Rebooting learning for the digital age: What next for technology-enhanced higher education?

Sarah Davies, Joel Mullan, Paul Feldman

Higher Education Policy Institute

HEPI Report 93

About the Authors

Sarah Davies is head of Higher Education and Student Experience at Jisc. She has worked in technology-enhanced learning for over 20 years, predominantly in higher education, and currently leads Jisc's work to support learning and teaching in higher education. She has managed significant change and research and development projects in a number of areas of technology-enhanced learning, including digital literacies, learning environments, and assessment.

Joel Mullan is Senior Adviser to Jisc's Chief Executive, working primarily on policy, and strategic projects. He was previously research and policy adviser at the 1994 Group of universities; and education and skills manager at the cross-party think tank Policy Connect, where he set up the Higher Education Commission. He has written widely on higher and further education, including for the Institute of Education Press, CentreForum and the Guardian.

Dr Paul Feldman is Chief Executive of Jisc. Previously, he was an executive partner at Gartner UK, a technology research and advisory firm. He spent over 20 years in financial services at Nationwide Building Society, Barclays Bank and First Data EMEA, both in IT and business roles. He has also worked in knowledge-based IT companies, including Thomson Reuters, Legal UK and the Intellectual Property Office.

Cover image by Jisc - Matt Lincoln

Acknowledgements

The authors thank the many people from across the higher education sector, ranging from vice-chancellors to education technology practitioners, who have discussed the ideas contained in this publication with us.

Contents

Executive Summary

Just as elite sports teams are able to analyse what helps to boost performance, learning technologies and data-rich approaches can help identify what works in learning and teaching. This publication highlights some of the key areas in which digital technology can support efforts by higher education leaders and policymakers to boost student outcomes and enhance the student experience.

Designing technology-enhanced curricula

When 'designed in' as part of the overall pedagogic approach, technology can be used to enable great teaching and improve student outcomes. At Manchester Metropolitan University, for example, systematic wide-scale technology-enhanced curriculum design and improvement of the online learning environment have had a substantial impact on National Student Survey (NSS) scores. So, in light of the new possibilities enabled by digital technology and by data, university staff should look again at their teaching practices.

Examples of technology-enhanced approaches already in use in UK higher education institutions include:

- the use of technology to simulate experiments and field trips;
- the use of Massive Open Online Courses (MOOCs) within face-to-face provision;
- the redesign of assessment; and

- flipped learning – the use of online preparatory activities to enable face-to-face time to be used less for content transmission and more for richer interaction, or to improve utilisation of time in expensive facilities such as laboratories.

Technology-enhanced learning can improve the efficiency of provision. Evidence from 15 years of project work in the United States suggests systematic curriculum redesign using technology-enhanced learning can enable institutions to improve learning outcomes and reduce costs simultaneously. On average, these projects achieved savings of 31 per cent, with 72 per cent of projects resulting in improved student outcomes, with outcomes in the other 28 per cent remaining constant. The time has come to evaluate how such approaches can be applied in the UK.

It is essential that any changes to delivery are driven by educational considerations rather than university balance sheets. Any perception that technology is being used just to cut costs will make it harder for universities and students to benefit from future developments in educational technology.

Recommendation 1: Higher education institutions should ensure that the effective use of technology for learning and teaching is built into curriculum design processes. This should include consideration of win-win methods, which offer both improved outcomes and lower costs.

Recommendation 2: To support this, the UK higher education sector should develop an evidence and knowledge base on what works in technology-enhanced learning to help universities, faculties and course teams

make informed decisions. Mechanisms to share, discuss and disseminate these insights to the rest of the sector will also be required.

Learning analytics

Learning analytics, which correlates patterns of student activity with learning outcomes, offer staff the opportunity to spot disengaged and underachieving students at the earliest possible opportunity. Growing evidence from the UK, US and Australia demonstrates that, when used effectively, learning analytics can reduce university non-retention rates:

- at Columbus State University College in the US, retention rose by 4.2 per cent (5.7 per cent for low-income students);
- in the UK, Open University pilots have seen a 2.1 per cent boost in retention; and
- in Australia, pilot schemes at the University of New England saw drop-out rates fall from 18 per cent to 12 per cent.

