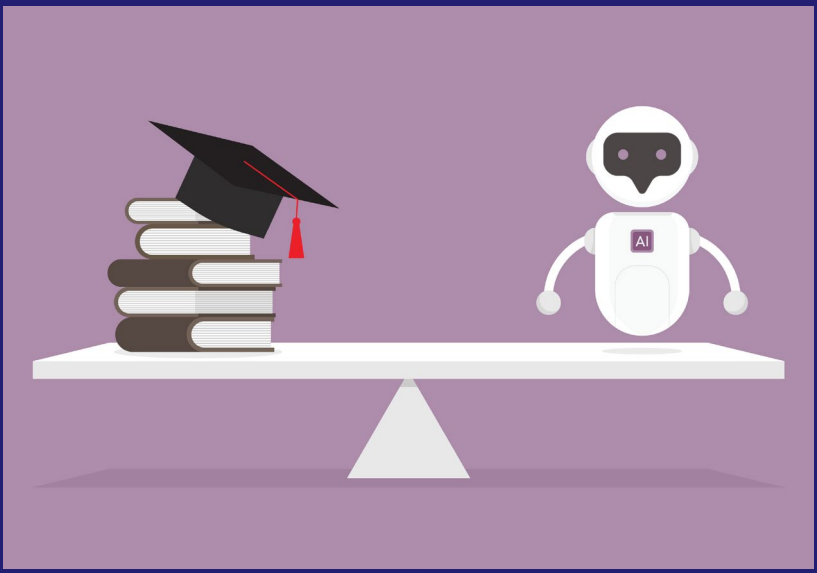
Technology Foundations for Twenty-First Century Higher Education

Edited by Mary Curnock Cook



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About the Editor

Mary Curnock Cook CBE has long been an advocate for using technology in education, both for back-office functions and for student facing services such as teaching, learning and assessment. She developed her first e-learning programme in 1999 while working in the hospitality sector. Working in education and higher education for over 30 years, Mary led the early phases of UCAS's technology transformation as CEO from 2010 to 2017. Since then, she has developed a portfolio of non-executive roles in education, including chairing Pearson's UK qualifications business and the Dyson Institute. She is network chair for Emerge, the edtech venture capital fund, regularly chairing a higher education edtech group for Emerge and Jisc. She also chairs LearningMate's Advisory Board.

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About LearningMate

LearningMate focuses on integrating technology with education to enhance learning experiences. For over 20 years, we have worked with institutions, companies and publishers to develop solutions that make education more accessible and effective. We are known for creating flexible, accessible and career-oriented online programmes and resources, partnering with institutions like the University of Surrey, the University of Leeds and Southern New Hampshire University.

Our services improve the digital infrastructure and operations of higher education institutions, covering integration support, digital and customer service resources, content migration and accessibility audits. Chapter 7 of this report discusses our work with Learning Content Management Systems (LCMS) to improve student services.

We are also exploring artificial intelligence to augment our services, focusing on human-led, AI-powered solutions.

Our business model is straightforward: we collaborate with universities, publishers and corporations to address their challenges and tailor our services to accelerate their digital strategies efficiently. Our commitment to education and flexibility makes us a valuable partner in the EdTech sector.

We have grown by acquiring and investing in complementary companies and remain open to investment opportunities. For more information, contact: prasad.mohare@learningmate.com.

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Foreword

Mary Curnock Cook CBE

Technology is undoubtedly a foundational asset for higher education providers, but for many leaders in the sector it remains something of a black box. This collection of essays aims to demystify technology and to provide some insights to elevate the discourse to a strategic level. Our authors are in leadership roles across the sector and several have no direct technology background. Two vice-chancellors, from Durham and from Greenwich, bookend the list.

With student needs changing and financial strains across the sector, technology has two principal roles: as a driver of operating efficiency and as a key contributor to the student experience. Nevertheless, universities still rely on outdated legacy systems to operate, with large in-house IT teams whose job it is to keep the technology lights on and try to avoid disastrous cyber-attacks and IT downtime. All that cost and expertise is rarely available for innovation and improvements. Data, arguably the foundation of any technology architecture, is held in multiple systems, management information is delivered through multiplying spreadsheets, satellite IT efforts are set up in disgruntled faculties and hard-pressed IT professionals become the department of saying 'no'.

Many university strategies will tilt at 'digital transformation' initiatives and most governing bodies will have discussed delays, cost over runs and sometimes the total failure of such projects. Perhaps 'digital transformation' is the wrong term, suggesting as it does that there is an end state that is 'transformed'. Thinking of digital as a journey of continuous improvement that can be accelerated or scaled back is perhaps more realistic, but doing this requires some core architectural building blocks upon which a flexible technology estate can be built. First among these is curating and storing data at an enterprise level; migrating from on-premise data centres to the cloud is another. Both of these foundational moves will enable quicker and less costly adoption of staff and student-facing applications and tools. The sector's dependency on a small number of suppliers of student record systems and virtual learning environments (VLEs) is a problem yet to be

cracked; but with better technology foundations, universities can reduce their reliance on these often cumbersome tools and be more confident in testing new options.

More recently, the emergence of generative AI has called into question the dominant model of teaching, learning and assessment. Meanwhile, the cost-of-learning crisis for students and, perhaps, the development of the Lifelong Learning Entitlement (LLE) modular funding options will start to change how and when students want to access higher education. This points to more complex models of multi-modal learning, credit accumulation / stacking and transfer, and step-on, step-off learning patterns.

The higher education sector can successfully put in place the foundational technologies that enable such changing models, and it can do so at lower cost and risk than the all-encompassing digital transformations that some have planned. From there, the investment in and speed of technology change can be managed within available resources to suit the changing needs of staff and students.

LearningMate, the 'education-first technology company', is to be commended for sponsoring this collection and I hope that it sparks and supports a productive conversation in university leadership teams about practical and affordable ways to modernise technology in the sector for the benefit of students and staff. As Professor Karen O'Brien, Vice-Chancellor at Durham University, says in her contribution, we are all part of the 'IT crowd' now.

1. Governance and leadership of a modern university

Professor Karen O'Brien, Vice-Chancellor and Warden, Durham University

University management teams long ago abandoned the idea that IT is simply an adjunct to the delivery of university operations and strategy, or something they can safely devolve to an IT subcommittee. Those of us in management roles see core enterprise systems and digital technologies as the fabric of a higher education (HE) institution as much as classrooms, books and labs.

Digital technologies are the transport vehicles for the student journey from enquiry to graduation, and the means, mode and often subject of much of our research. Discussions of IT systems, innovation and cybersecurity regularly consume as much time in executive meetings, audit committees and governing boards as finances, estates and HR matters.

Despite the fact that the UK plays a globally important role in computational research of all kinds (not only technological innovation but also social impacts of technology, digital humanities, digital public health and much more), it remains the case that many universities are not fully mature in the ways in which they manage and govern IT within their overall management frameworks.

Management teams typically lack specialist expertise, and are heavily reliant on their Chief Information Officer (CIO) to carry out the work of explanation and translation. Members of these teams often bear the scars of failed or disastrous IT transformation projects (automated timetabling systems that have crashed leaving students stranded, payroll systems that have not paid out or major cyber attacks).

Management teams are not always willing to take on board carefully benchmarked data from their CIO demonstrating (as data often tend to do in UK higher education) systemic under-investment in the IT estate and mountains of technical debt. Or if they do accept the implications of the benchmarking, they often cannot make the resource commitments to do very much about it. Many management teams have for years embraced and encouraged innovation, but have been frustrated: by slow returns on

multitudes of overly bespoke, non-scalable 'technology-enhanced learning' projects; exciting MOOCs that delivered few returns on investment; and the most recent, somewhat disappointing, period of 'reversion' to the *status quo ante* following the great COVID Teams experiment.

Yet management teams, including my own at Durham, are nevertheless continually striving to build a mature institutional edifice that rests upon the three pillars of people, place and IT estate. Some universities in the UK exemplify this to a high degree. The University of Sheffield has organised its IT services into product domains, along with cross-cutting capabilities and a new governing architecture for IT.

In almost all universities, we have accepted that digital strategy is the responsibility of everyone in leadership roles, that accountability sits at the top (and not in the IT department) and that we all need to have a shared overview of our organisation's IT architecture – for example what data and technology underpin key processes such as enrolment, assessment and graduation.

We are learning to oversee decisions that are made in the interests of the whole organisation, ensuring that risks are mitigated, resources are deployed effectively and benefits are realised and tracked. We are getting better at anticipating risks and nasty surprises: such as systems that do not integrate with other legacy systems, poor client engagement at early project stages limiting the benefits of enhancement or over-customisation and over-complexity.

Above all, we have grasped that technological change is a people-centred phenomenon. We are paying more attention to the labour market and skills scarcity in the IT sector, as well as the need to invest in the digital capabilities of our own staff.

Universities like my own certainly also recognise that student strategy and digital strategy are inseparable, whether we are heavily engaged with online degrees or seeking to enhance in-person learning. For some years now we have been talking about digital strategies that deliver a 'seamless' student experience – 'device-neutral', interactive, assistive, community-building through collaboration tools, combining elements of synchronous and self-paced learning, and so on.

We have tried to learn from the best: the University of Arizona led the way in online learning pedagogies and remote exam proctoring; applicant journeys at the National University of Singapore; or augmented reality headsets for medical education at Imperial College London.

Some of the slickest innovations have been in support of our core customer imperatives, such as guiding students through the enquiry and application process. At Durham, for instance, we have implemented a 24/7 AI assistant, 'Holly', which has answered thousands of questions and freed staff to add value in other places. Yet we know that the seamlessness of this customer experience does not always continue as students enter university and are handed off to less friendly student record systems (the market here being monopolised by just two main system providers), clunky timetabling systems and variable quality Virtual Learning Environments.

As senior leadership teams we continue to set our sights on an ambitious vision of what we would like the digital university experience to be for our students (responsive, intuitive, connecting and personalised), even though procurement processes, uneven technological development and regulatory controls mean that a 'seamless', straight-to-smartphone student experience is still some way off.

That said, no educational organisation would ever consider 'experience' to be something that simply 'happens' to students. We are seeking to implement digital strategies in ways that empower and equip our students with the knowledge and skills they will need to succeed in the era of AI.

Moreover, many of us try to position students themselves as agents of digital change in our organisations, recognising their native grasp of technologies, and the entrepreneurial leadership that comes from the student body. Some universities have succeeded in positioning students as digital changemakers within their structures, for example, in the recent case of University College London, tackling head-on the implications of generative AI and AI technologies for our shared educational endeavour.

