in a community of practice, but they do struggle with not having enough time. They have to work part time in different industries and work on teaching preparation while they are employed in other work. They teach and learn in French language which is auto translated by an app linked to ‘Edz’.

Technology is not particularly fit for purpose, but machine learning is being promised and it will take more time for African/French languages to be translated 100%. The library is largely virtual these days with few hard copy books. Facilities generally are good, in terms of the building provided in a warming country.

Technology innovation was already evident in 2018, and many people grew up as digital natives/residents since 2020, and by 2023 there was good satellite coverage and strong regulation relating to the cost of data. Digital education has become more and more team based. By this time there was also recognised accreditation by business accepting the value of open education and MOOCs. Governments have been trying to pay more towards teacher’s salaries but this is taking time. In the short term a salary agreement contribution from EdX has been introduced in 2025 which is progress. Since 2020 the country has also become far more stable politically benefitting from effective conflict resolution processes.

Desirable strategies

If this scenario is the world we envisage, then are a number of positive strategies that can help enhance the good progress being made in DRC:



- Education should be made compulsory to 18 years old
- Strong innovative leadership needs to be encouraged
- Strong financial commitment to Higher Education needs to be promoted
- The country should be empowered to replace ‘Edz’ course resources with local content
- All teachers should have a compulsory digital skills certificate with accreditation
- Collaboration with Africa rising, and Africa Virtual University should also be encouraged to promote relevant courses and content

To reduce negative aspects of this scenario, DRC needs to consider:

- Intellectual property / knowledge transfer with an NGO partner or local African partner to plug the skills gap
- Negotiating partnerships with local business (e.g skills swap) will enhance employability of students
- Discounts and vouchers for food, housing etc will benefit those who need to find more time to teach and study
- Grants for tuition fees to cover the cost of teaching need to be considered

Comments on the role of Digital educator and Universities:

Digital education is benefitting from disaggregating academic and other roles and this is leading to more team-based approaches. MOOCs have become more relevant and useful due to repurposing of local context. There is more involvement of local people and organisations from the local context in developing and delivering courses and there is more choice of modes of delivery. Digital literacy upskilling is particularly relevant.

B3 Strategies for achieving (more) desirable outcomes

Following the group work on the four scenarios, the participants were invited to identify whether strategies that worked well to strengthen positive outcomes for other scenarios, and reduce negative ones, would work or not for the other three scenarios. They could respond by saying they would be 'robust', would 'need modification' to be useful, or they 'wouldn't work'.

The 'top five' strategies that came out as having the most potential to benefit other scenarios were as follows:

Beneficial to all four scenarios:

- Speed up change process within institutions – invest in change management, and skill set development.
- Build relationships with other providers, e.g. publishers, who can support the vision for a digital education future in 10 years' time.
- Find 'win wins' for the educators, educated, Universities and 3rd parties. Data can play a role. This can be a driver, which adds agility within a change management process
- Institutions with high quality education give some away free (n.b. this highlights the value of scholarships)
- Digital skills training for teachers supported by accreditation/certificates for all teachers

B4. Conclusions

The workshop provided the opportunity for sharing on a wide range of topics relevant to the future contexts for digital learning. A wide and diverse range of insights were reflected through the activities focussed on:

- Generating headline ideas of future priorities
- Discussion around overview of relevant literature
- Identification of drivers of change

- Development of narratives for contrasting future scenarios

The purpose of the workshop was not to predict the future, or to develop solutions for problems identified, but to create a structured space and set of activities, for gathering this wide range of insights and perspectives drawing in different types of evidence from literature and personal experience.

This was successfully achieved in a short space of time, and it is hoped that this progress report with its focus on the outputs from the foresight workshop will be of value for those with an interest in digital education. It is also an input for the next stages of the CDE 'Digital Educator' project, where a survey will be designed to explore further some of the priority topics coming out of the project draft literature review and from this workshop. After the survey has been analysed a further workshop will take place with key stakeholders to develop a roadmap for skill development for digital educators for the next 2-5 years.

There are many important points and topics that can be the subject of further exploration. The list below is indicative of some of the main themes that came out of this workshop that will need to be explored further to inform the skill development needs of future digital educators are as follows:

- We need to learn to use existing technologies better, making more informed use of what we already have to support improved digital education
- The 'new' technologies mentioned most, which need to be better understood by digital educators are artificial intelligence, machine learning and virtual and augmented reality. In addition, the need for more personalisation was stressed, which implicitly requires effective use of data
- The different scenarios described highlight the need to understand better the future role and needs of academics involved in distance education, and more clearly set out how a team-based approach to support distance learning course design and delivery can be undertaken
- The scenarios also highlight the importance of monitoring geopolitical events and understanding how different business models for HE/DE present new challenges and opportunities for the digital educator.
- This further links to a need for a University to be clear on its values, and how it can promote affordable access to high quality education. Open access approaches need to be understood and integrated in ways that support localisation, and improvement of course relevance and accreditation, without removing the incentives needed by authors and institutions to produce and market quality materials and courses
- The changing nature of jobs (casualisation and the gig economy) need to be understood, and in particular we need to understand how this affects those involved in digital education. Furthermore, we need to recognise the drive to either 'Westernise' or 'Easternise' HE/DE approaches, and consciously reflect and draw on good practices from different parts of the world, in order to remain competitive and cutting edge in relation to digital teaching and learning.

In summary, teams and individuals focussed on design and delivery of digital education, need to have a very good understanding of the tools available to them now and in the future, and also need to assess carefully their aims, and how they may reflect different values in the manner in which they license and use learning materials and explore the scope for wider international or cross-sectoral collaboration

Finally, it is clear that it is important to plan now for the situation in ten years' time, as that is not too far away, and the technologies that are emerging now will be mature by that time.

B4.1 List of Participants Present

Name	Organisation
Jonathon Thomas	University of London Worldwide
Nic Charlton	University of London Worldwide
Gemma Shields	University of London Worldwide
Caroline Tutty	University of London Worldwide
Larisa Grice	University of London Worldwide
Linda Amrane-Cooper	University of London Worldwide
Marco Gillies	Goldsmiths College
Christine Thuranira-McKeever	RVC
Sarah Sherman	Bloomsbury Learning Environment
Sam Brenton	Cass Business School
Sally Parsley	LSHTM
Santanu Vasant	University of East London
Dr. Paul Dudley	Royal Holloway
Meaghan Brugha	Jigsaw Consulting
Jo Fung	SOAS
Nason Bimbe	Independent (formerly IDS)
James Earl- Fraser	JISC
Tony Sheehan	CDE Fellow (facilitator)
Jon Gregson	CDE Fellow / Development Dreamers (facilitator/organiser)

B4.2 Digital Educator Foresight Workshop Programme

9.30am	Arrivals, Senate House
10.00am	'About the workshop', introductions, and 'headline ideas (1-3)'
10.30am	Introduction to foresight methodology and short presentation on challenges and opportunities for digital education (based on ongoing literature review)
11.15am	Tea/Coffee
11.30am	Digital education - Drivers of Change Group Work and feedback from groups
12.30pm	Introduction to scenario group work
1.00pm	Lunch
1.45pm	Developing scenario narratives group work – highlighting the role of the digital educator and digital technologies
3.15pm	Tea/Coffee
3.30pm	Groups share their scenarios in a plenary session
4.00pm	Discussion of key features of a preferred scenario for digital educators
4.20pm	Planning a wider survey – Key 'take aways' for this from the scenario narratives
4.50pm	Wrap up
5.00pm	End of Workshop

Annex C: Digital Educator Survey Report

C1 Introduction

This project team review of related literature (see Annex A of this report) on significant developments in Educational Technology within the medium term (2-5 years) for the HE Distance Learning sector (SOAS, Lead Institution). From this review, possible impacts of innovations on the role of educator and the related specific risks and opportunities were identified. A workshop was also conducted to corroborate the review findings.

This survey was conducted to provide further evidence and to examine the future digital landscape of educational technologies in distance learning *(Ethics clearance from King's College London: MRA-18/19-8428)*. It aims to assess the current readiness of academics employed at UoL Member Institutions (MI) and home institutions of CDE Fellow members. It also aims to assess risks and opportunities for the digital educator. This will allow for the identification of subject areas that need to be focused on to effectively take advantage of future educational digital technologies.

C1.1 Survey participants

Participants were recruited from academics employed at UoL Member Institutions and home institutions of CDE Fellow members involved in distance learning. They were asked to provide demographic information such as: Gender, Age, Academic Position/Role; Discipline affiliation; Geographical locations of their students; Total number of years in teaching.

Forty-eight (n=48) participated in the survey, of which 40% were males and 60% were females. Other demographic classifications were as follows:

- 35% were 45 years old below; 30% were between 46 and 55 years old; and 35% were 56 years old above.
- 73% belong to UoL and MI institutions whilst the rest were from outside.
- 54% were academics and the 46% were non-academics.
- Most respondents were from the UK (96%).
- 39% had been teaching for about 10 years; 21% between 11 to 15 years; 40% has 16 years or more.