Learning analytics is a tool that supports students to reach their potential. So its potential uses could well beyond retention. Some universities are using it to support students to improve their performance across grade boundaries, for example, moving from an Upper Second to a First class degree.

Drawing on behavioural insights and 'nudge theory', UK universities are giving students access to learning analytics data on their own engagement and performance to help them understand how to improve. At Nottingham Trent University, 81 per cent of first-year students reported that they increased

the amount of time they spent studying after viewing their engagement data.

Learning analytics could soon be ubiquitous across the sector – becoming a foundational technology that drives data-driven practice in institutions. At a time when there is greater focus on the efficacy of spending on student success, learning analytics data provide a useful mechanism to check in near-real time whether interventions are working.

We also expect, as technology matures, that learning analytics data will provide a basis for the delivery of personalised learning, tailored to the areas where individual students are struggling.

At a sector-wide level, the big dataset created by the UK's national learning analytics service – a world first – is a huge new asset for educational research in UK higher and further education, which could help generate new insights on what works in teaching and learning.

Recommendation 3: Institutions that do not currently have learning analytics in place should give consideration to adopting it at the earliest opportunity.

Recommendation 4: Education researchers should consider how the learning analytics big dataset can be harnessed to provide new insights into teaching and learning.

The Teaching Excellence Framework

The introduction of the Teaching Excellence Framework (TEF) is a key moment for the use of technology-enhanced learning

in the UK. With a new focus on teaching, and strategies for measuring excellence or identification and resolution of areas for improvement, the TEF is focusing university leaders' attention on the new opportunities presented by technology-enhanced learning.

Recommendation 5: Digital technology should be recognised as a key tool for higher education institutions responding to the TEF. Providers should be expected to include information on how they are improving teaching through the use of digital technology in their submissions to the TEF. The Department for Education (DfE) and the TEF panel must ensure the TEF does not act as a barrier against institutions innovating with technology-enhanced approaches.

Realising the opportunity

As a prerequisite for sustainable success in the use of digital technology, universities should develop strong digital leadership and a suitably skilled workforce.

Recommendation 6: Higher education institutions should ensure the digital agenda is being led at senior levels – and should embed digital capabilities into recruitment, staff development, appraisal, reward and recognition.

Recommendation 7: Academic leads for learning and teaching should embrace technology-enhanced learning and the digital environment and recognise the relationship with other aspects of learning and teaching.

Conclusions

Alongside Australia and the United States, the UK is already leading in the use of technologies to improve learning and teaching, but other countries are also investing in these areas and the UK cannot risk falling behind. The UK should now build upon its existing investments to increase its competitive advantage.

For most institutional leaders, the question is no longer whether or not to invest in technology-enabled learning, but rather how and where to invest for the best results. Now is the time to seize the opportunities that technology-enhanced learning provide for students and universities alike.

Introduction

Learning and teaching practices within higher education have changed surprisingly little over the last 20 years. Other sectors, such as banking, music and publishing, have been turned upside down by digital technology, but the UK's research and education sector has yet to fully exploit the potential of new technologies. Pockets of innovation are found in almost every institution, but few have fundamentally changed how they teach.

Technology-enhanced face-to-face learning includes, but is in no way limited to:

- electronic delivery of course content and learning resources;
- the use of technology to enable communication, collaboration and reflection; and
- the use of data generated from the many ways students interact with electronic systems to provide new forms of learner support.

University leaders are becoming more aware of the transformational potential of technology. In a 2015 survey of vice-chancellors carried out by PA Consulting, 70 per cent believed technology-enhanced learning is essential for survival and/or the key to competitiveness, a message reinforced by our experience when engaging with senior leaders across the sector.[1]

This report highlights where higher education institutions in the UK, and beyond, are investing and seeing the greatest returns.

It provides a primer on new evidence from across the sector and around the world to map some of the most innovative uses of technology and sets out the key opportunities for higher education institutions.

It does not propose implementing technological solutions for their own sake or as an end in itself, but explores where experience of using digital technologies to re-engineer face-to-face teaching may have wider implications for the whole sector.