Looking ahead, those management teams that take holistic, collective and clear-sighted accountability for their university's digital strategy will be well-placed to equip their organisations for the challenges ahead. In

doing so, we also need to look constantly beyond our own organisations and seek to harness the shared power of the sector to unlock more opportunity. We have seen how groups like UCISA and Jisc can negotiate greater value-for-money with big technology vendors. And we have seen how cloud computing offers huge possibilities for sharing resources and services across regional boundaries. For example, the Universitat Oberta de Catalunya reduced its operating costs by €300,000 per year by moving to the cloud under a manifesto which articulates a commitment to lifelong learning, collaboration and 'social return'.

We can also use our combined purchasing power, our growing research requirement for high-performance computing and our sustainability expertise to leverage far more efficient cooling and energy capture in data centres. At Durham, the UK home of the Cosma supercomputer, funded by the Science and Technology Facilities Council (STFC), we are using c.£1 million grant funding from UKRI to install Solar Photovoltaic systems on the site hosting the data centre. This provides power for Cosma, helping to offset CO_2. The University of York is migrating its data to an EcoDataCenter in Sweden as part of its plans to reach net zero. As our sector continues to host and lead a revolution in research computing power and quantum computing, we will also collaborate to reduce energy consumption and improve sustainability.

Universities are (rightly) places of multiple voices and priorities. Yet in this multi-polar environment it is vital that the voice of IT and digital is heard clearly and consistently. Whether or not the CIO is a member or a regular attendee at the executive is less important than an ethos of collective ownership of this agenda by the whole team. Ideally, boards should include at least one trustee with IT governance expertise, just as they typically include individuals with backgrounds in accountancy and financial management. We are all part of the 'IT crowd' now.

2. Risks and challenges of AI in higher education

Professor Kathleen Armour FAcSS, Vice-Provost Education & Student Experience, University College London

Writing about Artificial Intelligence (AI) in higher education presents an interesting challenge because these digital technologies are moving so fast. Nonetheless, as I write in late 2023, we seem to be in a period of relative calm – at least compared to the autumn of 2022 – so I will attempt to summarise how we got here and where we might be headed next.

How did we get here?

We can probably all agree that digital technologies have had a major transformative impact on many aspects of society. In higher education, a wide range of digital technologies has long formed a core element of our provision in, for example, student and staff services, libraries, communications and learning and teaching (ever more expansive Learning Management Systems). Growth in the use of digital technologies in higher education was, until recently, mainly incremental and planned and AI has been quietly helping our digital tools to become more effective.

Over time, digital technologies have delivered radical changes to the ways in which knowledge is created, curated, synthesised, shared and accessed, and in the speed of transactions. There has been exponential growth in opportunities for connectedness between learners and between learners and teachers. Through these changes, it is interesting to note that the fundamental structures, activities and processes of higher education have remained largely intact.

The COVID-19 pandemic arrived and turbo-charged our use of tools such as Zoom and Teams for communication, messaging and information-sharing, and brought online assessment at scale. This was change at warp-speed. During this period, plagiarism detection tools – which had been in use for many years – became even more important as students completed all their assessments at home and submitted most of them online. Even through this revolution, however, the fundamentals of higher education assessment remained largely unchanged and after the pandemic, there

was encouragement to go back to pre-pandemic business-as-usual while retaining some of the benefits gained.[1]

Then, everything changed again. In the autumn of 2022, the arrival of generative AI and OpenAI's now infamous ChatGPT took the sector by surprise. It seemed to appear out of nowhere. Of course, this was not the beginning of AI, but it was the first time an easily identifiable and accessible AI tool became publicly available; moreover, it was a tool that did something quite different to what had come before. Crucially, our standard plagiarism detection tools struggled to function and, as a result, preserving academic integrity became a pressing concern. Assuring integrity was not a new challenge. The sector had already expanded its assessment instruments from exams to include more coursework, and there was some uneasiness about the widespread use of grammar checking and language translation tools. The challenge of detecting contract cheating was also attracting growing media and government interest.[2] Yet, ChatGPT took these challenges to new levels. It was also apparent that ChatGPT was democratising access to the kind of assessment support tool that previously had been available only to those who could pay, and this caused us all to reflect.

The higher education sector had to respond to ChatGPT, and fast. At UCL, we put out a call to our colleagues for AI 'experts' to join a steering group to help us to formulate teaching, learning and assessment guidance for staff and students, with assessment guidance being the immediate priority. We received an enthusiastic response from colleagues from different disciplines and perspectives. In our meetings, there was a clear sense that we were at the beginning of something new and that this time, there was no 'going back' to business as usual. We determined from the start that we needed to find ways to work *with* generative AI, and that we should make all our discussions and outputs open-access so we could learn with and from the wider sector both nationally and internationally.

1 https://educationhub.blog.gov.uk/2022/01/17/face-to-face-teaching-is-a-vital-part-of-getting-a-high-quality-student-experience-education-secretary-nadhim-zahawi-writes-to-students/

2 https://www.gov.uk/government/news/government-pledge-to-beat-the-cheats-at-university

Around the world, governments have also been attempting to catch up with developments in generative AI and its potential impacts on education; examples include the European Union (EU) and the Organisation for Economic Co-operation and Development (OECD).[3] In the UK, the Department for Education has issued a wide-ranging call for evidence and this reminds us that all parts of the education sector must engage in this challenge together, given that decisions taken in one part of the sector will impact on learners and learning in other parts.[4]

So, where are we now and what next?

The frenzy of early activity at UCL and elsewhere in the sector has abated for the time being, and we seem to be in a slightly uneasy holding position. We have developed a cautious understanding of what generative AI can and cannot do (current versions, at least), and universities have put guidelines and training in place for students and staff.

Predictably, there have been calls to move all significant assessments back to the exam hall to assure integrity, or to change coursework assessments to other physical 'in-person' options. At the same time, we are all acutely aware that the world of work into which we will be sending our graduates is adapting to AI.[5] It seems clear, therefore, that we must support our students to become competent and confident in the appropriate use of AI, and that we will need to do this through all aspects of our pedagogies. As a recent Demos report put it:

> *The dramatic changes ahead call for a fresh dialogue; universities should lead discussions with government, professional bodies and employers on the workforce and skills that we will need to flourish individually and as a society in coming years, and to identify how*

3 https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6338; https://www.oecd.org/education/ceri/ai-and-the-future-of-skills-volume-1-5ee71f34-en.htm.

4 https://www.gov.uk/government/consultations/generative-artificial-intelligence-in-education-call-for-evidence

5 https://www.theguardian.com/global-development/2023/may/12/why-would-we-employ-people-experts-on-five-ways-ai-will-change-work

to give today's young people the best opportunity to fulfil their potential.[6]

In attempting to get to grips with generative AI, some academic staff have called for institutional subscriptions to the paid-for versions of ChatGPT and other generative AI tools to ensure they can be accessed by everyone equally. Yet, companies such as OpenAI have not (so far) developed such subscription models. Moreover, other technologies such as Bard, DALL-E and Google DeepMind are evolving so fast that it is difficult to make a case for expenditure on one over another. Meanwhile, Microsoft is integrating AI into its Office Tools (Co-Pilot) so we are making new capabilities available to all students and staff anyway through our existing technologies.

The UK Russell Group of research-intensive universities have recognised the need for a sector response and collaborated to agree five principles for supporting staff and students in an increasingly AI-enabled world:[7]

1. *Universities will support students and staff to become AI-literate.*
2. *Staff should be equipped to support students to use generative AI tools effectively and appropriately in their learning experience.*
3. *Universities will adapt teaching and assessment to incorporate the ethical use of generative AI and support equal access.*
4. *Universities will ensure academic rigour and integrity is upheld.*
5. *Universities will work collaboratively to share best practice as the technology and its application in education evolves.*

This set of principles reflects an emerging consensus that higher education will need to adapt, and this leads us to the really interesting questions. There is a sense in which we know AI is going to impact the sector and our traditional models of education provision but, at this stage, it is difficult to predict exactly how. Like others in society, we are unsure about where AI is going to take us.

6 https://demos.co.uk/wp-content/uploads/2023/11/The-AI-Generation-2.pdf

7 https://russellgroup.ac.uk/news/new-principles-on-use-of-ai-in-education/

Phil Baty, the chief global affairs officer for the *Times Higher Education (THE)* recently posted the following on LinkedIn (and it is also worth looking at some of the responses to his post):

> *Disclaimer: I asked an #AI model itself (#ChatGPT) to tell me how AI in general is going to disrupt and challenge traditional higher education providers, and this is its top-five list (in its own words):*
>
> *1. Disruption of Teaching and Learning Methods.*
>
> *AI-driven adaptive learning platforms can deliver personalized educational content, assessments, and feedback to students. This challenges traditional lecture-based teaching methods, potentially making them less effective and relevant in comparison.*
>
> *2. Competition from Online Learning Platforms.*
>
> *AI-powered online learning platforms offer flexible and accessible educational options, reaching a global audience. Traditional universities may face competition from these platforms, particularly for non-degree courses and continuing education programs.*
>
> *3. AI-Enhanced Research and Publication.*
>
> *AI can accelerate research processes, analyze vast amounts of data, and generate insights. As AI becomes more prevalent in research, traditional universities may face pressure to keep up or risk falling behind in terms of cutting-edge research.*
>
> *4. Changing Role of Faculty.*
>
> *AI-driven educational tools and virtual assistants can automate administrative tasks, course grading, and tutoring. This could lead to a shift in the role of faculty, with a potential reduction in certain teaching and administrative positions.*
>
> *5. Impact on University Business Models.*
>
> *The rise of AI-driven education and competition from online platforms may impact the traditional revenue streams of universities. Declining*

enrolments, reduced demand for certain courses, and the need to invest in AI technologies could strain financial sustainability.[8]

Each of these suggestions is plausible. 'Impact on University Business Models' is pertinent in the UK where the traditional model is already under pressure from a combination of economic and geopolitical challenges. There are no easy economic solutions on the horizon for either teaching or research, so potential impact on current business models feels like both a risk and an opportunity. As an example, if it is accepted that preserving assessment integrity is our priority, and it is neither feasible nor desirable to return all assessments to the traditional exam hall model, then we need to think about the financial and infrastructure implications of putting in place more resource-intensive in-person assessments. The traditional coursework essay or report currently forms a large part of the assessment portfolio of many disciplines but, if the essay is 'dead' or in need of transformation, how are we planning to resource the alternatives?[9] On the other hand, if we use this challenge as an opportunity to make radical changes to the types and volumes of assessment across a degree course, thereby reducing workload pressures on staff and students, we could see benefits. Alternatively, we could challenge AI developers to develop new tools that would help us to assess existing coursework tasks in new ways. These are all live questions.

In 2023, at UCL we funded 80 students to work as changemakers with staff and in their academic departments. The task was to set up locally relevant projects to investigate the challenges and opportunities of using generative AI in their discipline The results are just becoming available and are being published on our open-access generative AI hub.[10] One of the projects investigated students' perspectives on generative AI. The results confirmed that students are already using ChatGPT and other AI tools to support a wide range of academic and personal tasks and activities.