C1.2 Survey Design and data collection

The survey contained statements about digital technology functionalities and pedagogical innovations in distance learning. Each respondent was asked to rate each statement which referenced a specific digital technology functionality or pedagogical innovation in terms of the following:

- perceived level of awareness on the digital technology functionality in distance learning;
- perceived level of awareness on the pedagogical innovation in distance learning;
- perceived level of importance on the digital technology functionality in distance learning;
- perceived level of importance on the pedagogical innovation in distance learning;
- perceived level of relevance on the digital technology functionality in distance learning;
- perceived level of relevance on the pedagogical innovation in distance learning;
- perceived level of willingness to adopt the digital technology functionality in distance learning;
- perceived level of willingness to adopt the pedagogical innovation in distance learning

Participants were also asked to give their opinion on two open-ended questions on:

- Perceived threats and opportunities amongst the digital technologies/pedagogical innovations identified.
- Awareness of other digital technologies functionality or pedagogical innovations not specified in the questionnaire

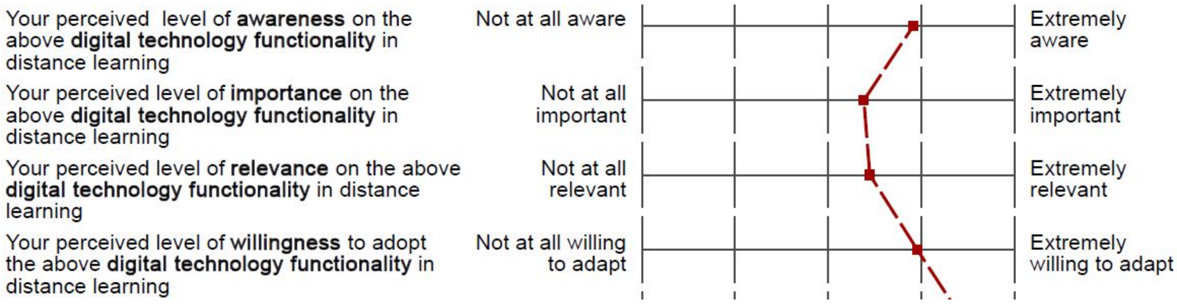
The different technologies considered in the survey were informed by the review conducted by the project team and these are: Mobile devices/apps; social media; artificial intelligence; virtual reality; learning analytics. From the Review Report (Annex A above) some of the technological functionalities corresponding to these technologies were identified, as well as pedagogical innovations.

C2 *Some descriptive results*

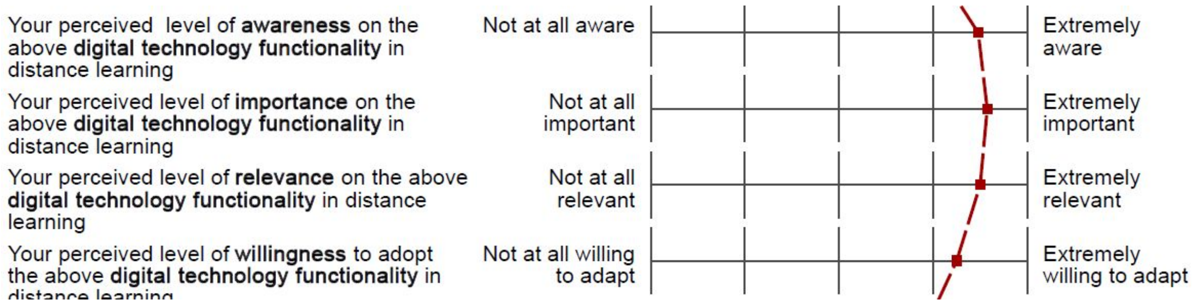
Descriptive results are presented in the figures shown below.

C2.1 Mobile devices functionality and pedagogical innovations

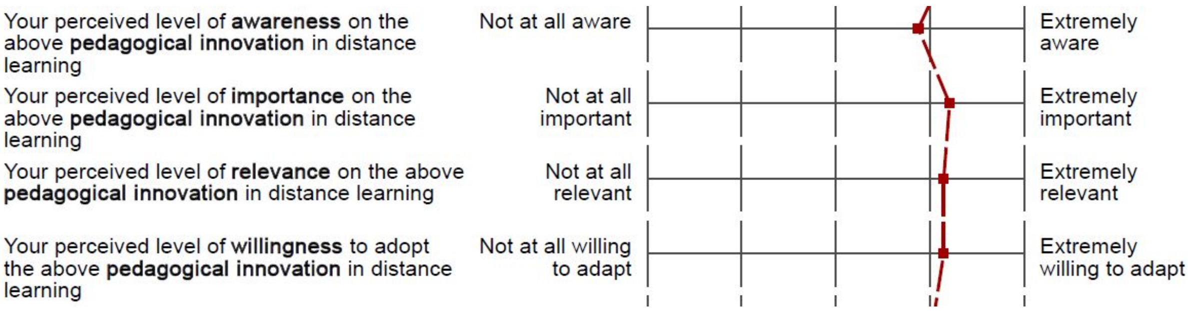
Mobile devices functionality: Mobile devices have applications that are being used as voting systems that support lectures whether face-to-face and online.



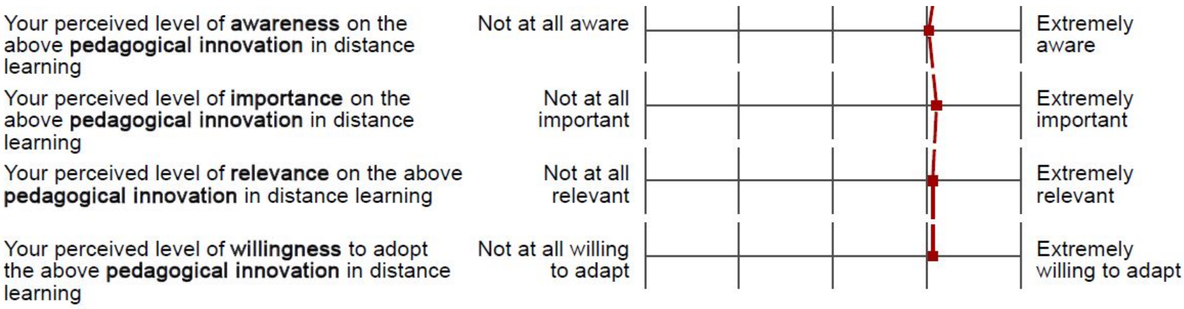
Mobile devices functionality: Mobile devices allow course material to be provided in mobile-compatible format allowing students quick, flexible and full-time access.



Mobile devices pedagogical innovation: Mobile devices can provide different applications to engage students in learning.

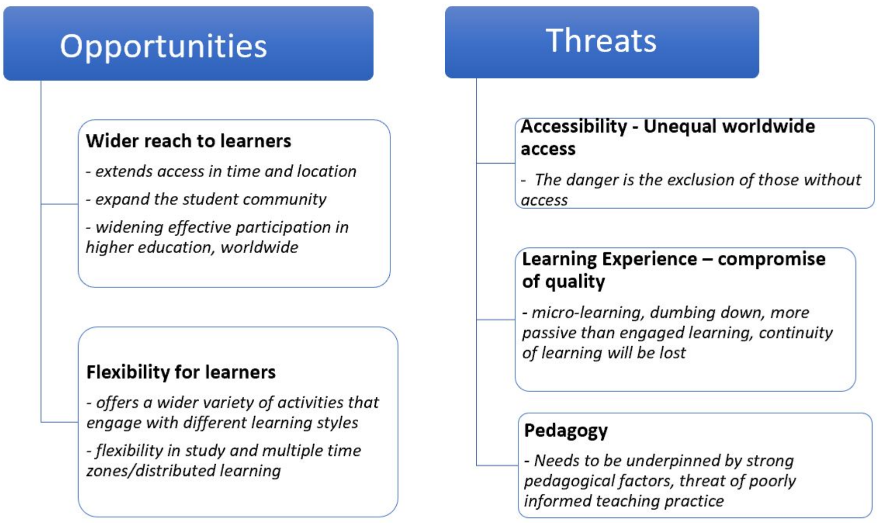


Mobile devices pedagogical innovation: Mobile devices support micro-learning by supporting the provision of course material in small discrete chunks.



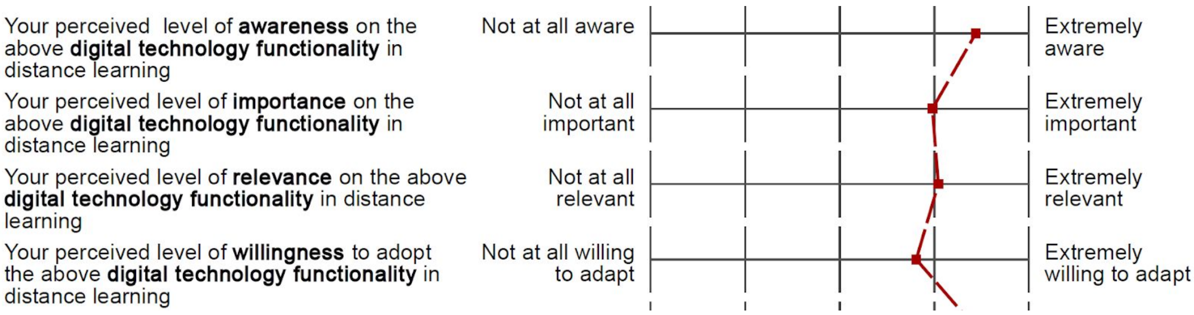
For mobile devices, almost responses to the questions about perceived; awareness, importance, relevance and willingness to adapt to various digital technology functionalities and pedagogical innovations were positive. However, respondents seemed to perceive that mobile devices used as voting system functionality to be shifting towards only somewhat important and somewhat relevant.

The comments on the open question on threats and opportunities suggested a good awareness of mobile technologies and associated pedagogies. Their flexibility and wide reach were perceived to offer opportunities. The threats posed by mobile technologies and pedagogies were around issues of unequal accessibility and a lack of strong pedagogies underpinning the use of these technologies.