Much public discussion and debate about digital technology in higher education over the last five years has focused on online distance learning and MOOCs. In this publication we have deliberately focused instead on how technology can support face-to-face learning. Jisc will however be looking closely at the future of online learning as another strand of our technology-enhanced learning programme.

Where are we now?

Historically, there has been significant variability in the use of technology within institutions. This has been due in part to the tendency for individual members of staff to drive innovation, rather than it emerging from strategic initiatives. In response, almost all institutions now provide a baseline level of technology-enhanced learning to meet staff and student expectations. This generally consists of, at least, virtual learning environments, access to online content, plagiarism detection and electronic submission of assignments.

Student expectations can change relatively quickly however. The case of lecture capture illustrates how quickly some technologies can go from being peripheral to mainstream.

Lecture capture

Lecture capture allows students to catch up on contact hours they have missed and review past lectures. Online recordings of lectures have been available for some years but provision has been patchy and it has often been the individual academic's decision whether to record their lectures or not.

Recently, this has changed and many universities now mandate or strongly encourage the recording of all lectures in rooms where this is enabled. By September 2015, 42,000 lectures had been recorded (80 per cent of the total lectures taking place) at the University of Manchester, and 95 per cent of students surveyed wanted to see the system used even more widely.

Despite initial concerns that students would stop going to lectures if recordings were made available, evidence to date suggests that students tend to use recordings to reinforce lecture content rather than as a replacement for attending lectures.[2]

A recent survey of over 7,000 higher education students found that nearly three-quarters thought digital technology improved their learning when used effectively by teaching staff.[3] Students value 24/7 access to online content, slides and lecture notes, and want greater use of lecture capture and more consistent use of online services, including virtual learning environments, online activities and assessment submission.[4]

The big opportunities in technology-enhanced learning

There are two big opportunities – curriculum redesign and learning analytics – that universities should be considering if they are to make the most of the potential of technology to transform teaching and learning.

Opportunity 1: Designing technology-enhanced curricula

Technology can be used in a range of ways to enable great teaching and improve student outcomes when it is 'designed in' as part of the overall pedagogic approach of the course. Doing this often involves systematically redesigning whole modules or courses, taking advantage of technology to support learning. It includes rethinking the way we teach in the light of the possibilities offered by technology.[5]

The technology-enhanced curriculum designs which support excellent teaching vary across disciplines and the type and level of courses, but some common underlying features can be identified.[6]

- **Active learning using alternatives to the traditional lecture:** This might include learners researching topics online, using simulations and online tutorials, carrying out collaborative online assignments and interrogating datasets. In a flipped model, technology is used to deliver or engage learners with course content online before class, freeing up face-to-face time for active group work and discussion.

- **Frequent formative assessment and rapid feedback:** Online tests are a classic example of this, and can be

particularly effective in STEM (Science, Technology, Engineering and Mathematics) subjects and other curriculum areas for which meaningful multiple-choice questions can be designed. Clickers or other audience response systems can be used in class to enable immediate feedback, and can be used by lecturers to identify topics requiring further explanation. Online discussion groups and social media can be used to encourage learners to share their understanding and receive feedback.

- **Peer-to-peer learning and increased interaction among students:** This might include group work and shared digital assignments in a range of formats, using collaborative online environments (sometimes known as wikis) for shared writing and using discussion groups as well as social media.

- **Monitoring student progress and intervening when necessary:** This is often facilitated by formative assessment, but can also be enabled by checking on students' work in open environments such as blogs and wikis. Using face-to-face time for group work or tutorials rather than lectures can also allow lecturers to listen to students and identify and tackle misconceptions.

Redesigning learning in practice – some examples

As a Quality Assurance Agency (QAA) study recently identified, technology-enhanced learning initiatives will only lead to excellent teaching if they are applied with a focus on pedagogy, aligned with strategy, and suited to the institutional, learner and discipline context.[7]

There are a number of examples of how technology-enhanced learning is being used to increase the effectiveness of face-to-face teaching.

- In the flipped learning approach being used at **Nottingham Trent University**, students use self-study time to review content presented in a range of formats – including short videos, podcasts and readings – with face-to-face time used for collaborative small-group activities, often in specially designed, technology-rich spaces, with the tutor acting as facilitator and guide.