8 https://www.linkedin.com/posts/philbaty_the-podcast-how-to-use-generative-ai-in-activity-7090594257098416128-U80M?utm_source=share&utm_medium=member_desktop

9 https://www.theatlantic.com/technology/archive/2022/12/chatgpt-ai-writing-college-student-essays/672371/

10 https://www.ucl.ac.uk/teaching-learning/generative-ai-hub

Students also feel that some of the sector's current guidance is unrealistic; they are aware of some of the data, equality and ethics implications; and they want to be engaged in an ongoing dialogue with staff about the best ways forward. In other words, some disruption to teaching and learning is already baked into the system.[11]

It is in the personalisation potential of AI, however, that we see the biggest potential for disruption, and it could be very positive disruption indeed. In a mass higher education system with financial challenges and large numbers of students, personalisation of learning support is often an aspiration that is difficult to realise. To see where this could take us, the work of the Khan academy for schools is interesting with the development of its Khanmigo tutor:

> *By leveraging AI, we can bring the benefits of one-on-one tutoring – deep understanding, confidence, clarity, and empowerment – to all students.*[12]

In the university sector, Deakin University in Australia has been a leader in personalising digital technologies and is developing a new AI automated feedback tool.[13] The question I am left with is: should the higher education sector in the UK come together to collaborate with lead AI developers to construct a credible AI tutor for higher education students? We probably do not have the resources individually to do this at the scale and quality that would make it worthwhile, so collaboration may be the only way to exploit these technologies optimally.

AI tutoring highlights another live issue for higher education, and it threads through all the points made so far: how should humans and AI interact in ways that are safe, ethical and positive? At a recent 'in conversation' event held at UCL, Sam Altman, the CEO of OpenAI, was the guest speaker. In addition to a large and enthusiastic audience, there were vociferous protesters expressing fears about uncontrolled AI and predicting the 'end

11 https://www.ucl.ac.uk/teaching-learning/case-studies/2023/aug/listening-students-perspectives-generative-ai

12 https://www.khanacademy.org/khan-labs

13 https://dteach.deakin.edu.au/2022/05/piloting-the-feedbackfruits-a-i-automated-feedback-tool/

of the world'. For these protesters, stopping AI was the answer. As has been reported in the media, Altman and his digital innovation peers at the forefront of this technology see the risks with AI and accept the need for regulation. Yet Altman also argued that the benefits of 'super-intelligence' greatly outweigh the risks, leading to accelerated economic growth, more jobs and, potentially, greater equality:

> *'My basic model of the world is that the cost of intelligence and the cost of energy are the two limited inputs', he said. 'If you can make those dramatically cheaper, dramatically more accessible, that does more to help poor people than rich people … This technology will lift all of the world up'.*[14]

'Stopping' AI seems impossible, and regulating it requires the kind of global collaboration on regulation that will surely be difficult to deliver. So, returning to the Russell Group principles cited earlier, it is going to be essential that the higher education sector is active and leading, particularly in the human-AI interface.

In 2020, Jessy Lin, a grad student studying AI at Berkley, wrote about needing hybrid human-AI systems, and 'human-in-the-loop' options.[15] She described the most common interaction then as 'human as fallback'; that is, the machine makes a first pass at a task, and if it fails, the human takes over (think autonomous cars). This seems to describe where we are currently with ChatGPT in higher education.

Lin argues that 'humans-as-backup' as the dominant paradigm of human-machine collaboration is limiting our imagination, and we need to ask other questions about the interaction:

Change the loop: *how can humans direct where / when machine aid is helpful?*

Change the inputs: *how can we make it more natural for humans to specify what they want?*

14 https://www.ucl.ac.uk/news/2023/may/openais-sam-altman-talks-ai-super-intelligence-and-mars-during-ucl-visit

15 http://jessylin.com/2020/06/08/rethinking-human-ai-interaction/

Change the outputs: *how can we help humans understand and solve their own problems?*

All three of these questions are pertinent to higher education as we consider AI in the context of assessment formats, potential new forms of support for assessment and marking, and academic and personal tutoring, to name just a few areas.

What of the more dramatic claims about the future impacts of AI? An article written early in 2024 posed a theoretical question: 'What will ChatGPT-2030 look like?' and concludes, among other things, that the potential developments are 'surprising'; for example: 'GPT2030 will likely be superhuman at various specific tasks, including coding, hacking, and math, and potentially protein design' and 'GPT2030 can "work" and "think" quickly: I estimate it will be 5x as fast as humans as measured by words processed per minute *[range: 0.5x-20x]*, and that this could be increased to 125x'.[16]

Certainly, it could be argued that these kinds of developments will be transformative for many different aspects of education and society more broadly. Would we, however, see this as a risk, an opportunity or both?

Bill Gates has put together a helpful summary of the commonly cited risks of AI and potential mitigations, and he warns that the impacts of AI are likely to be neither as positive nor as negative as some are claiming. Nonetheless, he makes the clear point that AI will be a major part of the future of society. As he concludes:

> *I encourage everyone to follow developments in AI as much as possible. It's the most transformative innovation any of us will see in our lifetimes, and a healthy public debate will depend on everyone being knowledgeable about the technology, its benefits, and its risks. The benefits will be massive, and the best reason to believe that we can manage the risks is that we have done it before.*[17]

So, returning to the Russell Group principles, the underlying argument is that we, in higher education, need to support our staff and teach our

16 https://bounded-regret.ghost.io/what-will-gpt-2030-look-like/

17 https://www.gatesnotes.com/The-risks-of-AI-are-real-but-manageable

students to work *with* AI. Moreover, we could add that we need to be critical, asking the right questions of AI developers and commissioning higher education specific applications, with tutoring support having considerable potential.

To conclude, therefore, I would draw attention to Dr Sarah Eaton's comments on writing in the age of AI. In noting that human-AI writing will become the norm, Eaton appears to be describing the here and now if the comments made by students in the UCL project cited earlier are representative. In this context, relinquishing control – *but not responsibility* – for what is written is a particularly helpful guide.[18]

Figure 1: Six tenets of postplagiarism: writing in the age of artificifical intelligence

Hybrid Human-AI Writing Will Become Normal

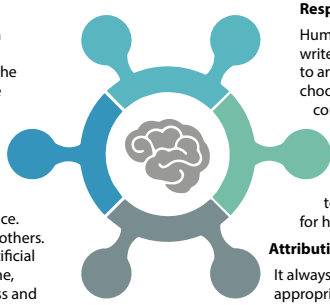
Hybrid writing, co-created by human and artificial intelligence together is becoming prevalent. Soon it will be the norm. Trying to determine where the human ends and where the artificial intelligence begins is pointless and futile.

Human Creativity is Enhanced

Human creativity is enhanced, not threatened by artificial intelligence. Humans can be inspired and inspire others. Humans may even be inspired by artificial intelligence, but our ability to imagine, inspire, and create remains boundless and inexhaustible.

Language Barriers Disappear

One's first language will begin to matter less and less as tools become available for humans to understand each other in countless languages.



Humans can Relinquish Control, but not Responsibility

Humans can retain control over what they write, but they can also relinquish control to artificial intelligence tools if they choose. Although humans can relinquish control, they do not relinquish responsibility for what is written. Humans can and must - remain accountable for fact-checking, verification procedures, and truth-telling. Humans are also responsible for how AI-tools are developed.

Attribution Remains Important

It always has been, and always will be, appropriate and desirable to appreciate, admire, and respect our teachers, mentors, and guides. Humans learn in community with one another, even when they are learning alone. Citing, referencing, and attribution remain important skills.

Historical Definitions of Plagiarism No Longer Apply

Historical definitions of plagiarism will not be rewritten because of artificial intelligence; they will be transcended. Policy definitions can and must adapt.

What comes next is exciting and concerning in equal measure, but AI is here to stay and education in higher education will have to adopt, adapt, collaborate and lead. At UCL, as in other universities, our researchers are constructing the AI-enabled and AI-led futures of work in sectors ranging across medicine, business, science, engineering and the arts. As we look to

18 https://drsaraheaton.wordpress.com/2023/02/25/6-tenets-of-postplagiarism-writing-in-the-age-of-artificial-intelligence/

their outputs, we need to ensure that higher education pedagogies and processes are keeping up while retaining a critical eye on the risks. Yet, as noted earlier, ChatGPT and similar tools have the potential to offer students access to new forms of learning assessment support. If we collaborate with AI developers to address the challenges, our students and the sector have much to gain.

3. Future-proofing HE: three anticipated changes

Professor Nick Mount, Professor of Learning Innovation, Academic Director, The University of Nottingham Online

The dominant model of contemporary higher education in the UK, and across much of the world, is an ephemeral one where learning happens in a pre-determined programme of study, experienced over a discrete time period, most commonly on-campus. This model has its roots in the educational ideals and structures of the twelfth century and has changed relatively little over the last 500 years.[19] Yet it is now being criticised as an overly expensive model that favours elites.[20] It is ill-equipped to meet the lifelong learning demands of a contemporary world characterised by the dynamism of a fourth industrial revolution that is in full flight.[21] These criticisms are especially relevant for regions of the world where demographic trends are driving exponential growth in demand for higher education, but where supply is lacking.[22] They are similarly relevant where there is an imperative for on-demand upskilling and reskilling to support economic growth, but where the limited availability of funding prevents access to expensive, traditional degree models or overseas study.[23] In the UK, where national demographic trends mean the sustainability of the higher education sector will become reliant on increasing levels of participation post-2030, it is reasonable to predict that the providers who flourish will be those that offer models of higher education that can tap into this latent unmet demand.[24]

19 Gavan Butler, 'Higher education: its evolution and present trend', *Journal of Australian Political Economy,* No 60, 2007, pp.28-53 https://www.ppesydney.net/content/uploads/2020/05/Higher-education-its-evolution-and-present-trend.pdf

20 Derek Bok, *Our Underachieving Colleges*, 2008, p.440

21 Cathy N. Davidson, *The New Education: How to Revolutionize the University to Prepare Students for a World in Flux*, Basic Books, 2017, pp.352

22 Simon Baker, 'How can Africa's vast appetite for higher education be met?', *Times Higher Education*, 1 September 2022

23 Louise Fox and Landry Signé, Inclusion, inequality, and the Fourth Industrial Revolution (4IR) in Africa, The Brookings Institute, 2022 https://www.brookings.edu/articles/inclusion-inequality-and-the-fourth-industrial-revolution-4ir-in-africa/

24 Rachel Hewitt, *Demand for Higher Education to 2035*, HEPI Report 134, 2020

In this context, the task of future-proofing UK higher education would appear to centre around the implementation of strategies that can deliver a greater diversity of educational models, reduce friction and barriers to access, are available on demand to a global student body and that offer personalised programme formats and lifelong routes to qualification. Achieving this is likely to involve several significant sector-wide changes that will need to be supported by enabling policy regimes and incentivisation. In the following paragraphs, I outline three significant changes that can be anticipated, and highlight their implications for future higher education policy in the UK.