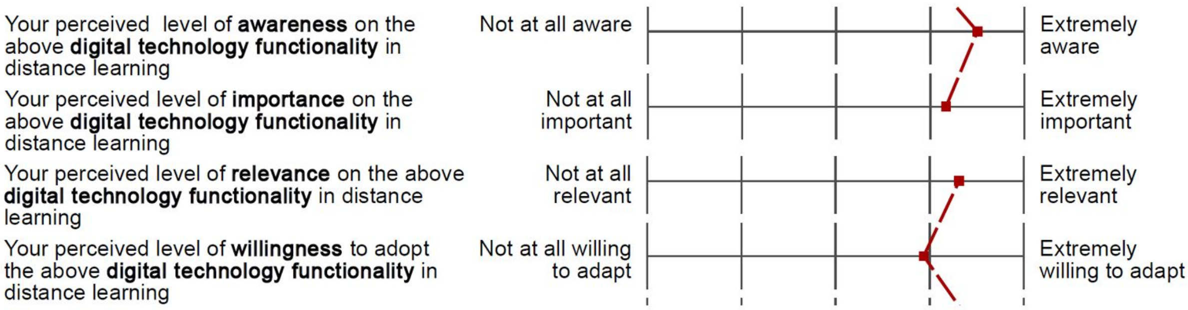


C2.2 Social Media functionality and pedagogical innovations

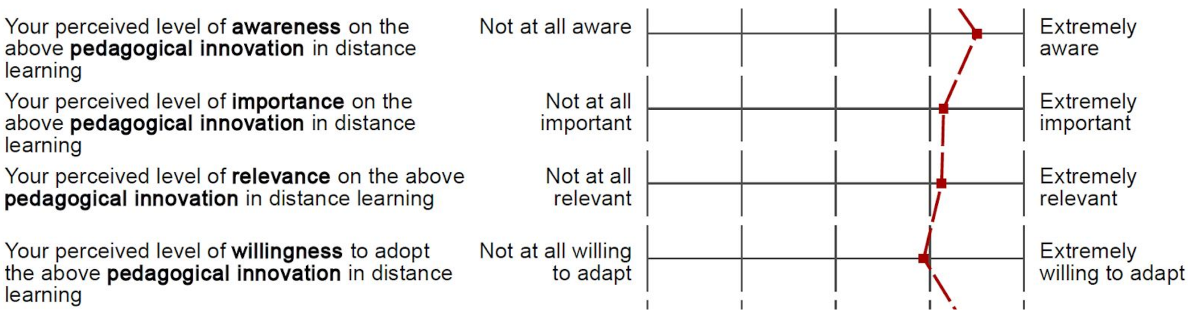
Social media functionality: Social media allows students to exchange conversations online in a flexible, self-regulated way.



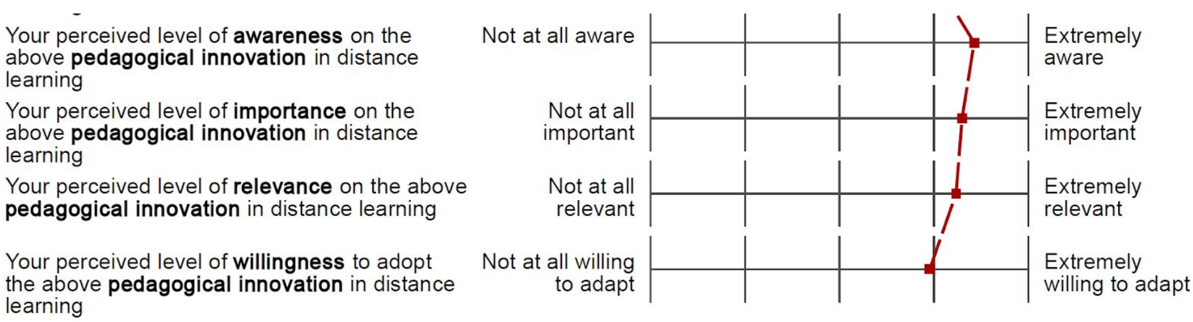
Social media functionality: Social media applications allow users to create and share online informational content (e.g. lecture videos on YouTube)



Social media pedagogical innovation: Social media discussion forums create student peer learning opportunities



Social media pedagogical innovation: Social media provides students with opportunities for learning through online interaction with each other



For social media, responses to the questions were almost all extremely positive, about perceived; awareness, importance, relevance and willingness to adapt to various digital technology functionalities and pedagogical innovations.

The opportunities that were strongly identified around the use of social media were centred around the possibilities these technologies offer for learner interaction and the creation of study communities. Respondents also identified a number of threats; key amongst these were the strong potential for abuse and misuse, difficulties around moderation and unequal access for users in different locations.

Opportunities

Learner interaction and creation of study communities

- *I welcome the use of social media for online discussions, creating and sharing content*
- *....create the sort of working / study communities that face to face students do*
- *Opportunity to network , support learning and advance learning is a huge opportunity*

Threats

Misuse, abuse, cyber-bullying & exclusion, no moderation

- *potential for bullying, mistaken understanding. Monitoring is essential*
- *would have to be boundaries in place to ensure discussions are facilitated/monitored to ensure positive interaction*
- *risk of bullying and exclusion*
- *lack of control and regulation by the academic*

Accessibility

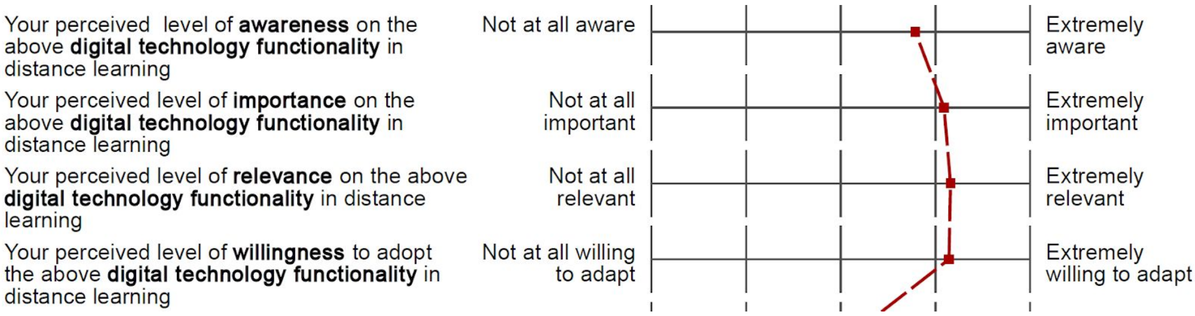
- *not available everywhere in the world, unregulated..*
- *different countries use different social media*
- *inequity of access for some students*

Cheating/collusion/illegal data transfer and sharing

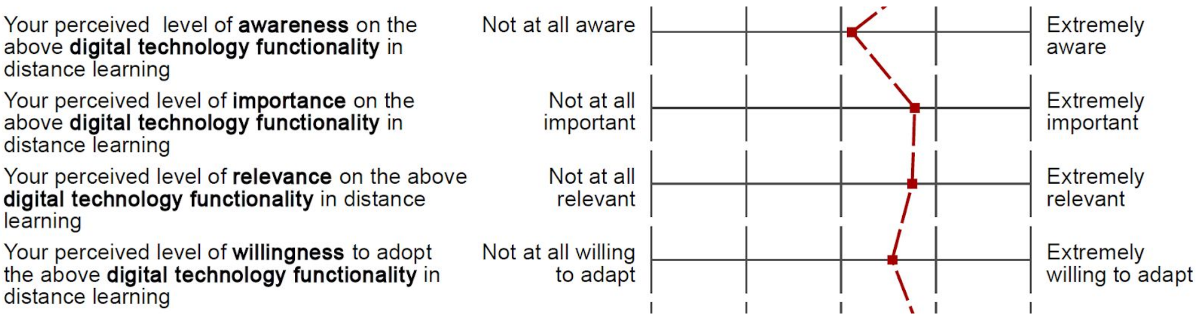
- *plagiarism*
- *data ownership & sharing is obfuscated*
- *already had an examination breach with a WhatsApp group*

C2.3 Learning analytics functionality and pedagogical innovations

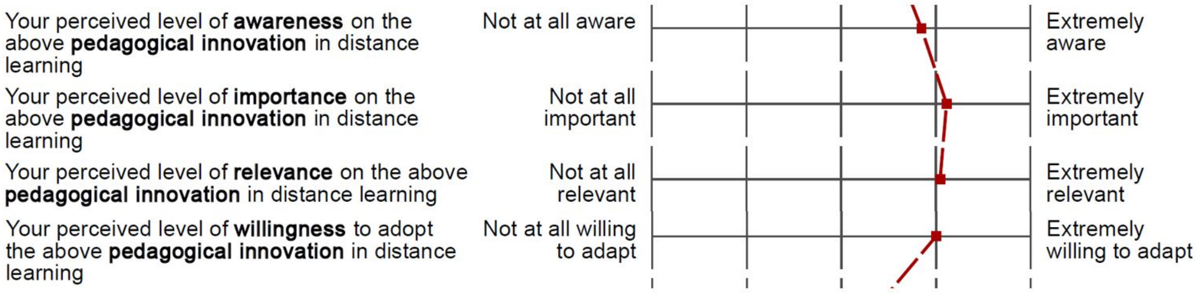
Learning analytics functionality: Learning analytic application are available to monitor learner online activity.



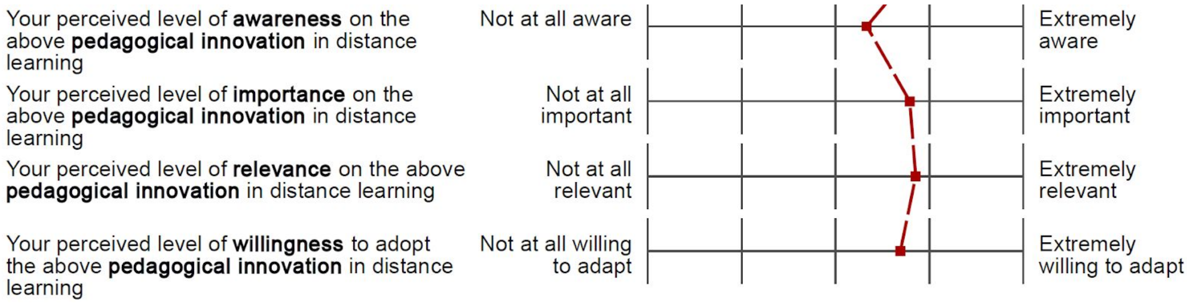
Learning analytics functionality: Resources are available to create packages of content rather than having to design new programmes.