- In laboratory-focused subjects, online learning can help ensure lab time is well spent. At the **University of Strathclyde**, for example, students prepare for Materials Science practicals by working through a mandatory online learning activity, including video and automatically marked self-assessment questions. The tutors start the face-to-face sessions assuming a higher level of knowledge among students, freeing up time for practical work. After the lab session, students from different groups share their results and work collaboratively online to discuss and analyse them. The **University of Bristol** and others have successfully used similar approaches for Biological Sciences.

- Some course teams are using technology to change the type of learning activities that students undertake in order to make them more relevant to employment. The **University of Greenwich** has a Virtual Law Clinic that enables teams of students to work together in a secure online environment to draft legal advice collaboratively in response to queries from the public. The students are supported by staff and

legal professionals and are given feedback until their legal advice reaches an acceptable standard, when it is signed off and emailed to the client. Students reflect on what they have learned in an assessed online log.

- The School of Business and Society at **Glasgow Caledonian University** uses a similar wiki-based process to enable students to research and answer international entrepreneurs' current business questions collaboratively. This 'challenge' approach is also being used by second-year Business Studies students at **Edge Hill University**. Students on a project management module watch a pre-recorded lecture each week, spend an hour of face-to-face time discussing the content with the lecturer, and use the rest of their study time for the module working in two large self-organising groups on online projects that are of wider benefit, even racking up 'billable hours'.

- The availability of digitised primary sources such as rare Early English books or parliamentary papers enables history and related disciplines to incorporate independent research activities which would not previously have been possible in many settings. History lecturers at **Canterbury Christ Church University** ask students to independently research a topic through online and other sources, and then use online forums and online debates to assess students' skills in presenting an argument, using appropriate sources, and engaging with the views of others. Class time can then be used for a range of interactive workshops. At the **University of York**, cultural heritage and archaeology students produce blogs to develop new ideas, engage the public, and begin to shape their professional profile.[8]

- Some universities use MOOCs and other online courses to extend the experience of their on-campus students. **Coventry University** Photography students take some of their modules as part of an open online 'borderless classroom', using social media and blogs to post and discuss their photographs with thousands of online learners worldwide, preparing them for modern digital practice and developing their online presence. The **University of Edinburgh** has a commitment to enable campus-based students to take online credit-bearing modules to broaden their studies.

In order to help universities, faculties and course teams make effective use of technology to support teaching and learning, the UK higher education sector needs to share and discuss what is known about technology-enhanced approaches that make the most difference to student learning, and build on that knowledge base to provide robust evidence of what works for learners in different contexts.[9] The recent QAA study points to the importance of an evidence-based rationale for technology-enhanced learning at an institutional level, with ongoing evaluation. This evidence base can then provide the foundation for curriculum design and delivery, using technology to maximise impact. Jisc are currently exploring options for pulling together an evidence base at a national level, informed by qualitative and quantitative evaluations and building on data-driven approaches, including such as learning analytics.

Making the most of new student data

The key types of institutional data that best inform curriculum

redesign, in addition to specific case studies and evaluations, are:

- student results at assignment and module level;
- student employment destinations;
- student views on their learning experience (including satisfaction measures), derived through focus groups, student engagement initiatives or surveys; and
- activity data and analytics showing what students are doing with the resources, activities and opportunities provided.

Universities already analyse key datasets – such as student satisfaction scores, module feedback, patterns in assignment marks, final grade and employment destination – to identify areas for improvement. A more detailed picture of how well learning activities and teaching strategies are working on a given module can be obtained by comparing these existing measures against the kind of activity data collected for learning analytics, data which is now being collected and effectively used for the first time.

However, even fairly simple data sources can be useful drivers for informed change, and some universities are using data on how often students visit key learning and teaching systems to prompt conversations with teaching staff.