Change 1: Providers will invest much more in online technologies to take their learning to where their students are, rather than assuming that their students will come to them.

The investment that most UK higher education institutions have made into their online learning environments is a fraction of what has been invested in their physical campuses. Their investment strategies are likely to require rebalancing. The rapid global growth in internet penetration and expansion of 5G data and new satellite-based internet services such as SpaceX's Starlink are projected to bring hundreds of millions of potential new higher education learners online in the next decade.[25] The Association of Southeast Asian Nations (ASEAN) region has seen 40 million new internet users every year since 2019.[26] Sub-Saharan Africa is forecast to see smartphone penetration grow from 51% in 2022 to 87% by 2030 with Latin America also forecasting significant growth, underpinned by widespread expansion of 5G data services.[27] Online learners, globally distributed, are arguably the most significant growth opportunity for UK higher

25 Marian Selorm Sapah, 'Starlink: SpaceX's new internet service could be a gamechanger in Africa', *The Conversation*, 1 March 2023 https://theconversation.com/starlink-spacexs-new-internet-service-could-be-a-gamechanger-in-africa-200746

26 Google, TEMASEK, Bain&Co, *e-Conomy SEA 2022: Through the waves towards a sea of opportunity*, 2022 https://services.google.com/fh/files/misc/e_conomy_sea_2022_report.pdf?utm_source=bain&utm_medium=website&utm_campaign=2022

27 GSMA, *The Mobile Economy 2023*, 2023, pp.52 https://www.gsma.com/mobileeconomy/wp-content/uploads/2023/03/270223-The-Mobile-Economy-2023.pdf; GSMA, *The Mobile Economy Latin America 2022*, 2022 https://www.gsma.com/mobileeconomy/wp-content/uploads/2022/11/GSMA_LATAM_ME2022_R_Web.pdf

education from 2030. But competition to attract them will be intense and international, and significant investment in online infrastructure and services will be needed.[28]

UK higher education's status as a trusted, global brand provides a solid foundation for capturing market share, but it would seem inevitable that stronger partnership between providers of higher education and educational technologies will be needed if the secure reliable and seamless end-to-end experiences that online learners expect is to be delivered. Marketing functions, that are commonly optimised for on-campus learners and defined degree programmes, will need technologies that can help them develop and implement sophisticated digital marketing strategies and data analytics capabilities for the online market. Without these, they are unlikely to be effective at maintaining brand loyalty with an increasingly diversified, distributed, remote and transient student body. Admissions processes will need to be redesigned to reduce friction of access for online learners through the integration of e-commerce portals, online payment gateways and digital identity verification technologies.[29] These will need to integrate with new student records and administration technologies that can manage increasingly flexible and unpredictable learner lifecycles. IT systems will need to adapt through technologies that can provide secure, reliable, device-agnostic services and support to global online student communities.

Fundamental changes to the digital platforms through which learning is conducted will also be needed. The role of institutional virtual learning environments will need to evolve from the storage and distribution of content to the provision of device-agnostic platforms capable of supporting active and engaging online learning. This will require investment in purpose-built, live virtual classrooms, synchronous and asynchronous collaboration and virtual study spaces, interactive and immersive online content and the adoption of learner analytics and emerging AI-driven tools designed to improve the guidance and support provided to online

28 Nadine Diaz-Infante et al, *Demand for online education is growing. Are providers ready?*, McKinsey Insights, 20 July 2022 https://www.mckinsey.com/industries/education/our-insights/demand-for-online-education-is-growing-are-providers-ready

29 https://www.coursemerchant.com and https://www.yoti.com

learners.[30] It will also require significant reskilling of those academic and learning support staff who are inexperienced in meeting the expectations and needs of online learners.

Change 2: Providers will diversify their offer through new hyper-flexible, skills-focussed, credit-bearing courses that can stack to a degree award.

Given the dominance of the degree within the UK higher education model, it is not surprising that the sector tends to think in programmes and apply the logic of programmes across the majority of its activities – from its approach to learning design and outcome specification, to quality assurance and delivery, regulatory compliance and statutory reporting. But in a future where increased participation will be essential for the higher education sector's sustainability, and the provision of flexible learning that addresses skills gaps is expected to be a primary driver of increased participation, considerable innovation in how learning is structured, delivered, assured and regulated will be needed.[31]

Microcredentials – short, quality-assured, credit-bearing and stackable learning products – are emerging as a key mechanism by which this can be done, and globally-recognised frameworks and standards are already beginning to emerge.[32] These endorse the tailoring of microcredential assurance processes and highlight the new challenges that microcredentials present; including the risks of unbundling

30 https://www.engageli.com; https://www.Studyverse.live; https://uk.learningmate.com; https://www.cadmus.io

31 Robert E. Moritz and Kevin Frey, *How to address the widening youth skills gap,* World Economic Forum, 31 March 2022 https://www.weforum.org/agenda/2022/03/how-to-address-the-widening-youth-skills-gap/

32 Alejandro Caballero et al, 'Microcredentials: a new category of education is rising', University World News, 5 July 2022 https://www.universityworldnews.com/post.php?story=20220705223949571; Giedre Tamouline et al, 'Exploring the potential of micro-credentials: A systematic literature review', Frontiers in Education, Volume 7, 9 January 2023 https://doi.org/10.3389/feduc.2022.1006811; Lifelong Education Commission, *The role of microcredentials in modular learning*, ResRepublica, June 2022 https://www.respublica.org.uk/wp-content/uploads/2022/06/The-Role-of-Microcredentials-in-Modular-Learning-LEC-Report.pdf; Peter van der Hijden and Michaela Martin, Short courses, micro-credentials, and flexible learning pathways: A blueprint for policy development and action, IIEP – UNESCO Policy Paper, 2023 https://unesdoc.unesco.org/ark:/48223/pf0000384326/PDF/384326eng.pdf.multi

existing degree modules, mixing and matching microcredentials within degree programmes and delivering coherent qualifications through the stacking of short-course credits.[33] They also imply the need for regulatory approaches that differentiate between microcredentials and degrees, and that facilitate innovation and flexibility by avoiding over-regulation.[34] In the UK such differentiation is yet to be achieved and there is a risk that UK providers will be required to operate in an over-burdensome regulatory regime that makes it difficult to compete in a global microcredential marketplace.

The highly modularised models underpinning innovations such as microcredentials also present opportunities to evolve the ways that higher education is funded and to increase access by lowering the costs of study. From 2025 the UK's Lifelong Learning Entitlement is set to create a single funding system to help learners in England and Wales pay for university courses, train, retrain and upskill flexibly over their lives.[35] However, the relatively large number of credits required for a course to be eligible (the equivalent of 300 study hours), and geographical restrictions on eligibility will present barriers to access for most learners, and it is reasonable to assume that alternative, consumer credit-based funding providers will emerge to fill the gap. To this end, financial startups such as Knoma offer important insights into how revenue share arrangements between higher education providers and specialist credit providers could enable completely new funding models to emerge, independent of government provision.[36]

33 David Boud and Trina Jorre de St Jorre, 'The move to micro-credentials exposes the deficiencies of existing credentials', *Journal of Teaching and Learning for Graduate Employability*, Volume 12, Issue 1, February 2021, pp.3 https://ojs.deakin.edu.au/index.php/jtlge/article/view/1023

34 Quality Assurance Agency, *Characteristics Statement: Micro-credentials*, May 2022 https://www.qaa.ac.uk/docs/qaa/quality-code/micro-credentials-characteristics-statement.pdf?sfvrsn=32bda081_4

35 Department for Education, *Lifelong Learning Entitlement overview*, updated 28 February 2024 19 September 2023 https://www.gov.uk/government/publications/lifelong-learning-entitlement-lle-overview/lifelong-learning-entitlement-overview

36 www.knoma.io

Change 3: Providers will empower their students as trusted, verifiable owners of their own educational credentials.

A higher education future with greater levels of participation, enabled by greater diversity and flexibility, is likely to be characterised by enhanced student mobility within and between institutions. Learners will expect low friction access to learning that meets their needs, when they need it, from their provider of choice. For providers, who have a statutory duty to ensure they only admit students onto courses for which they are appropriately experienced or qualified, this presents a significant challenge. How can rapid, frictionless admission and enrolment be achieved while also ensuring learners are appropriately suited to their chosen course of study?

Empowering students as trusted owners of their own academic credit records, and making these records digital, open and instantly verifiable will be a key part of the solution to this problem. These imperatives have underpinned the rapid growth of the digital badging and credentialing sector, which is projected to be valued at $80 billion by 2030, and underlines its emerging global importance to future higher education providers.[37] Indeed, given the relative maturity of digital credentialing services, and the introduction of blockchain technologies to ensure their veracity and non-fungibility, it is perhaps surprising that UK higher education providers have not yet embraced these technologies more enthusiastically.[38] Instead they continue to rely on legacies of centralised, institutional records and transcripts as proof of learner attainment and credit. This contrasts with the approach being taken by MIT, and its eight partner universities (including Delft University of Technology, UC Berkley and the University of Toronto) which have teamed up to create the first global infrastructure for the

37 Shubham Munde, 'Digital Badges Market Research Information by Type', *Market Research Future*, March 2024 https://www.marketresearchfuture.com/reports/digital-badges-market-6706

38 Merija Jirgensons and Janis Kapenieks, 'Blockchain and the Future of Digital Learning Credential Assessment and Management', *Journal of Teacher Education for Sustainabilty*, Volume 20, Issue 1, June 2018, pp.145-156 https://www.researchgate.net/publication/326038406_Blockchain_and_the_Future_of_Digital_Learning_Credential_Assessment_and_Management; Alex Grech et al, 'Blockchain, Self-Sovereign Identify and Digital Credentials: Promise Versus Praxis in Education', *Frontiers in Blockchain*, Volume 4, 2021 doi.org/10.3389/fbloc.2021.616779

recognition of digital academic credentials, with the potential to transform the movement of students between the partner institutuons.[39]

If it fails to embrace a digital credentials future, the UK higher education sector risks generating unnecessary friction and delay within its course admissions and enrolment processes relative to its competitors. This is likely to be a significant barrier to participation by potential students seeking on-demand access to learning. It also risks failure to capitalise on new digital marketing opportunities that digital credentials provide. These include social media and 'close the loop' strategies that can enhance future participation by directing credential holders to their next course of study and those verifying digital credentials to a provider's offer.