Learning analytics pedagogical innovation: Learning analytic metrics are available to monitor student progress.

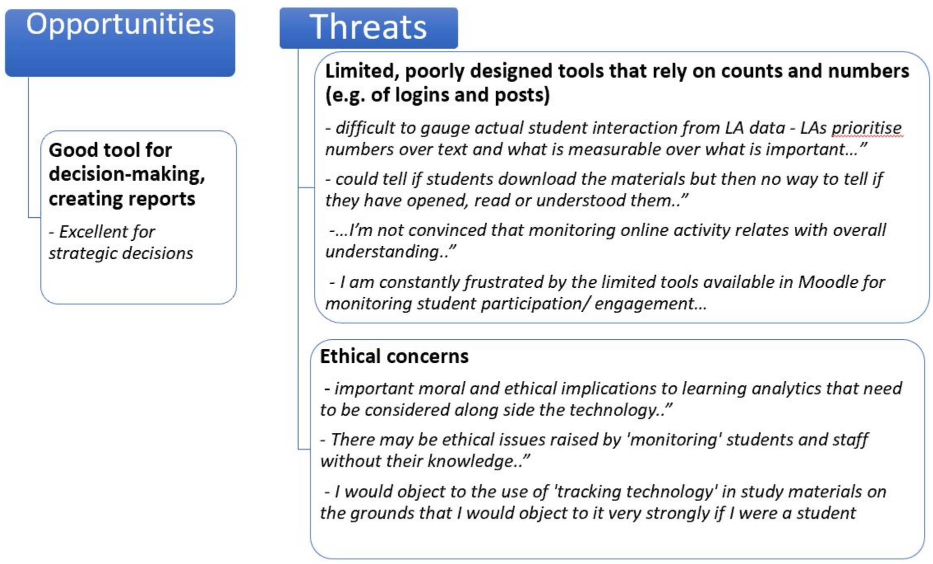


Learning analytics pedagogical innovation: Learning analytics provides personalised learning experience online.



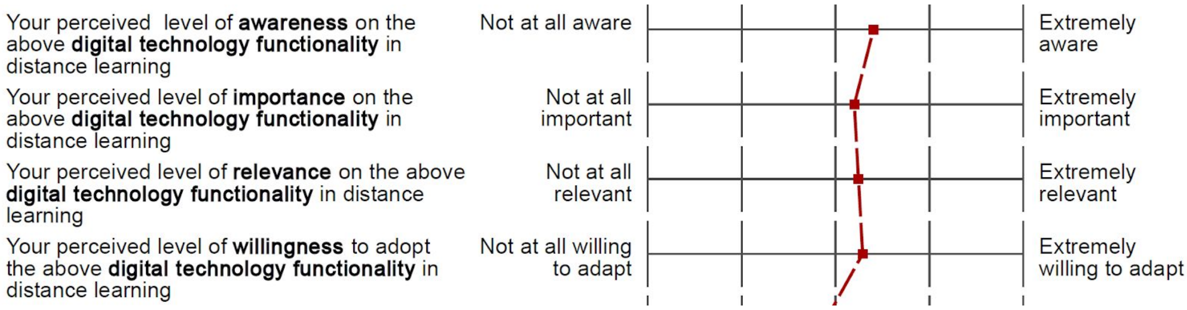
Compared with mobile devices and social media, learning analytics is not yet mainstream. Surprisingly, responses to the questions were almost a positive, about perceived; awareness, importance, relevance and willingness to adapt to various digital technology functionalities and pedagogical innovations.

The open comments on opportunities around learner analytics mainly recognise the technology as offering a good tool for decision making and creating reports. The threats identified were around the issues of design and how far the existing technologies go in terms of being useful for measuring important indicators in student performance.

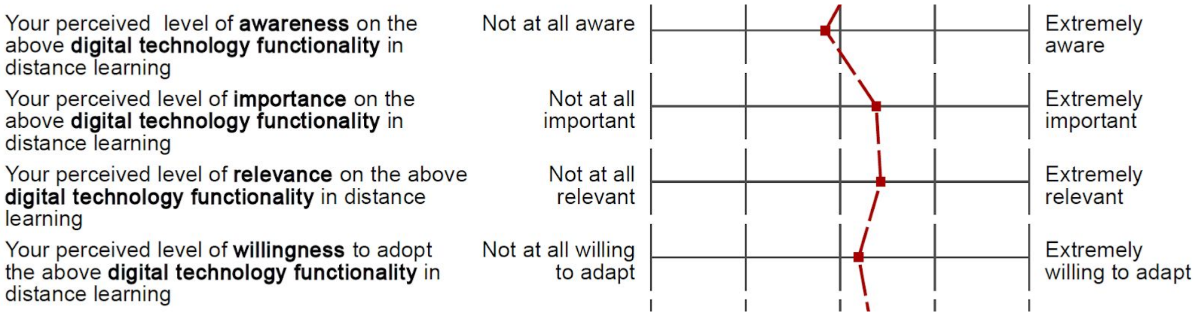


C2.4 Virtual reality functionality and pedagogical innovations

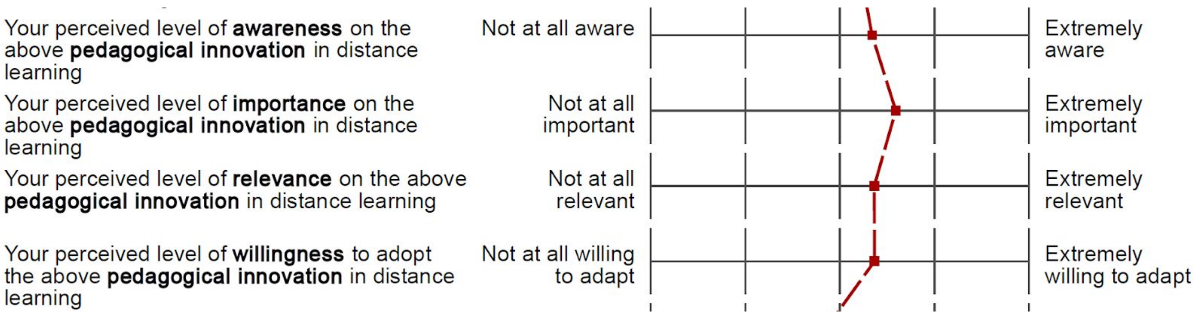
Virtual reality functionality: Virtual Reality headsets allows users to experience 3D world applications.



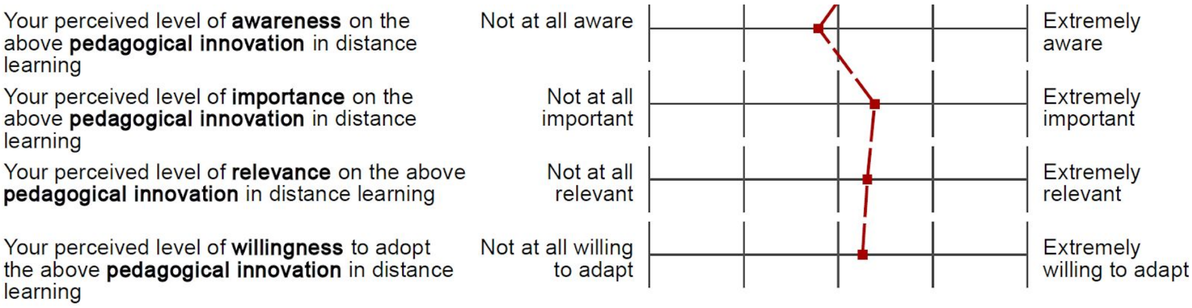
Virtual reality functionality: Virtual reality with haptics (Virtual touch) is available for teaching students at a distance train certain manual dexterity, for example, on concepts where touch feedback is important (e.g. feeling texture of materials).



Virtual reality pedagogical innovation: Virtual reality headsets provides' a platform for students to gain a greater understanding of a learning topic that cannot be taught in the traditional classroom setting.

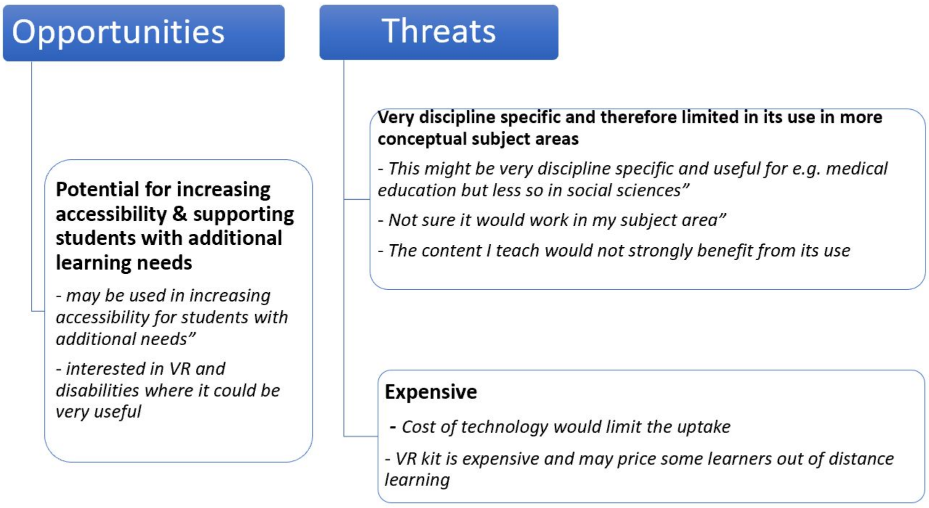


Virtual reality pedagogical innovation: Virtual reality with haptics enable multimodal learning including touch.