Student engagement

Sustained student engagement is crucial in any curriculum redevelopment. In the absence of informed dialogue with staff about the aims and design of their course – or experience

of non-traditional delivery models – students can be fairly conservative about course design. They may retain a lasting affection for lectures and other forms of traditional face-to-face contact.[10] They can be suspicious of approaches such as flipped, collaborative and problem-based learning until they have experienced them for long enough to reflect on their overall learning progress.[11]

Nottingham Trent University found students needed to be carefully introduced to a new flipped collaborative model of teaching and learning, but that once they had experienced it, they had high levels of satisfaction. Universities such as Exeter and Winchester have engaged students as partners in educational development and curriculum redesign projects and have found that their involvement benefits both staff and students and results in new insights which inform course design.[12]

Assessment

Assessment is a key driver – or inhibitor – of innovation, and the focus of an enormous amount of staff and student effort. Reviewing assessment design and practice is crucial to improving the teaching and learning experience as well as student employment outcomes. It should be the starting point for institutional approaches to curriculum redesign. What messages do the assessments we set send our students about the knowledge-based, analytic and creative practices that are important to the disciplines we teach? Do they focus on challenging or professionally-relevant activities? Do they support the development of the digital and collaborative skills that are more important than ever for employability?

The University of Strathclyde carried out a large-scale redesign of its approach to assessment, using technology and clear pedagogic principles, and was able to demonstrate improved learning and more efficient use of staff time.[13]

Institutional approaches to curriculum design at Manchester Metropolitan University

Institutional approaches to curriculum design combine educational design – the pedagogical decisions taken by course teams – with institutional processes such as information management, market research, marketing, quality enhancement, quality assurance and programme and course approval.

Some UK universities have successfully undertaken coordinated approaches to curriculum redesign in recent years, usually to tackle issues with the student experience or to enable delivery of strategic priorities relating to employability or a research-informed curriculum.

At Manchester Metropolitan University, a dip in National Student Survey (NSS) scores and follow-up student focus groups pointed to student dissatisfaction with course organisation and assessment. Students wanted a clearer view of what they needed to do and when, where they were meant to be and which books and past exam papers they needed to consult. Further exploration revealed the curriculum had grown organically and become unwieldy, with more assessments than necessary.

In 2010, the University launched a large-scale programme to bring together everything students needed for a personalised timetable and study plan, alongside an engaging blended learning experience. This involved the complete redesign of the undergraduate curriculum over a three-year period, working within a new curriculum framework and a more responsive, technology-supported design and validation process. The new framework required fewer summative assessments and had better alignment between learning outcomes and assessments. After the initiative began, the university saw improvements in NSS scores in teaching (5 percentage points), organisation and management (11 percentage points), assessment (9 percentage points), learning resources (12 percentage points) and overall satisfaction (8 percentage points).[14]

Learning spaces

As universities start to make strategic drives towards more technology-transformed teaching models, many are redesigning their learning spaces to fit these approaches better. Whereas the trend a few years ago was towards building larger lecture theatres to accommodate bigger cohorts, now institutions need to consider what kind of spaces enable them to carry out high-impact and engaging learning and teaching activities. Many universities have created flexible spaces which enable group work and the easy display and sharing of students' work. The University of Northampton's new Waterside Campus, built with 'teaching spaces' in place of lecture theatres, is perhaps the most high-profile and furthest-reaching example of this in the UK.

The University of Northampton

Northampton wants to develop students to be digitally capable in both learning and in life. Some of the teaching is, therefore, online but it is always connected to face-to-face interactions and always involves actively working with tutors. Northampton call this Active Blended Learning – with an emphasis on high-quality contact time, and where face-to-face teaching is facilitated in a practical and collaborative manner, clearly linked to structured online activity outside the classroom. Two-thirds of all the modules have been redesigned in this way.

Technology is used as an enabler of student learning in and outside the classroom, at home and on the move. Electronic submission of assessed work has been a standard at Northampton for the past five years. This approach to programme redesign delivers an enhanced, student-centred, personalised and technology-enabled experience for all students, which will be further expanded at the new campus, which opens in 2018.

Cost-effective teaching

Although much discussion on the benefits of technology-enhanced learning focuses on improvements to learning, teaching and the student experience, some applications can improve the efficiency of provision.

The impact that technology-enhanced learning has on learning outcomes are enough to justify the investment and effort required. Nevertheless, especially with spending likely to remain tight, it is worth looking at the savings that can be delivered through technology-enhanced learning.