Implications and recommendations for policymakers and sector bodies

For the higher education sector to thrive in the future presented here, policy regimes and regulatory frameworks that foreground and champion innovation as the basis of long-term sustainability will be needed. But these will also need to acknowledge and balance the risks that innovation can bring. The UK's rigorous approach to quality assurance continues to underpin its globally trusted status but it should also be evolving to enable its future success. To this end, it is likely that a fundamental shift in the programme-based logic and assumptions that underpin assurance and regulation within the sector will be required. Without this, the structural norms around which regulatory conditions have been designed would make it difficult for providers to remain compliant while also implementing meaningful change in the ways that they configure their learning offers and deliver them to consumers. In this context, one can envisage a greater role for sector-wide bodies such as Advance HE and the Quality Assurance Agency (QAA) as trusted adjudicators of the benefits (or otherwise) that new educational technologies and innovative delivery models bring to students. Similarly, the ways in which the Office for Students discharges it statutory duty to guarantee value-for-money to students may need to

39 Suzanne Day, 'Nine universities team up to create global infrastructure for digital academic credentials', *MIT News*, 23 April 2019 https://news.mit.edu/2019/nine-universities-team-up-global-infrastructure-digital-academic-credentials-0423

evolve for a future where a significant proportion of learning is offered through microcredentials at price points that can be funded through consumer credit providers rather than state-backed loans.

Structural challenges can also be anticipated around the collection and reporting of student data to statutory authorities. The current approach, designed to capture relatively predictable student journeys, structured within programmes, and operating on predictable cycles, will struggle in a future where learners have greater control of their learning journey, and may engage repeatedly, and unpredictably, with providers. More flexible ways of measuring and codifying student experience and outcomes will be required. Credit accumulation rather than the academic year may represent a more appropriate quantum on which to base returns, and ways of both connecting and disaggregating student data, shared across the multiple different providers that a student might engage with may be needed. Measures of education value and benefit may also need to be reconsidered, including a greater focus on assessing the longitudinal impacts of lifelong learning journeys.

Navigating these changes and developing appropriate policy and regulatory solutions will require sector-wide cooperation and coordination in areas as diverse as digital transformation and investment planning, the diversification of course and programme formats, academic credit transfer between institutions and stackable credit models. It will require rapid learning from higher education providers, especially those in North America, who are further along the journey.[40] Sector bodies including Universities UK and MillionPlus are well placed to provide leadership, build cross-institutional support and engender regulatory engagement in the innovation that is required. The convening of groups to take on this work would be a positive first step. These could be important vehicles for the

40 Chris Burt, 'Model for the future? One fully online university's stunning success', *University Business*, 6 December 2021 https://universitybusiness.com/model-for-the-future-one-fully-online-universitys-stunning-success/; Jon Marcus, 'Is Arizona State University the model for the new American university?', *The Hechinger Report*, 11 March 2015 https://hechingerreport.org/is-arizona-state-university-the-model-for-the-new-american-university/; Rebecca LeBoeuf Blanchette, *The Future of Education: Leveraging Tech, Data to Support Students*, Southern New Hampshire University, 31 March 2022 https://www.snhu.edu/about-us/newsroom/education/future-of-education

creation of risk-managed opportunities for members to scope, test and refine the new higher education models of the future.

4. The landscape of twenty-first century learning

Professor Ian Dunn, Provost, Coventry University

In this chapter, I argue that we need to make the role of technology one of support for the struggle for equity of access and success in education. The amazing possibility to extend great learning opportunities must serve the many, delivering many of the qualities of an elite education for a mass population. It may be fair to say that our track record of equity in higher education is not glorious and so I would argue that we must amplify our efforts.

It would be inappropriate to start a conversation about learning in a twenty-first century context without reference to the history of the concept of mass higher education. In *Problems in the Transition from Elite to Mass Higher Education* in 1973, Martin Trow, the prominent director of the Centre for Studies in Higher Education at the University of California at Berkeley, commented on the changing dynamic as higher education grew from elite to mass participation.[41] He defined mass participation as 15% of the age cohort and went further to describe universal participation at 50%. This has relevance because the last 50 years have seen such massive change in our universities, yet the fundamental structures beneath them would be so familiar to Trow. On the face of it, there have been many changes – we have technology in the classroom and across our administrative systems, and we have many more universities. These facts alone have been remarkable bringers of opportunity to many and because of that, we have not really focussed hard on those left behind.

We must, however, face up to the fact that we maintain massive inequity of access, dependent on the school that you attend and your familial social and economic demography. And this in a system that still depends so much on social capital to define, for a significant few, the pathways to powerful careers, while ensuring the majority remain on the outside.

It is therefore my contention that now is the moment to deploy the latest technologies to serve the many. To work collaboratively to ensure that

41 https://eric.ed.gov/?id=ED091983

the powerful technologies we see emerging are mobilised to the benefit of the mass, or universal, participants of higher education. It is possible to envisage, without becoming too far-fetched, a role for technology, in addition to the role of the teacher, to augment the provision and deliver a proxy for the elite education model that is otherwise unaffordable to a mass audience.

The students in our institutions are a marvellous source of data that we largely exclude from the conversation. Their demands for technology to make learning accessible, connected and instantaneous, are often asserted but rarely evidenced – other than the anecdote of someone's child. We must do more to bring their voice to the front of design and development. After all, they are much more likely to be digitally aware.

Technology does afford a very exciting opportunity to bring great learning to life, to revolutionise access to systems and to allow the prediction of student future demands, in real-time. All of this does, however, demand massive cultural change in our institutions. The role of the academic changes to become a learning mentor and coach. The role of the student record system changes to become a holder of data that must be translated into predictive insight, and how we share content means that we cannot all be the authors of our course.

When we receive an enquiry from a potential student, we aim to turn that enquiry into an application. When we receive an application from a prospective student, we work hard to convert them to enrolment. Once we have enrolled a student, we work hard to ensure they are successful and that they graduate. For graduates, we look to track their progress in the world of work.

Connecting and linking these data points, married to the wealth of biographical data, we could introduce more sophisticated machine-learning approaches to help us support our students. We need to maintain an ethical position on the deployment of these data and indeed we have an opportunity to encourage our students to become more aware of their data in doing so.

The opportunities are many-fold. We can understand the characteristics of a successful student within a cohort, we can understand the patterns of behaviour of an individual student and act on deviation from those norms and we can pick up signs of students who appear to be disengaging and nudge them back into engagement.

More controversially, we can look for aspects of a student's background that raise potential red flags and marry those with the behavioural data to focus extra support on those students deemed most likely to be at risk.

We have the exciting prospect of intelligent agents being able to identify useful support texts that could be used to scaffold a student who is falling behind in a subject and to stretch a student who is romping ahead. We could identify issues of confidence with the material and again support in a differentiated way. This does mean that we need to find ways to deploy technology to scan the literature in a way that does not introduce bias and is confident about reliability, but these characteristics will come.

Ultimately, I can envisage a time when students share their social media feeds and other personal sources, with appropriate safeguards, and these data are then married with university sources to serve as proxies for wellbeing. Identifying anxiety before it becomes an issue and linking in support services feels like a more targeted approach to managing limited resources.

If more students have more support when they need it and in ways that allow them to move forward before they realise that they are stuck, then the time with teachers can be maximised for impact. Supporting the non-traditional learner with information that allows them to feel truly part of the institution; nudging the disengaged learner back into study before they consider dropping out; ensuring that the engaged student is stretched to learn beyond the confines of the curriculum and that the struggling learner is scaffolded with sources of information that introduce the concept in different ways; and supporting the anxious student before their mental health is impacted adversely. All these are ways in which technology and data may come together to serve a mass population in higher education and ensure that more students are more confident as they leave their course.

These hopes and aspirations for the transformative power of technology are often expressed, but how do we then make this happen? What are the challenges to the leadership of universities?

Our institutions are 'blessed' with many legacy systems, some so beloved because they are bespoke. Secondly, our organisational structures are incredibly devolved and so embedding new approaches and removing some of the legacy systems can be tough. We need to be bold and take on a few battles to reduce costs and increase operating efficiencies. None of which challenges academic freedoms, no matter what we may be told. While we may hold student record-type data centrally, there are many other forms of data that we will need to gain the insight to be predictive. These are most often held in a myriad of locations, often on spreadsheets. The GDPR implications alone may make you shudder, but the opportunity is massive. Creating that central data lake and managing our data professionally is essential.

We then need to create an education technology strategy that is clear and simple. It also needs to be properly costed, by which I mean it needs to be much larger than we may imagine. Implementation will mean the pain of transformation, the removal of legacy systems – not when everyone finally agrees, but on time according to the plan. The re-engineering of our processes is essential while simply forcing new solutions to map old processes is a recipe for massive spend and much pain.

Finally, as I am told often by a senior colleague, and I apologise for repeating, culture eats strategy for breakfast. Preparing the ground, from the board across the institution, is essential.

5. Technology foundations: the building blocks for excellence in modern universities

Gavin McLachlan, Vice-Principal, Chief Information Officer and Librarian, University of Edinburgh

Advancements in technology have fundamentally transformed how universities operate and educate students. While chalkboards and textbooks once defined the learning experience, universities now rely on complex digital ecosystems to deliver world-class education. In this chapter, I will explore the essential infrastructure underlying a modern university and how technologies like digital learning platforms, data analytics and cloud computing can establish some of the building blocks for institutional excellence.

Any leading university requires a robust technological foundation to support its academic mission. At the core is a versatile and highly secure network infrastructure that provides high-speed, reliable connectivity across campus facilities and the internet. With learning transcending the physical classroom, students expect seamless access to online instructional materials, lecture recording and web-based portals to submit assignments from anywhere, at any time. Increasingly, students are looking for options across on-campus courses, online and remote courses and various mixes of hybrid and fusion education. Powerful Wi-Fi and cellular networks enable this boundaryless education, while firewalls and gateways keep networks secure.

On top of this network backbone sits critical software platforms and services. A virtual learning environment (VLE) like Canvas or Blackboard proves essential for organising courses, delivering content, facilitating online discussions and tracking grades. VLE platforms house digital learning materials, foster collaborative workflows and centralise all course activities. Integrated lecture recording and virtual classroom software embedded within VLE ecosystems further bridge the physical distance between the classroom, students and educators.

An array of additional software tools and classroom technologies enhance teaching and learning. Note-taking, collaboration, ideation and interactive

applications like OneNote, Google Classroom, Microsoft Teams, Miro and Wooclap improve information retention, comprehension and participation. Interactive 3D and virtual reality medical and science tools bring abstract concepts to life through immersive simulations. Often, all these applications can be reached through a central personalised student portal.

Chatbots powered by artificial intelligence lend a helping hand with administrative tasks, like support and registration, freeing students to focus on learning and making the back-office more efficient.