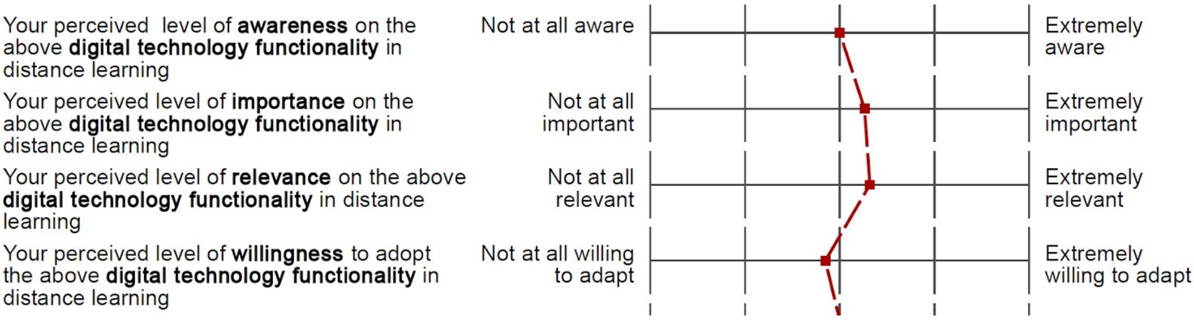
Virtual reality is not yet widely used in distance learning. So, it is not unexpected that responses were shifting towards the middle rating. Responses to the questions for virtual reality were somewhat neutral about perceived; awareness, importance, relevance and willingness to adapt to various digital technology functionalities and pedagogical innovations.

The open comments on opportunities and threats in virtual reality demonstrated that this is technology that is still not widely used. Respondents felt that the cost of the technology was a limiting factor in its uptake, and makes this technology inaccessible to most learners. There was also a strong view that it is a technology that is generally suited to some subject areas more than others.

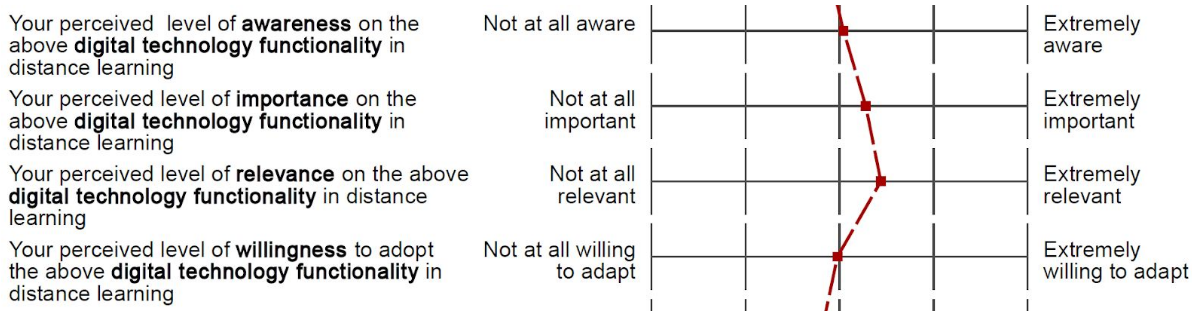


C2.5 Artificial intelligence functionality and pedagogical innovations

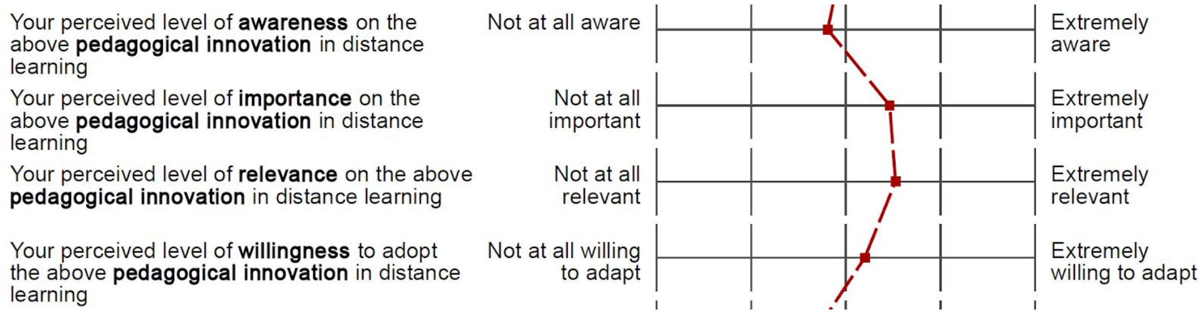
Artificial intelligence functionality: Artificial Intelligence technologies (e.g. automatic grading) have been used to provide feedback faster than before.



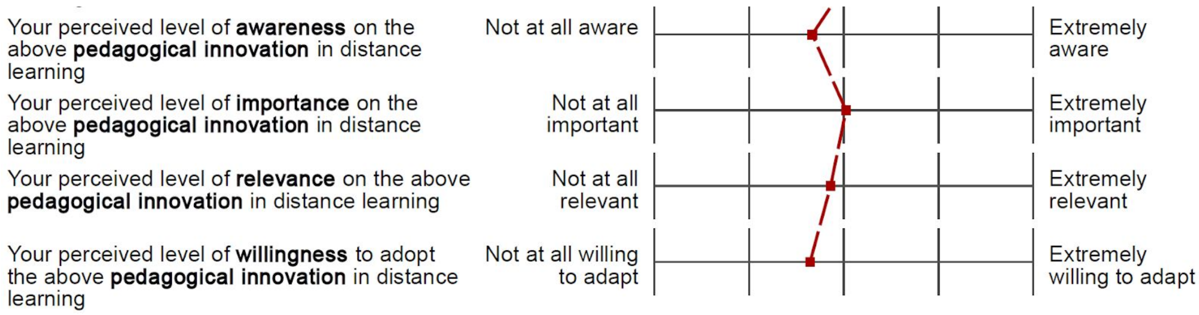
Artificial intelligence functionality: Artificial Intelligence technologies (e.g. chat bots) have been used to answer student support queries.



Artificial intelligence pedagogical innovation: AI technologies allow students to immediately read and address feedback.



Artificial intelligence pedagogical innovation: AI technologies allow students to ask and receive answers to educational queries at any time without teacher interaction.



For artificial intelligence, similarly to virtual reality is not yet widely used in distance learning. So, it is also unsurprisingly, that responses were shifting towards the middle rating. Responses to the questions were also somewhat neutral about perceived; awareness, importance, relevance and willingness to adapt to various digital technology functionalities and pedagogical innovations.

Open comments on opportunities and threats around artificial intelligence were similar to those under virtual reality, in that the responses suggested these technologies and associated pedagogies are not at a stage where they are widely used. Some of the strongly identified threats were around the potential negative impact the use of artificial intelligence could have on the student experience, in that it removes the personal communication with academics. There was also concern expressed about the potential limitations that the technologies have in dealing with complex ideas and questions and the impact of this on learning.

Opportunities

Efficiency

- *Very attractive as saving time*

Threats

Limitations in how much AI can deal with complex, nuanced ideas, questions

Content that does not have fixed answers, but is based on development from the students experience, may be difficult to apply AI"

- dependent on pre-arranged answers and FAQs. Difficult to cover all eventualities. Multiple choice...

- My concern would be for their application to postgraduate/professional students where the focus of assessment is on developing criticality and original argumentation...

- ...may not be able to deal with complex queries

Negative impact on student experience

- If students know they are not communicating with a person, it may increase the risk of alienation

- not convinced that AI will give students a coherent and cumulative learning experience

-Students value human contact and personal awareness

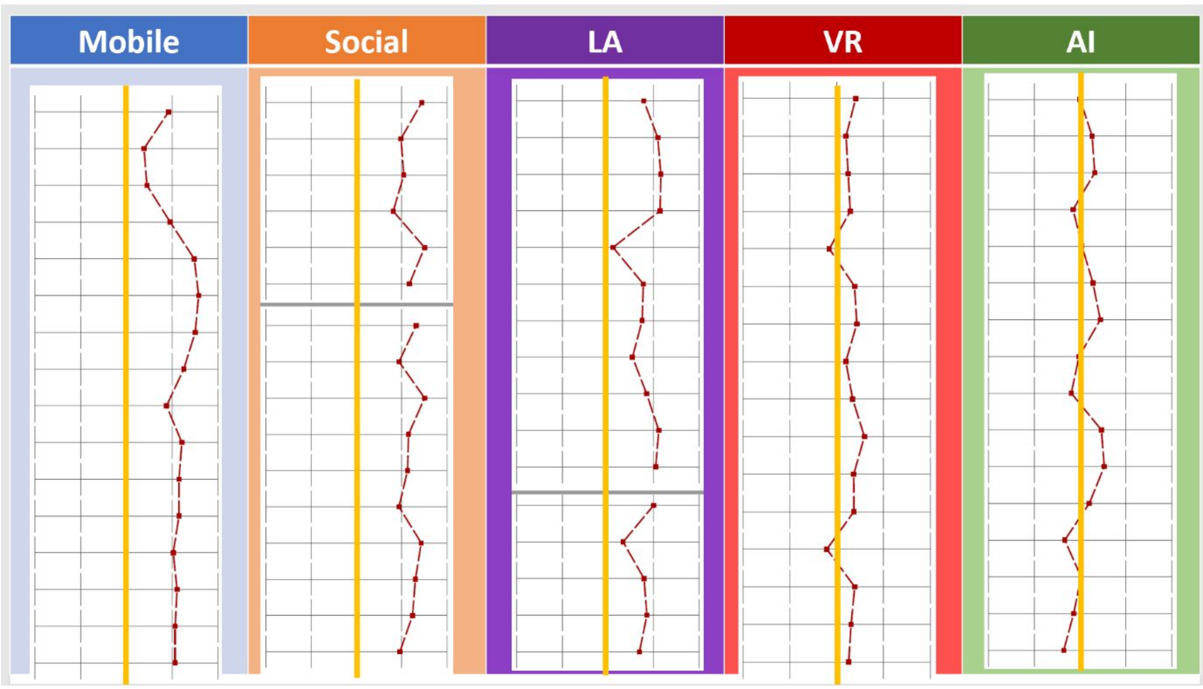
Threat to academic roles

- How much do these threaten or liberate the role of the academic educator

Lack of take up due to the threat to academic jobs

C3 Some reflections on the descriptive results

In summary, the survey shows there is a good level of awareness and appreciation of the relevance of mainstream technologies and pedagogies such as mobile devices and social media. Learner analytics is still in its infancy and does not yet have high uptake but there was a moderate level of awareness and opportunities for its potential use. The less mainstream technologies such as artificial intelligence and virtual reality are viewed as being limited in their accessibility to teachers and learners, largely for reasons for cost and suitability of subject areas. These views are largely based on limited awareness and interaction with these technologies and pedagogies, rather than experience of their use.