Studies by the National Center for Academic Transformation (NCAT) in the USA over a 15-year period show that systematic institutional-wide approaches to course design can lead to better outcomes and retention while also yielding savings.

A meta-analysis of 156 NCAT projects found all but three had reduced the costs of delivery, with an average saving of 31 per cent (savings ranged from 4 per cent to 81 per cent). In addition, 72 per cent of the projects demonstrated an improvement in learning outcomes, while outcomes in the other 28 per cent remained broadly the same as before the course redesign. The evaluation also noted increased completion rates and 'increased student and faculty satisfaction with the new mode of instruction'.[15]

Key aspects of course redesign which lead to efficiencies were identified by NCAT as:

- working together as a course team to redesign a given programme or module, so that work is shared and the teaching team can use common resources;
- the use of interactive learning resources and students working in teams in preference to lectures;
- taking advantage of automated assessment where possible;
- the use of course management systems, including those that track student progress
- a system of teaching and support that uses appropriately skilled and trained staff for the type of support required.

The efficiencies created can be used to allow faculty teams to teach larger student numbers or to create new courses.

In a similar vein, Professor John Hennessy, the former President of Stanford University, estimates that blended learning can reduce the cost of classes 'by around 15 per cent … without an accompanying reduction in quality.'[16] The emerging evidence from the school sector in the US supports this presupposition – though further research and evaluation are required.

A recent evaluation by the University System of Maryland found course redesign projects had improved outcomes and freed up US$7.5 million for other investment. Yet more telling is its description of barriers: the University System found the implementation hard, with a need for clear leadership at the top of participating institutions, dialogue with teaching staff to overcome preconceptions and misaligned beliefs and appetite to address infrastructure or process issues.[17] As ever, the success of a technology-enhanced change can only ever be as effective as the ability of the project's leaders to take colleagues with them.

In the early 2000s the NCAT approaches were discussed in the UK by educationalists and policymakers, but were not at the time deemed suitable for transfer to the UK. Nonetheless, in 2010, Graham Gibbs cited the NCAT findings in his influential report *Dimensions of Quality* as evidence that standards could be maintained in large cohorts with reduced funding.[18]

With technology-based approaches and learning design now maturing, and with a vastly changed funding landscape, the time has come to re-evaluate how approaches like these can be applied in the UK.

Although significant curriculum redesign projects are not a quick win, they offer improved outcomes and lower costs. It is essential, however, that any changes to delivery are driven by educational considerations rather than university balance sheets. Any perception that technology is just being used to cut costs makes it harder for universities and students to benefit from future developments in educational technology.

Recommendation 1: Higher education institutions should ensure that the effective use of technology for learning and teaching is built into curriculum design processes. This should include consideration of win-win methods, which offer both improved outcomes and lower costs.

Recommendation 2: To support this, the UK higher education sector should develop an evidence and knowledge base on what works in technology-enhanced learning to help universities, faculties and course teams make informed decisions. Mechanisms to share, discuss and disseminate these insights to the rest of the sector will also be required.

Opportunity 2: Learning analytics

Learning analytics refers to the measurement, collection, analysis and reporting of data on the progress of learners and the contexts in which learning takes place. Every time a student interacts with their college or university, whether going to the library, logging into a virtual learning environment or submitting assessments online, they leave a digital footprint behind. Learning analytics is the process of correlating this data with learning outcomes.

From this data, universities can then:

- measure how engaged learners are with their studies;
- identify preferred personal learning styles; and
- predict whether learners are likely to complete their studies and what grade they are on course to achieve.

Learning analytics draws data from across university systems into a single data warehouse. A data processor then compares the individual level data with current and historical data from that university to identify any students who might be disengaged, as well as broader trends. The data are made available to teaching staff and on an aggregate level to university managers. Individual students are also able to access their own data – and take control of their own learning – via an app.

Learning analytics are being used by institutions to reduce non-continuation rates by providing early indications of disengagement and to support students to achieve their full potential.

Increasing retention

Learning analytics systems enable universities to track individual student engagement, attainment and progression in near-real time, flagging potential issues to tutors. This means tutors and other student support staff receive the earliest possible alerts of students at risk of dropping out or underachieving.