Digital accessibility is becoming increasingly vital to ensure all students and staff have equality of access and usage to all learning platforms and other digital services at the university. Recently upgraded Web Content Accessibility Guidelines (WCAG version 2.2) provide clear standards to underpin the Public Sector's Bodies Accessibility Regulations. Any university classified as a public sector body must reach the AA threshold as a minimum accessibility requirement for its websites and applications.

Underneath these front-facing systems are expansive datacentres housing powerful servers, data storage, networking hardware and supercomputers. While students experience learning through user friendly and personalised applications and websites, server racks provide the raw computing power to deliver these services at scale. State-of-the-art datacentres rely on virtualisation and cloud technologies to seamlessly scale resources up or down based on real-time demands, keeping costs efficient, while providing the platform to run secure and high availability digital services. Because of their critical role, datacentres are critical university buildings that require uninterrupted power supplies, good physical security, back-up generators and a comprehensive business continuity and disaster recovery plan.

Cloud platforms also enable institutions to tap into vast ready-made services typically managed and run by the vendors at scale from their own datacentres. The learning ecosystem integrates with third-party cloud tools for web conferencing, video streaming, file sharing, productivity software and more. This interconnection of best-in-class cloud services creates boundless possibilities for enhancing learning.

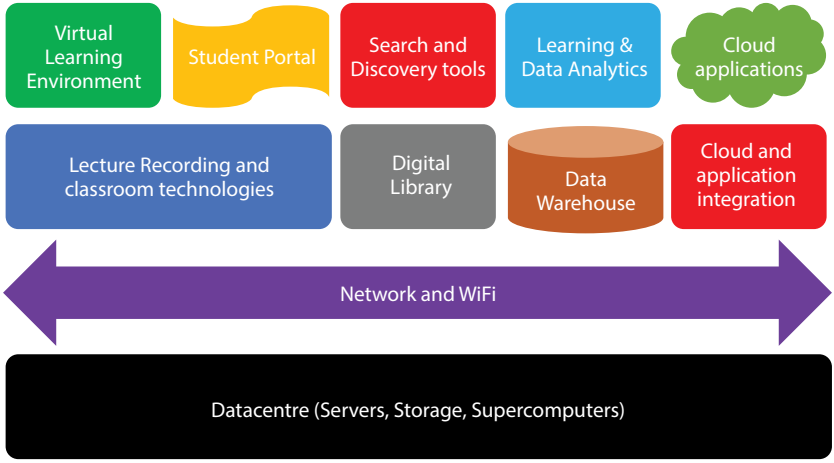
Each institution will need to make its own complex decision on what digital services it runs in the vendor's cloud or operates its own datacentres.

Of course, a major downside of fragmented systems is data silos. To gain insights, universities are embracing 'big data' consolidated in enterprise data warehouses. Analysing real-time student performance metrics, learning behaviours and engagement patterns allows continuously improving pedagogy, resources and predictive interventions. Analytics illuminate bottlenecks in curriculum development and areas where supplemental support may help at-risk students. When grounded in learning theory and pedagogical practice, and used within an ethical framework and policy, data analytics elevate educational experiences.

Technology is also the core building block of a modern university library. The vast majority of new library materials are digital with e-textbooks and electronic journals, articles and reference materials. Deriving value from these materials requires advanced search tools, digital librarian skills and highly integrated databases of educational and reference materials. Integration with other libraries and data sources is key to ensure the most comprehensive access to information for students and educators. Digitisation technologies and services allow any remaining books, objects or source material that are still in physical form to join this highly accessible body of knowledge. Search and discovery tools allow students and educators to find, compare and explore these huge rich information sources.

By integrating robust technical foundations spanning devices, networks, platforms, analytics and the cloud, universities dissolve geographic and temporal barriers. Students can enjoy seamless learning, tightly integrated with their digital lifestyles and preferences. For universities, technical excellence establishes the bedrock to deliver pioneering education that opens minds and changes lives. The great universities of tomorrow will be distinguished by how intelligently they harness technology to empower people to learn without limits. A diagram showing some of the key building blocks can be found in Figure 2.

Figure 2: Building blocks of digital infrastructure



Case study: University of Edinburgh Network Replacement

The University of Edinburgh invested £14 million in a comprehensive upgrade of its network. This project started with a replacement of the core firewalls and core network switches in its three datacentres, followed by a replacement of all switches, on every floor in each of its 550 buildings. Finally, the entire Wi-Fi network was replaced with state-of-the-art high speed Wi-Fi. The benefits were considerable. Security was significantly enhanced through strong protection, excellent detection and a quick and sophisticated ability to remediate any threats that occur. The speed and ease of access to the network was greatly enhanced for staff and students. All lecture theatres were built with enough capacity to allow five connected devices per student. The network can also now be leveraged to provide detailed business insight on key data such as building occupancy, energy and usage patterns. A university-wide standard network also ensures: a high-quality and consistent experience for all users; efficient, agile and effective in terms of managing and further adapting the network; and also greatly reduces any weak points or secondary networks that cyber attackers could potentially exploit.

In summary, a modern university relies on a cohesive technology ecosystem uniting infrastructure, platforms, services and data. The network backbone and datacentres provide access and computing power at scale. Intuitive learning platforms organise academic life, while cloud interconnection enables boundless services. Analytics extract insights from educational data to improve experiences. Together these interlinked technical blocks create a foundation enabling universities to spearhead learning innovation and positively impact society. Technology capabilities can no longer be an afterthought. Instead they form the cornerstones for institutional excellence in a digital-first world.

6. Data as a foundation for the future of education

Alex Leigh, Data Strategist, The Leigh Partnership

Technology will change education, and education will inevitably drive technological change. These are the certainties, but the success of both individual institutions and the wider sector in this complex space is not. In this chapter, I will examine the role of trusted data supporting, assuring and accelerating institution-wide initiatives targeted at reframing technology for the benefit of staff and students.

Digital transformation is a proxy for endeavours that focus technology delivery in support of the academic mission. As such, senior leaders are rightly invested in digital transformation and its outcomes. However, such programmes often fail to deliver sustainable outcomes or the promised return on investment of time, resources and money.

The simple reason for these failures is that digital transformation is hard. It is beyond the scope of this chapter to unpack the reasons for this. Instead, we shall focus on the critical data foundations that can positively or negatively affect such programmes:

1. **A lack of strategic data leadership:** Without a functional head, data leadership is often, at best, franchised or more often fragmented, leaving technology teams to take the lead. Having data positioned as a technical-only component reduces both its scope and utility.

2. **A fragmented understanding of the current state of data:** Storing data in multiple unconnected silos blocks much of the value of first identifying and then linking datasets to provide actionable insights.

3. **An under-investment in data skills:** Specifically in the areas of data governance and data architecture. These roles are often underfunded or not recognised as critical capabilities to unlock the power of an institution's data. Data skills are not the same as technology / IT skills, leaving this professional data class under-represented.

4. **Conflating data and technology:** This leads to a mindset that 'we just need a new system, and all our data will be fine'. Unintended consequences and future disappointments lie ahead if this thinking remains unchallenged.

The consequences of an incoherent approach to data include: an inability to make evidence-based decisions; staff and student frustration; exposure to regulatory risk; inability to access all funding streams; and sustained high cost of change.

These are driven by a host of issues not even recognised as a priority to resolve – they include data not documented, data not trusted, data not available, data hard to integrate and the high cost of data management, manipulation and visualisation.

Management responses to this toxic data environment often focus on data-quality cleansing projects. Attempting to fix problems at their point of use does not address the structural and systemic issues where the focus needs to be.

Data then become more of a problem than a solution. It is therefore time to rethink how data assets can visibly support universities' objectives – both for digital transformation and for wider themes, including effective decision making, efficient operation and risk mitigation.

It is important to start by positioning data as a strategic asset. Consider how to manage data like other respected assets – for example, people, finance and buildings. These assets are explicitly managed to align their scarcity to where they can be best used. To configure these assets to support university objectives does not require specialist expertise, but it does demand an understanding of strengths, weaknesses, priorities, deployment options and operational cost.

Most key university assets have an 'office of state' – an accountable senior officer, documented processes and embedded behaviours – for example, a Chief Finance Officer, a Director of Estates and so on. Significant training and support are provided to ensure staff and students have the skills and confidence to utilise these assets.

To elevate data to be a peer asset, five areas of activity need to be addressed:

1. **Data architecture:** This is the blueprint of how the institution organises and structures its data, making it easier to understand, use, develop and evolve in a sustainable way.

2. Data integration: This is the seamless merging of diverse data sources and often hidden data into one complete picture, bringing these together for a trusted and unified view.

3. Data governance: This creates an accountability framework and a broad swathe of best practices to manage data as an asset. It brings data 'out of the weeds' and into the centre of the institution where everyone can benefit.

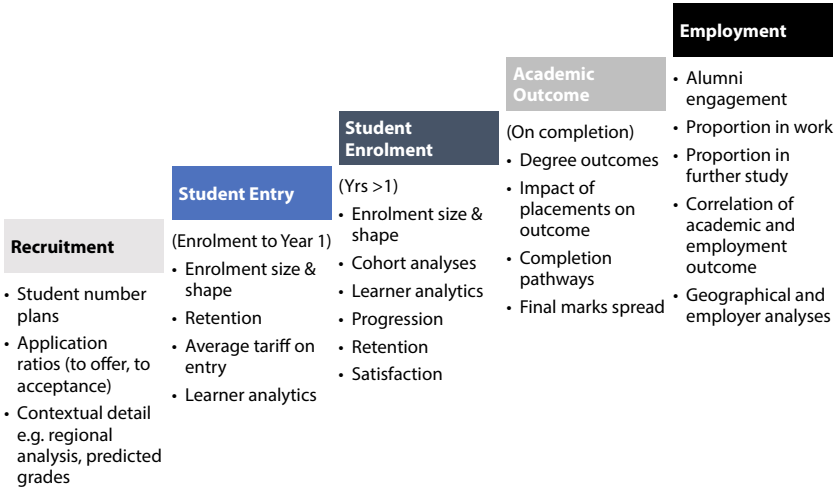
4. Digital skills: These are the tools and techniques that help navigate and understand the institution's data landscape. Done properly, these will empower staff to interpret, analyse and derive meaningful insights from information to support decision making and innovation.

5. Culture: This encapsulates the behaviours and approaches which will enable the themes described above. While data is powered by technology, the benefits can only be realised if the institution has a culture that understands, respects and manages data appropriately at all levels. That starts with senior teams explaining the change of approach and supporting others to do so. These activities are clearly interlinked. Data architecture is the blueprint to an end state aligned to the institution's strategy, while data governance builds the accountability and trust to act as guardrails for this journey. Data integration automates manual processes and breaks data out of silos, while prioritising digital skills increases participation and productivity.