Annex D: Technology Roadmaps

The final part of the project aimed to produce technology roadmaps that summarized the current state of the art in technology for education, make some predictions of emerging technologies in the 2-5 year timeframe and identify the major barriers and training needs for the various technologies. This report presents the resulting roadmaps, as well as a summary of methodology used to develop them.

D1 Roadmap workshop

The roadmap ideation happened during the final project workshop. This was attended by 15 participants. They were a mix of academics with experience of distance education and distance learning professionals with other roles in supporting distance programmes (primarily learning technologists or similar roles).

The workshop was a full day, with the morning devoted to presenting the results of the previous parts of the project. The roadmap ideation activity was in the afternoon. This part of the workshop began with a brief presentation of the technology areas discussed in the project. The participants were then divided into groups representing different disciplines. They were given cards, each of which represented a technology and were asked to sort the technologies according to their stages along the roadmap. The disciplines, technologies and roadmap stages will be discussed below.

Once they had completed the initial task, they were asked to identify major themes emerging from their discussion and to identify major barriers and training needs for the adoption of the technologies being discussed.

D1.1 Disciplines

The participants were divided into groups, each representing major groups of academic disciplines. Each group had academic representatives of that discipline but also included learning technologists and other professionals who had experience in that discipline but potentially worked across many disciplines. The group members were therefore not necessarily all from the discipline in question.

The disciplinary groups were chosen to represent broad classes of pedagogy. The aim was that each group would have a different pedagogical approach and make use of technologies in different ways. This was designed to ensure that the roadmaps brought out this disciplinary diversity in technology use and did not simply homogenise the results.

The disciplines were also chosen to represent the degrees available through University of London Worldwide and to reflect the participants in the workshop.

These are the four disciplinary groups:

- **Biomedical:** this group represented biological sciences and their application in medicine (including veterinary medicine). The participants included pure scientists (molecular biology) and medical educators (e.g. epidemiology and veterinary science)
- **Humanities:** this group aimed to represent a broad class of discursive and scholarly pedagogy characteristic of the humanities but also the more theoretical social sciences.
- **Professional Education:** this group aimed to represent disciplines that education professional practitioners, whose practice is grounded primarily in the social sciences (not medicine or engineering) but with a strong element of professional practice. The participants in this group came from education and business.

- **Mathematics and Technology:** This group represented the pedagogy of mathematical fields and applied technologies. The participants mostly had a computer science background and their results mostly represent computing technologies and mathematics but connections were made to other engineering disciplines.

D1.2 Technology Areas

The workshop used the same broad technology areas used in the survey:

- Mobile devices
- Social media
- Learning Analytics
- Artificial Intelligence (interpreted primarily as Machine Learning)
- Virtual and Augmented Reality

Each group was given four cards for each technology area. Each card described a specific technology or application of technology within education (the full list is at the end of this report). They were also given blank card and were encouraged to add technologies that they thought were missing from the original set (these are also listed at the end).

D1.3 Roadmaps

The groups were asked to place the various technology cards at various stages along a roadmap for current and future development.

The roadmap framework was designed to avoid asking participants to make predictions about how long it would take for a technology to become important. This is a notoriously imprecise and speculative task. Instead they were asked to put the technology into one of four categories representing their current stage of development, while still providing useful information about how far each technology is from practical use.

- **Established:** technologies at this stage are already widely used by educators (though not necessarily ubiquitous)
- **Low uptake:** these technologies are well developed and have validated pedagogies, but uptake from educators is low in practice.
- **Unexplored Pedagogy:** these technologies are well established as technologies, but their use in education is limited and pedagogical principles for their use are yet to emerge.
- **Emerging:** these technologies are still in their infancy. Their use in education is likely to require significant technological in addition to pedagogical innovation.

D2 Results and Discussion

The following pages will present the four roadmaps developed in the workshops. This section will summarize some of the major themes emerging.

The big picture is very consistent with the results of the survey. Mobile Technologies and Social Media are often quite well established, but AI and VR are more emerging, with learning analytics being somewhat in between.

While the linear model of technology development used is convenient, one group noted that technology acceptance is often more cyclical. Intelligent Tutoring Systems are a case in point. They have been on the point of successful emergence (and are still used in school mathematics) but have since largely disappeared from educational practice. This is not to say they have failed, or that “we have seen it all before”, but that technologies may disappear but return later in a better form (we are seeing this currently with Virtual Reality).

D2.1 Disciplinary Difference

There are many detailed differences in the update of particular technologies between disciplines, but there are also larger scale differences in overall uptake. Humanities disciplines have much less uptake of a whole range of technologies, while professional education and, perhaps unsurprisingly Mathematics/Technology are have made more use. Biomedical education has slightly lower update than the latter two domains, but there was considerable enthusiasm for a number of more avant-garde technologies, such as Augmented Reality and AI.

D2.2 Barriers and Training Needs

There was a sense among participants that technology itself is not the barrier, but that there were a number of individual and organisational barriers.

Many of the individual barriers are related to a lack of knowledge or familiarity with new developments. Here we again see major differences between disciplines, exemplified by the contrast between the Humanities, where academics rarely use technologies in their work, and so may be hesitant about using them, and Computing and Mathematics, where academics use and actively develop technologies in their research, but lack and understanding of the new approaches to pedagogy that they may enable, falling back on the way they were taught, which may be sub-optimal. Other individual barriers include a lack of time and resources due to high workload, and a lack of motivation.

Organisational barriers include incentive structures, strategic leadership and procurement processes. Pedagogical innovation is often not included, or included in a minor way, in incentive and promotional structures for academic staff. This is likely to result in academics not prioritising these activities, particularly as they require a lot of time and effort. This is part of a broader issue of strategic leadership. University management need to prioritise and resource distance learning if it is successful. This, in turn, means clearly articulating the return on investment of these activities (which can be considerable). Another institutional issue is procurement and outsourcing. Traditional procurement processes involve a distance between management who are responsible for procuring a technology and the staff that use them. This in turn can result in technologies that do not fit people’s needs and whose user experience is considerably inferior to that of consumer technologies. This issue becomes more extreme in the case of outsourcing of distance learning. When universities outsource their online learning activities to private “enablers” they give up responsibility and control over their students’ learning experience. While, this relationship can be cost effective in the short term and enable universities to develop distance learning quickly, in the longer term they fail to build the internal capacity for online learning that would support new developments. So outsourcing can be an enabler of distance learning in the short term, but a barrier to fuller development.

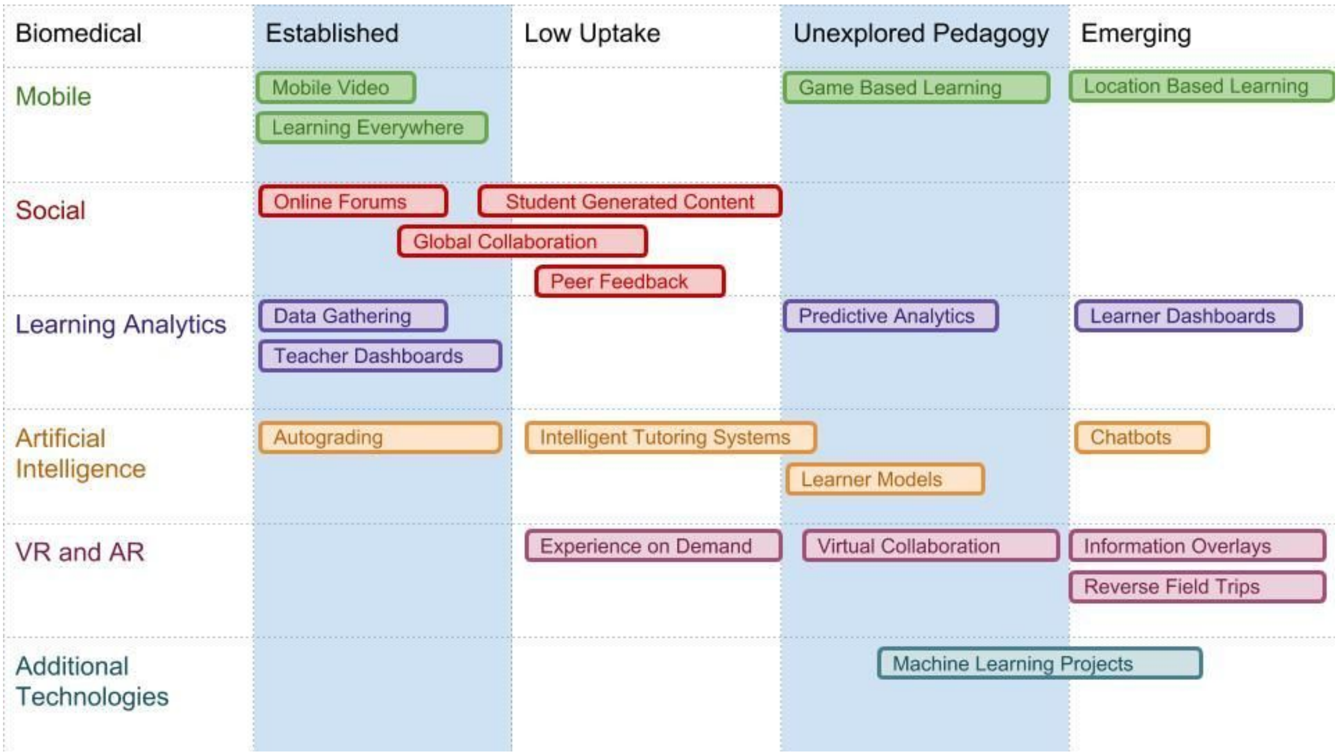
The technological barriers that do exist are mostly around technologies being insufficiently explored. Some are very new and still experimental or under development. However, there are many that are fully development in other domains but have not be applied in education to their full potential. This could mean that appropriate pedagogies have not been development around these technologies, or these pedagogies have not been fully evaluated so there is not a good sense of what works, or whether investment in these technologies is worth the effort. What is needed is funding for pilot studies and evaluations of novel technologies in the classroom.