Integrating multiple data sources and surfacing them through an integration layer (using products like Mulesoft or Boomi) is often the *sine qua non* of a successful digital transformation. Thinking of 'continuous improvement' rather than transformation can be helpful. Once the data is safely curated and available, a prioritised change journey can be implemented, adding architectural building blocks and software applications according to priorities and available resource. Curated, trusted data can define how to communicate the value and opportunity of data across the spectrum of a university's activities and goals.

An example would be the ubiquitous 'student journey'. In the schematic below, a metrics approach shows how treating data as an asset uplifts senior leaders' ability to manage key indicators to make necessary interventions.

Figure 3: Student journey – KPI data driven approach



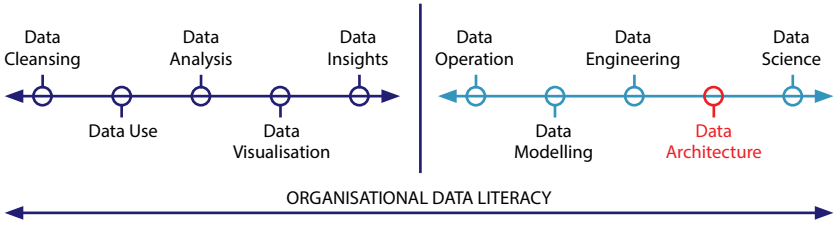
The data journey does more than mirror the student journey: it is the fundamental underpinning of it. It enables decisions and actions starting with recruitment targets and admissions levels before moving through enrolment and academic progress, finishing not just at graduation but looking beyond into employment and the alumni community.

The differences between this and how most universities manage their data is timeliness, accessibility, extensibility and trust. In short, the data required to make both university wide and single student decisions is embedded in the academic calendar. It is the opposite of the 'iceberg sighted behind' approach often seen in non-strategically aligned institutions.

The higher education sector has patchy success in harnessing data. However, this is changing, with data increasingly being seen as a differentiator for embarking on the digital journey, improving the outcomes of students, unlocking innovation in research, managing an increasingly difficult financial landscape and mitigating regulatory concerns.

The lack of investment in specialist data roles is problematic. While planning and academic teams have seen a welcome increase in data analyst roles, other important areas have suffered from long-term under investment.

Figure 4: Example of different kinds of data skills



There is often a misconception that 'data skills' and 'data literacy' are the same, and mostly generic. The full span of data literacy skills has many facets.

Data architecture helps us understand what the 'data world' should look like and prioritises our change portfolio to get there. It puts in place the building blocks and guardrails to create exciting new solutions and solve difficult old problems.

For example, if we cannot identify an individual how can we personalise support? That individual may be a staff member, an alumnus, an enquirer, an applicant, a student, a part-time lecturer or all of these. Data architecture takes a holistic view of who the people are that the institution needs to know the most about, and builds models to shape and direct projects, so each adds something to those critical data elements.

There are plenty of horror stories where this lack of strategic focus and investment in data, data skills and data practitioners have been lacking. Individual cases may seem unimportant or even trivial. One student being sent to the wrong seminar is unfortunate. A cohort suffering from this for three years will be reflected negatively in the National Student Survey. Taking a new data-led approach to resolving the issues most compromising to the institution in its ability to support its staff and students is critical.

Data are foundational to any and all digital transformations. Elevating data to the status of an asset, understanding its utility and where the same data can be used many times for many scenarios, managing data through

an accountability framework and laser focusing technology on business, not technical outcomes. All these themes support, enable and accelerate successful transformation of data.

Data are the foundation for navigating the changing landscape of technology-driven education. Unless we meet the challenges of managing data as a core institutional asset, we are in very real danger of building those foundations on sand.

7. The coexistence of the LMS and LCMS in higher education

Prasad Mohare, Senior VP, LearningMate UK and David Hopkins, Director of Content Services, LearningMate UK

Higher education is influenced by the technology employed at each institution. This is not a radical or disputed fact, but rather an uncomfortable introduction to the reality of running and maintaining a modern university.

Making good use of the technology will often fall on individual faculty members, while being maintained and managed by a central team as part of IT. However, the intersection and coexistence of the Learning Management System (LMS) and a Learning Content Management System (LCMS) within this framework presents a unique challenge. On the one hand, LMS platforms are designed to facilitate the educational process, hosting course materials, enabling assessments and fostering communication between students and academia. On the other hand, LCMS platforms are typically geared towards content creation and management, playing a pivotal role in the dissemination of information and the digital representation of the university's identity.

This contradiction often leads to a siloed approach to technology implementation, where LMS and LCMS operate independently, without fully leveraging the potential interactions between the two. In an era where digital integration is key to both educational and operational success, understanding the interplay between these systems becomes crucial. This chapter aims to unpack the complexities of LMS and LCMS coexistence, exploring how they can not only coexist but also complement each other to enhance the student journey and experience, streamline faculty workflows and contribute to the strategic goals of higher education institutions.

This journey is not without its challenges, but the potential rewards for students, faculty and the institution as a whole are substantial. The goal is to foster an environment where technology is not just a tool for management, but a strategic asset that enhances learning, teaching and the overall university experience.

The Learning Management System (LMS)

The most visible, and often derided, technology is the Learning Management System (LMS). This is the focal point for nearly all of the student's interaction or engagement with the teaching and administrative teams - accessing the timetable, assessing learning resources, assignment submission, links to live or recorded sessions, library reading lists, contact hours and / or study rooms, networking and / or team activities.

The LMS provides access to online materials, be it PDF or PowerPoint documents, bite-sized learning activities or video content, collaborative and group work, formative and summative assessments and more. The flexibility of the LMS is only bound by the imagination of the teams using them. While the LMS requires a careful and deliberate plan for installation, maintenance and usage (often aligned to an institution's teaching and learning strategy), the facilities available for non-technical faculty and administrative users enable them to deploy the options list of features for a variety of uses beyond the 'basic' requirement of teaching and learning.

Introducing the Learning Content Management System (LCMS)

A Learning Content Management System (LCMS) serves as a central hub for learning materials, enabling the storage, management and publishing of educational content to multiple courses across multiple platforms. Imagine having a SWOT analysis diagram loaded to multiple courses across multiple programmes or faculties. With an LCMS, if the diagram requires a style and branding refresh, you only need to update it once in the LCMS. With a simple action, the updated content is automatically distributed to every occurrence across the learning ecosystem.

This process underscores a key distinction between a Learning Content Management System and a Learning Management System. While the LMS is the front-facing environment where learners interact with the course content, the LCMS operates behind the scenes, managing and optimising the creation and distribution of learning materials. The LCMS facilitates efficient content reuse and repurposing across different courses and faculties, as well as seamless updates and enhancements, eliminating the need to overhaul entire courses within the LMS for minor content adjustments.

The role of the LCMS

As a LCMS is not a well-defined or understood tool in an institution's technology repository, it is perhaps worth noting the above view of a centralised store for learning content – be this text, multimedia or interactive materials. The LCMS can be viewed as a 'single source of truth' for content, ensuring consistency, flexibility and accessibility across uses and the institution.

The LCMS allows for efficient organisation, categorisation and tagging of content, aligned to a defined and carefully constructed set of metadata and tags, and supporting an institutional teaching and learning strategy. While the intended use of a LCMS is often a focus for teams who look for and procure such a technology, it is the teaching and learning professionals within the institution, often found in multiple departments and faculties and rarely in a centralised place, that are best placed to inform and advise on this structure. Such a streamlined management system of content makes it easier for academics and technologists to find and use relevant materials for their courses.

Challenges and solutions in LCMS and LMS coexistence

As with all technology integration in an institution as large as a modern university, it will require many systems and processes to align. The challenge will come on two fronts; understanding the requirements of the LCMS and ensuring the university systems can accommodate them (including non-technical factors of procurement that cover data protection, system requirements, accessibility and more), and ensuring the live link between the LCMS and LMS is stable to allow the updates to be actioned in real-time.

The implementation of a system like a LCMS, and the impact this could have across multiple areas of a university, require non-technical consideration. While the teams involved in procurement and technical integration may be able to get their head around the system, the academic and administrative users will need more time and more use cases to demonstrate the use, the power and the instructions to use it on a day-to-day basis. It cannot be overstated enough that a comprehensive training programme and

ongoing support are required to provide accessible support services to users.

Establishing clear governance for content creation, approval and updating within the LCMS is crucial. This ensures quality control and the relevance of the materials provided to students through the LMS.

Benefits of integrating LCMS with LMS

With an active LCMS and LMS working together aligned to an institutional teaching and learning strategy, the streamlined delivery of content from the LCMS enhances the capabilities of an LMS in managing and delivering accessible and flexible educational content in an organised yet efficient manner.

With the LMS often used to support both campus and online learning, the same artefact within the LCMS can be used multiple times, across multiple platforms, without fear of it being out-of-date or ignored when updates are made. With a fully integrated LCMS and buy-in from academic faculties, the possibility of better-organised content can lead to more engaging learning experiences, benefiting the student journey and fulfilling institutional goals.

Table 1: Main uses and users of a LMS versus a LCMS

	Learning Management System (LMS)	**Learning Content Management System (LCMS)**
Primary User	Educator Content Developer Administrator Student	Educator Content Developer Instructional Designer Project Manager
Manages	Teaching & Learning assessment Interaction & collaboration Progression & attainment support	Original content Organisation & structure Meta-data Reusable content Storage

Focus	Student progress Student experience Data & analytics	Organisation of content Accessibility Storage Flexibility Reuse & versioning Workflow Data & analytics

Practical integration

The integration of LMS and LCMS systems can take various forms, each one tailored to the specific needs and objectives of the institution – it is understood that most institutions will already have a working LMS, and it is the LCMS that is the addition to the toolset that needs integration.

One effective model is a complementary product integration approach. In this scenario the LMS continues, during the initial stages, to manage course delivery and student interaction while staff receive training on how and when to use the LCMS. Through Application Programming Interface (API) connectivity, content updated in the LCMS will eventually populate relevant sections in the LMS, ensuring consistency and up-to-date information across platforms.

Another model is a collaborative workflow system. Here the LCMS and LMS facilitate collaborative content creation and management. For instance, staff can use the LCMS to develop and refine course materials, which are then seamlessly integrated into the LMS for student access. This model encourages continuous improvement of educational content, driven by faculty expertise and student feedback.

Lastly, the 'Data-Driven Decision Making' (DDDM) model leverages the analytics capabilities of both systems. By combining data from the LMS (such as student engagement and performance metrics) with LCMS data (like content usage statistics), institutions can gain comprehensive insights into both the efficacy of educational content and the effectiveness of communication strategies.

Conclusion

To integrate these two distinct systems in a modern university is not just a consideration of the technological upgrade: it represents a strategic approach to enhancing the quality and flexibility of education. While both the LMS and LCMS play crucial roles in the learning ecosystem, their emphasis and functionalities differ: the LMS concentrates on managing the learner experience, while the LCMS is more content-centric, emphasising the creation, organisation and efficient management of learning content.

This collaboration ensures that the management and delivery of educational content is optimised, benefiting all stakeholders in the educational ecosystem. As the landscape of higher education continues to evolve, the combined use of these systems will be crucial in addressing the diverse needs of students and in shaping the future of learning and teaching.

8. Student-centric approaches to the university of the future

Professor Jane Harrington, Vice-Chancellor and CEO, University of Greenwich

I would like to think that the days of the 'sage on the stage', and didactic learning are long gone, although I suspect there are still pockets of resistance to their decline. While it is doubtful that they were ever effective, for a generation of students who have grown up with mobile phones and gaming, and see virtual reality (VR) and augmented reality (AR) as standard, it is increasingly hard to maintain this perspective. Alongside this is the growth of AI, with tools such as ChatGPT becoming part of students' expectations. It has become essential that we embrace the changes and focus on how to utilise technology to create student-centric approaches to learning.

While students as partners and students as co-deliverers has been the theme of numerous conferences and conference papers over the last 20 years, it is still rare to consider consulting students on how to shape the future of higher education. The global COVID-19 pandemic showed us that students are adaptable and if they have the tools (laptops, Wi-Fi, software) they can pivot their learning very quickly. Most students know what 'good' looks like when they see it and understand their own learning preferences. What was also evident was that many students felt isolated, and their mental health suffered considerably from the pandemic experience. The temptation is to see the solution as a return to the status quo. However, if you do ask students, you almost always get a more nuanced response. There is no doubt that a future university for students incorporates AI, allows them to move between face-to-face and online seamlessly and enables them to pace their learning and learning styles in a far more nuanced way than is generally seen today. It is also apparent that if we want students to feel invested in their learning, they need also to feel part of the development and experience of learning. In other words, student-centric technology enhanced learning is not an option for the future but essential.

To illustrate the ways in which we can and should be involving students in learning and the use of technology at universities, I will use examples

from the University of Greenwich where I am Vice-Chancellor and where, over the last few years, we have moved to a focus on students at the core of everything we do. This covers the very strategic aspects of our work and trickles down to the work of individuals and teams across the university.[42]

Two years ago, during the development of our Digital Enabling Strategy, it was very important for us to elicit requirements and ensure that our thoughts and ideas were tested with our student community.

We engaged with the Greenwich Students' Union (GSU) and a third-party higher education consultancy to facilitate a series of deep-dive workshops, to help us understand the future digital needs of our student body. The feedback we received was excellent and really helped shape the direction we took in developing our plans, our driving principles and our approach to digital engagement.

We have also engaged students in the recent development of our Digital Student Centre, a student enquiry platform, which allows students to get the help they need when they need it. They were welcome contributors, being both active and enthusiastic in helping design and give feedback on our early prototypes via dedicated student engagement and early adopter sessions. Additionally, the student contribution to our formal User Acceptance Testing was unprecedented, enabling us to have both staff and students in the same rooms for realistic and rigorous testing of all the issue logging, response and communications functions of the Digital Student Centre. Since its launch, the student take-up has been overwhelming and the feedback on resolution and response satisfaction has been consistently high.

At the University, we also use technology to ensure that students are actively engaged in their learning. For example, a student-centered learning environment has been developed by Dr Giulia Getti, an associate professor in microbiology, for her final-year students. Dr Getti approaches her module with the view that students should interact throughout and have a say in the course delivery. This starts with how they would like the lecture formatted – PowerPoint or Mentimeter? She has also created interactive lessons on our virtual learning environment (Moodle) that

42 To view the Digital Sub Strategy online, please go to https://docs.gre.ac.uk/__data/assets/pdf_file/0020/134570/digital-strategy-2022-2030.pdf

DIGITAL SUB STRATEGY 2022-2030

UNIVERSITY OF GREENWICH

Our Strategic Priorities *to help the university deliver its mission, vision & strategy*

The University's digital mission is to ensure everyone in our community is equipped to effectively use digital services, data and technology with confidence, resilience and creativity in their learning, teaching, research and organisational support.

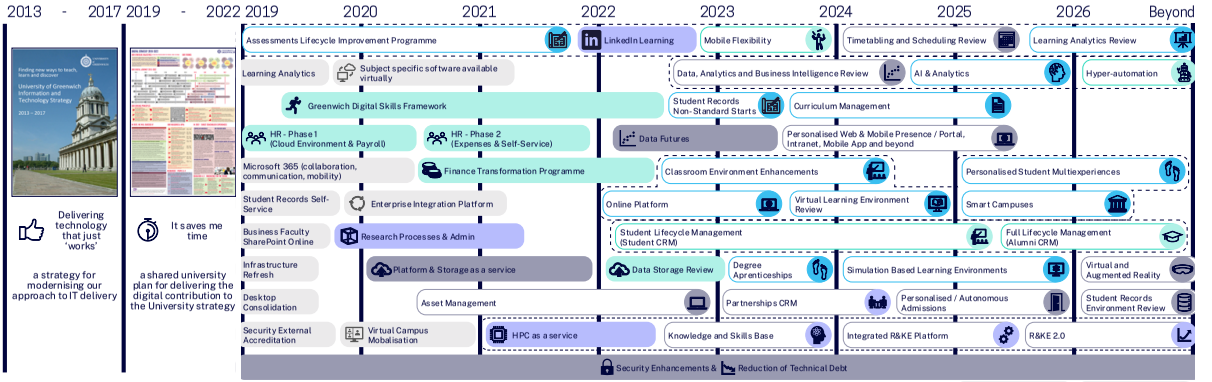
We will provide digital technology solutions which are highly performing, flexible and scalable to enable the university to adapt quickly and flourish in an increasingly challenging higher education environment.

1. Student Success
2. Research and Knowledge Exchange
3. Inclusivity and Culture
4. Connected and Sustainable Campuses

Our Priority Themes

- Learning Environment
- Student Lifecycle Management
- Data, Process and Decision Support
- Student Experience
- Research & Knowledge Exchange
- Digital Engagement

Our Digital Journey 2013-2030



Our Digital Principles

Digital By Default
We will be digital by default, ensuring digital is considered at the outset of every initiative.

We Are One University
We will operate consistently as an organisation, ensuring our processes and methods of working are simple and uniformly applied.

Inclusive By Design
We will deliver digital with respect for the full range of human diversity, working for as many of our students and staff as possible.

Digitally Competent
We will be a digitally competent workforce, embracing digital to enhance our working environment and prepare our students with life-ready skills.

Technology Excellence
Our technology solutions and infrastructure will be considered excellent and facilitate services which add value to every aspect of university life.

Product First
We will make use of commercial products and services by default and only develop internally where there is no viable alternative.

Consistent
Digital Skills
One University
Creative
Secure Simple Cloud
Service
Governance

Cloud First
Cloud products and services will be selected by default to gain benefits of scalability and as-a-service solutions whilst benefitting from a more sustainable IT environment.

Sustainable Digital
We will play our part in delivering on the sustainability strategy, incorporating the impact on the climate into the decision making processes with the aim of achieving net zero.

Security By Design
IT security must be embedded in our culture and within our governance, technology, applications and data. Security is everyone's responsibility and our systems and services must be secure by design.

Service Excellence
We will provide proactive support without delay, the way each student or colleague prefers to access it, to make effective use of available resources and to remove or eliminate unnecessary barriers.

Individual Experience
Boost individual productivity by providing an intuitive, effective and consistent self-service oriented experience that enables students and staff to learn, teach and work from anywhere at any time.

Meaningful Digital
Ensuring staff and students have the skills to use the digital solutions that are provided is crucial in ensuring our community gains the value from its investment in technology.

Key: Project | Capability

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they can use ahead of delivery so that interaction is about discussing the meaning of what they have learnt rather than sharing facts. Moodle-lessons include questions which are then discussed in more depth during tutorials and this allows learners time to think and permits deep learning. Moreover, it supports inclusion of those students who find it hard to think on the spot, plus there is much more that Dr Getti does 'in the room' to make students feel that they shape their course and are part of its development.

Another example is students studying on our Adult Nursing courses. To ensure that our future nurses are ready and confident from day one of their jobs, these courses match theory with clinical skills. To enhance those clinical skills, we have state-of-the-art Simulation / Clinical Skills labs equipped with a varied mixture of fidelity manikins (two of them with the capability of augmented reality), IP cameras, capture devices and captured audio. This gives students the opportunity to self-assess skills gaps in a safe and supported environment, allowing for practice to be corrected and refined prior to patient contact.

With cameras above every bed bay, simulations and scenarios can now be streamed live for debrief and reflection. This strategy puts the student at the centre of the classroom and allows them to self-assess their own understanding of the interactions to motivate them to seek out learning experiences pertinent to them. They can also be saved to the online learning space for review and reusable content. This gives us the flexibility to run simulations in a flipped approach to ensure our students experience simulation and take part in discussions.

My final illustrative case is Dr Katharina De Vita's approach to her undergraduate innovation module, where innovation is not only the subject matter but also a fundamental aspect of the teaching methodology and knowledge-creation process.

In this module, students are organised into small teams tasked with developing innovative ideas for products, services or business models within specific industries. Each group articulates a concise description of their idea, which they then submit to ChatGPT for evaluation and feedback. Following this initial step, students use specific prompts in ChatGPT to seek

insights on the feasibility, potential impact and uniqueness of their ideas. Equipped with the AI-generated feedback, each group then refines their ideas. The students actively participate in discussions, providing critical evaluations of ChatGPT's feedback, while the tutor offers guidance to pinpoint the aspects of the feedback that hold particular value or might be potentially misleading. Finally, the groups prepare brief presentations to showcase their innovations to the class. Ultimately, the class votes to determine the most innovative idea, using criteria such as feasibility, potential impact, uniqueness and presentation skills.

Each example is evidence of the move towards a student-centred learning environment, and the power of using technology. The increasing use of simulation and the learning from the health sciences in this field adds to the richness of what is possible. A student-centred learning environment has the potential for students to learn by doing and to facilitate and shape their learning in a multitude of ways, further enhanced through the use of technology. It also enables students to become critical friends to academics and to reshape the notion of the student and the academic.

The future for education is to place pedagogy firmly at the heart of what we do, and technology can and should assist this shift. It is essential that we approach the adoption of technology through the core understanding of what genuinely assists students' learning.

This collection of essays, edited by Mary Curnock Cook CBE and sponsored by LearningMate, brings together leading edtech voices to explain how technology is already improving higher education and how much more it could potentially do to transform the student experience for the better.

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