D3 Recommendations

A number of recommendations emerged from the roadmap exercise and the analysis of barriers to adoption.

- Universities should take strategic leadership of technological innovation. This includes investment in the development of expertise in-house rather than outsourcing.
- Staff should be incentivised and rewarded for pedagogical innovation, in order to motivate them and should be given sufficient time in their workloads.
- There should be support and training for academics and professional staff. This cannot be a “one-size-fits-all” programme as different disciplines (and individuals) have different requirements. Technologically enhanced pedagogies can look very different in different disciplines and academics in different disciplines have a very different levels of familiarity with technologies and innovative pedagogies.
- Training should be supplemented with a bank of exemplars of technological tools and good pedagogy to inspire and provide a template for new courses. Again, these should be adapted to specific disciplines.
- There should be funding for piloting and evaluating new pedagogical approaches and the application of new technologies. The results of these can be used as the basis for the exemplars described above.
- There should be a transition in the academy from the idea of a lone academic to team based working. Online learning requires a lot of resources and a wide range of skills which an individual is unlikely to have. Instead, close, collaborative working of teams with diverse expertise can enable greater creativity.

D3.1 Biomedical



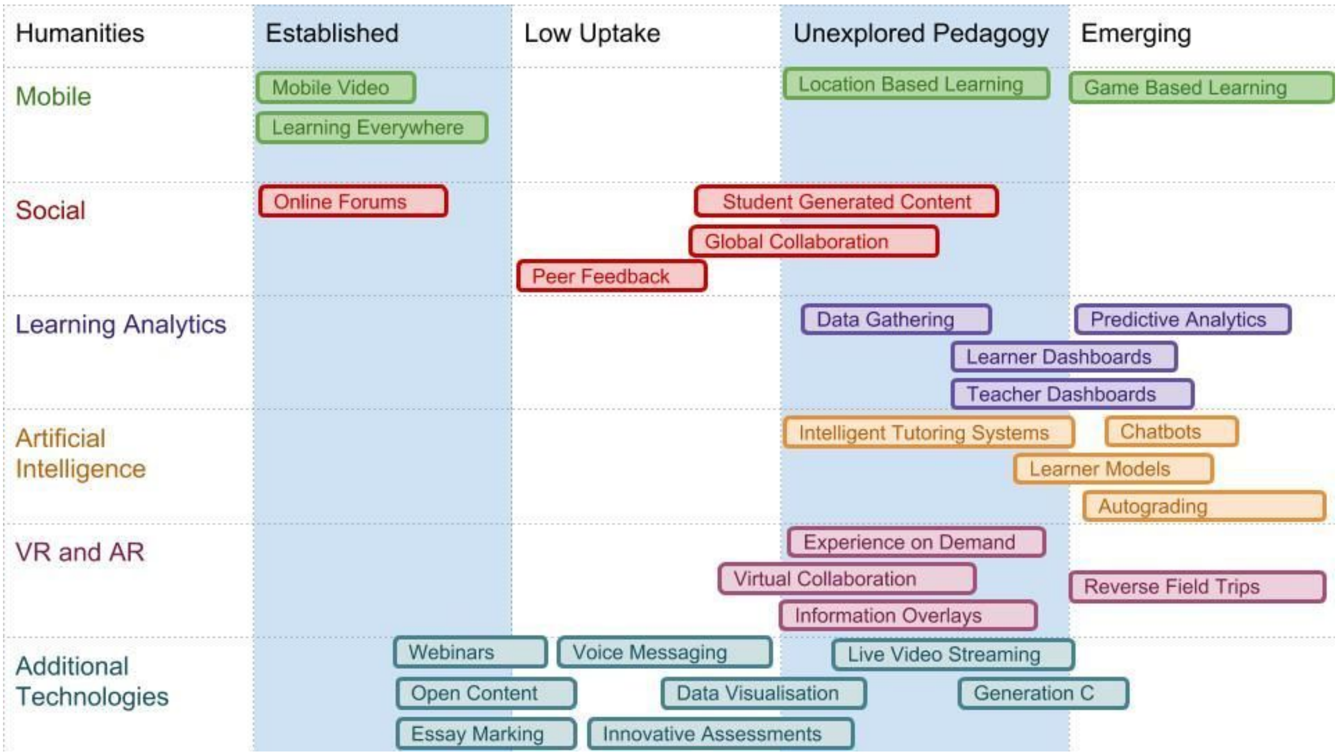
In this discipline area there were many well established technologies that are being used by educators. Mobile Video and Learning Everywhere were identified as particularly important.

There were also many emerging technologies that were considered highly desirable. These included using Virtual Reality to enable Experience on Demand; Augmented Reality Information Overlays and Chatbots to provide better student support.

Additional Technologies Greater use of machine learning in biomedical education was desirable, particularly for student projects.

Barriers: There are a combination of individual and structural barriers. Many of these are related to the resources required: the time needed from academics and the cost of the technology. Academics typically have many competing priorities, digital learning teams are small and budgets are tight. There is also a disconnect between the academics who the subject knowledge and the technologists who understand how to apply technologies to education. This requires greater education of the academics on the possibilities of learning technology. There is also a responsibility on senior management to champion distance learning as a strategic priority and ensure that staff are supported.

D3.2 Humanities

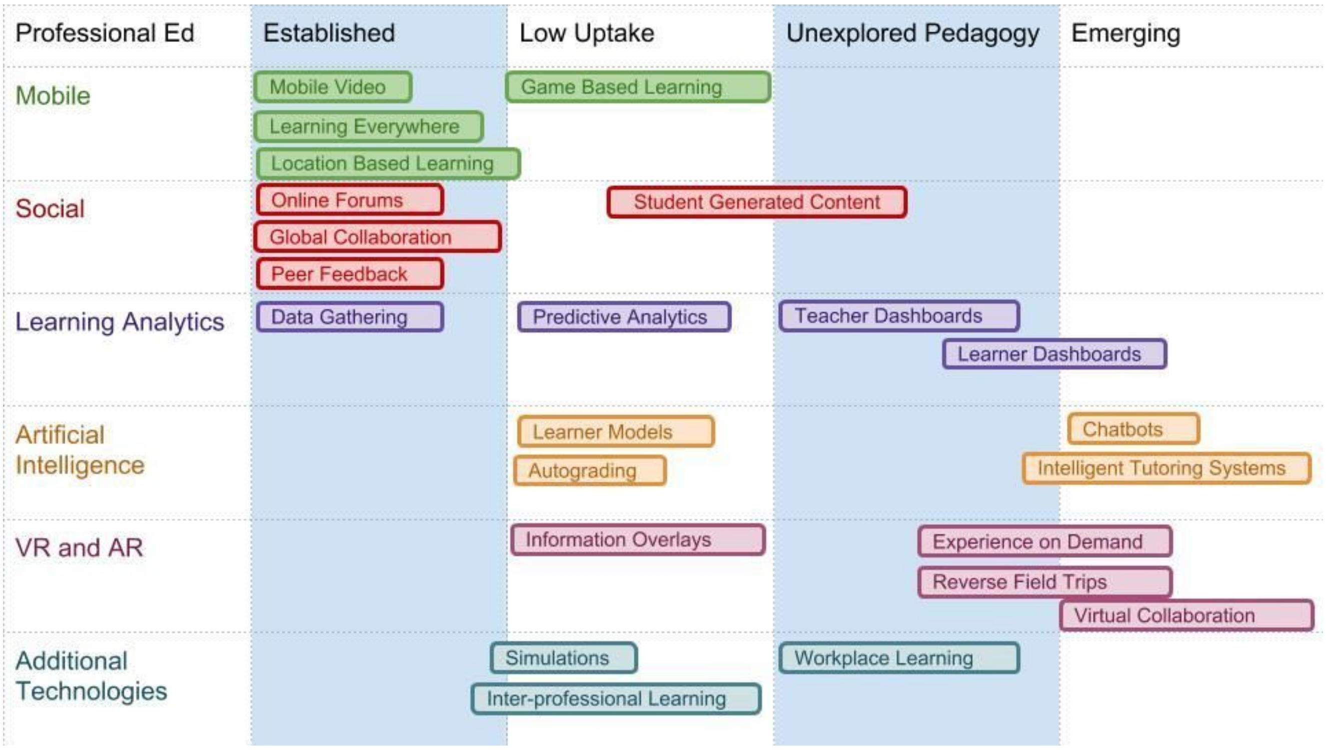


This group were notable for having most technologies on the emergent end of the roadmap. This reflects relatively low uptake of technologies within humanistic disciplines. This may in part be due to academic in this area being less comfortable with technology but also far greater challenges of the discipline (for example the difficulty of autograding essays). A suggestion was made that alternative modes of assessment beyond the essay could enable new uses of technology. Improving Digital Literacy was also an important theme.

Additional Technologies There were several suggested technologies: Open Content, Voice Messaging, Live Video Streaming. Given that humanities are often data rich data visualisation and machine learning could be used a lot more. Humanities students are often characteristic of "generation C": Creation, Collation, Collaboration and Curation.

Barriers: There are considerable barriers to the adoption of technologies in humanities education. In part these are due to incentive/reward structures not supporting educational innovation. However, an important issue is that humanities and social science academics often use technology less in their work and are therefore less comfortable with it. We should not overlook the greater technological challenges involved in the humanities. While technologies auto-grading and intelligent tutoring systems work well in mathematics, there are major challenge applying them to an essay based subject.

D3.3 Professional Education



A lot of technologies were put in the “established” column (“A lot of good stuff is going on”). This shows that technology has readily been accepted in the professional education domain. The picture was broadly optimistic, with many technologies having value.

Additional Technologies: Simulation was considered very valuable, an example of an airport simulation from the Masters in Professional Accountancy was discussed. It showed how students could learn to manage real situations through a complex simulations (which is related to, but distinct from game based learning). Interdisciplinary learning allowed students from different disciplines to work together and learn from each other. Finally, technology has the potential to support learning in the workplace, which is often challenging.

Barriers: The barrier is not the technology. People, organizations, pedagogy and fear are the barriers. An exception to this is that, while good technology is not a major barrier, bad technology can be. In particular, technology that is poorly designed and has major usability issues is likely to present obstacles to uptake and learning. This presents challenges for emerging technology as newer technologies are unlikely to have had the many iterations of improvement (and user experience of them) that make them truly usable. It does, however, point to important issues around the procurement of technology. Large scale corporate procurement tends to be people who never use the technology (sale executives) selling to people who never use the technology (senior management) on behalf of users. This results from a great distance from users that means that technology is unlikely to be designed around their needs. A related risk is the current trend for outsourcing of online learning to private “enablers”. While this may seem a cost effective strategy in the short term it can result in deskilling in the institution and a lack of control over the quality of content. Instead, what is needed is a commitment to learning teams that cover the different skills required for distance learning from the academic subject matter to the pedagogy and technology. These teams should not be technology driven but should focus on the creative design of pedagogy. They should design creative activities first and then move on to implementation.

D3.4 Mathematics/Computing

There was a paradox in the area. Academics in these disciplines (almost by definition) are comfortable with many established learning technologies and use them extensively in their teaching. However, there are a wide range of more emerging technologies and approaches that academics are very used to in their work (e.g. VR and AI for computer scientists and modelling and analytics for mathematicians). They research these areas and teach them, but they do not use them to teach their subjects. This is not due to a lack of understanding of the technology but a lack of understanding of pedagogy.

Additional Technologies: Simulation was also considered and important technology in this domain. Flipped classroom with social media support was also mention with an example of a lecturer who would be available on social media to answer questions for the remained of the day after a class (though this raises major workload concerns).

Barriers: understanding of technology is not a barrier for this group, though sometimes academics' understanding of new technologies is often exaggerated (not least by the academics themselves). One problem is that computing academics often distrust off-the-shelf technologies (such as VLEs) that they have not developed themselves. This can result in low uptake as they do not have the resources to develop their own platforms. However, the greatest barrier is academics lack of understanding of pedagogy, and particularly innovation. There is a tendency to feel that the way they learned is the only way to learn and a reluctance to adopt new ways of teaching. There are well established research venues in Computing and Mathematics education, but these are not well known by academics. There is a need for more subject specific pedagogy,, and case studies as general PG Certificates do not cover pedagogies of areas like programming. This is likely to change due to social, not technological innovations. Teaching programming to non-computer scientists is likely to drive innovation and the recent interest in computing in schools (e.g. Scratch) is likely to drive a greater interest in pedagogy. However, when computing academics take an interest in pedagogy, technology is likely to be their favoured method of implementing it.

D4 Technologies

This is a list of the technologies and pedagogical applications of technologies used in the roadmap exercises. The textual descriptions were included on the cards given to participants. They are listed according to the categories used in the survey. This section ends with a description of additional technologies suggested by participants.

D4.1 Mobile Technology

Learning Everywhere: Mobile devices enable students to access online learning opportunities where ever they are, including video lectures, readings, quizzes and other activities. Students can do “bite sized” learning during daily commutes or other “downtime”.

Mobile Video: Video allows students to access lectures and other teaching sources away from the standard campus environment, typically in short “single concept” videos. Video can enable “flipped classrooms”, in which lectures are watched in their own time and classrooms are active.

Location dependent learning: Mobile devices support learning at locations away from campus, for example, archeological sites, natural habitats or work places. The use of a mobile device can allow students to access relevant academic information and guidance while on location.

Game based learning: Game-like mechanics can be integrated into learning experience to enhance student engagements. This could be the trappings of games like points and high scores but also simulation mechanics like the game SimCity.

D4.2 Social Media

Online Forums: Students are able to discuss their learning online via VLE supported forums. These might be question and answer forums, in which students can help with each other’s difficulties, or more complex forms of discussion.

Global Collaboration: Students can use social media platforms like Slack or Skype to collaborate with students worldwide. These working patterns increasingly mirror global business collaboration.

Peer feedback and grading: Students give feedback to each other online. This is a valuable learning experience for both the student giving and receiving feedback. If grading is done via a standard rubric, students are able to get a deeper understanding of the grading criteria used by teachers.

Student Generated Content: Students are able to create and share digital content (e.g. blog posts, video, images). Students learn through creating but also by viewing the work of their peers.

D4.3 Learning Analytics

Data Gathering: Virtual Learning Environments are instrumented to gather data about student assessment, progress and engagement with the platform. Activities are sufficiently rich as to give useful data.

Teacher Dashboards: Teachers are able to view data and visualizations of their students activities. These can be whole class analytics that give insights into the success of activities or individual analytics that give can help identify at risk students.

Learner Dashboards: Students are able to view data about their progress and, in more advanced systems, are given predicted scores and advice based on their current course performance. Learner dashboards can help put students in control of their learning.

Predictive Analytics: Machine learning methods are used to predict students final results from their data and to automatically identify at risk students.

D4.4 Artificial Intelligence (Machine Learning)

Intelligent Tutoring Systems: Software is able to automatically adapt the pace and quantity of learning activities based on students performance. This is common in mathematics where students can be given more or fewer exercises on a particular topic. In other subjects it is emerging.

Autograding: Software is able to automatically mark student work and give instant feedback. This is relatively straightforward for multiple choice quizzes and for some mathematics and programming assignments. However, there have even been systems that claim to perform as well as humans on humanities essays.

Chatbots: Conversational AI systems (similar to text only versions of Alexa or Siri) are able to automatically understand and respond to student queries allowing for much quicker feedback than from a human.

Learner Models: Data is used to build a model of how a particular student learns and of their current knowledge. This can be used to adapt learning content or monitor their progress.

D4.5 Virtual and Augmented Reality

Experience on Demand:[2] VR and AR make it possible to virtually learn from experience that it would be difficult to have in real life, because they would be expensive, dangerous or even impossible. This could be a space walk, playing in a high level sports game or practicing a medical consultation with a patient.

Reverse Field Trips: Students are able to visit virtual reconstructions or 360 video of distant environments. These can include impossible places such as going back in time, .outer space or microscopic environments. These could be interactive sites like a virtual laboratory.

Virtual Collaboration: Virtual and Augmented Reality allow students to collaborate together virtually. VR can allow remote students to work together in the same 3D space, much as they would in the real world. On the other hand AR can allow students in the same room to work together on the same virtual object (e.g. assembling a 3D model of an engine). Though the latter is not generally available, yet.

Information Overlays: AR makes it possible to enhance real objects with virtual information displays. For example, it might be possible to ”see through” a body to the internal organs, enhance a building with data or see how an archaeological artefact might have originally looked.

D4.6 Additional Technologies

The following technologies were not in the original list, but were added by participants. In some cases, suggestions from two groups have been merged if they are sufficiently similar. The text is my own, but based on descriptions by the participants.

Machine Learning and Data visualisation for practice: Analytics techniques and machine learning are increasingly becoming important parts of academic and professional work in many domains. These techniques need to be brought into pedagogical practice. For example, machine learning is increasingly popular for student projects in data rich areas of biomedical science. Also, data

[2] This phrase comes from the title of a book by VR researcher Jeremy Bailenson

visualisation is an important part of the digital humanities and could be integrated within undergraduate humanities teaching. [suggested by the Biomedical and Humanities groups]

Open Education Resources: Education content such as videos, slides or written text is made available for other teachers on a Creative Commons basis. [suggested by the Humanities group]

Voice Messaging: For discursive subjects like the humanities, voice messaging might be a more natural method of asynchronous communication (and reduce the effort of typing). [suggested by the Humanities group]

Live Video Streaming: Video used in distance education is generally pre-recorded, but live video is also important, including video conferencing and live webinars. [suggested by the Humanities group]

Generation C: This is a phrase used to describe the use of media by the younger generation. The 'C' can stand for a number of things including Content, Creation, Collaboration, Curation. The more academic term 'Critique' was also added. [suggested by the Humanities group]

Simulation: Students learn by interaction with a computer simulation of a system with may be physical (e.g. fluid dynamics), biological (e.g. anatomy) or social (e.g. a company). This might include a graphical simulation but it is not necessary (a simulation could be a simple as a spreadsheet). This is related to game based learning but distinct, in that there do not need to be explicit game mechanics. [suggested by the Professional Education and Mathematics/Technology group]

Inter-professional (or inter-disciplinary) learning: Collaboration technologies allow group between students of different disciplines or professions. For example, medics, lawyers, aide workers, economists and journalists working together on a simulation of a natural disaster. [suggested by the Professional Education group]

Workplace learning: A variety of online technologies can be used to support learning in the workplace. This is related to location dependent learning, but the technologies involved are likely to be different and include collaboration platforms, e-portfolios and mobile video recording. [suggested by the Professional Education group]

Social Media Support: Educators can use live social media platforms to provide support for student outside of class time, for example, by answering student questions. This can be a rich form of support for students, but has important issues of workload and it could prove challenging to set limits. [suggested by the Mathematics/Technology group]