The models are increasingly accurate at identifying students at risk. At the New York Institute of Technology, the predictive

model is 74 per cent accurate – in other words, three out of every four students predicted as at risk by the model do not complete their course.

Having identified at-risk students, institutions can then follow up with students to investigate the causes of disengagement and offer support. At the University of New England in Australia, a pilot project saw student attrition rates fall from 18 per cent to 12 per cent.[19] A similar pilot at the UK's Open University found that retention was increased by 2.1 per cent.[20]

Evidence from the United States is also promising.

- At the University of Nebraska-Lincoln, the four-year graduation rate increased by 3.8 per cent in the four years after a student success system was deployed.
- At Columbus State University, Georgia, course completion rates rose by 4.2 per cent (5.7 per cent for low-income students).
- At Youngstown State University, Ohio, (where 56 per cent of students are first-generation higher education students and 88 per cent receive financial aid), completion rates increased from 81.1 per cent to 86.8 per cent in three years.[21]

Learning analytics data offer valuable insights into how university support systems can be improved, and can also help universities understand which interventions work best. At a time when there is increasing focus on the efficacy of spending on access and student success, this can help institutions to review and demonstrate the effectiveness of their student support. We expect learning analytics data to inform improvements to

the guidance and support available to students as well as the interventions offered to students at risk.

Supporting student success and empowering students

Learning analytics can also empower students to take control of their own learning – for example, through a student-facing app. In the same way that a fitness app gives users access to their own physical activity and health data, a learning analytics app provides students with access to their own learning activity data and predicted outcomes. Drawing on behavioural insight theory, we expect to see students empowered by such information to change their own behaviour.

At Purdue University in the United States, students receiving alerts from the Signals learning analytics pilot system had an increased probability of achieving a B or C grade and decreased probability of achieving a D (unsatisfactory pass) or F (fail) grade. In a Biology course, the Signals pilot produced 12 per cent more B and C grades than among students not involved in the pilot, and 14 per cent fewer D and F grades. Students in pilot groups sought help earlier and more frequently from subject help desks and additional tutoring sessions than those not taking part. Even after the interventions stopped, these students sought assistance 30 per cent more often than those in the control group.

In the near future, learning analytics data will also become a key component of personalised learning. The next generation of virtual learning environments are expected to use data captured from individual student interactions to signpost students to content that will help them develop their understanding of

areas where they are weakest. Teachers and lecturers might use similar data to identify the areas on which their face-to-face contact hours with a particular group of students should focus.

Nottingham Trent University[22]

Nottingham Trent University's learning analytics initiative, which was awarded the 2014 *Times Higher Education* award for Outstanding Student Support, is designed to increase retention, improve attainment and increase belonging within the course community.

Engagement scores for each student are calculated from Virtual Learning Environment (VLE) access, library usage, card swipes and assignment submissions, with tutors prompted to contact students when their engagement drops off.

Students are also provided with their own engagement data, along with information on how their engagement compares to others on the course.

Tutors are changing how they work with students because of the analytics system. Improved information allows them to target interventions with students more appropriately. During the pilot, most tutors used the dashboard once a week with minimal impact on their workload. One-third of tutors reported that they had contacted students as a result of viewing their engagement data.

Scaling up learning analytics in the UK

We believe it is likely that learning analytics will rapidly become the key digital tool for fostering student success.

The Higher Education Commission's inquiry into data in the higher education sector concluded that learning analytics 'has enormous potential to improve the student experience at university' and recommended that all institutions consider introducing an appropriate learning analytics system.[23] It now looks likely that the vast majority of universities will soon be using learning analytics of some sort.

A number of components are necessary for learning analytics to have a big impact within an institution.

- Firstly, there must be buy-in from senior leaders commensurate with what you would expect for any large strategic initiative, ensuring any issues can easily be resolved.
- Secondly, institutions need to consider what processes need to be put in place and what skills and capabilities need to be developed among staff.
- Thirdly, institutions need appropriate technology: learning analytics is a rapidly developing field, so institutions need to ensure the solutions they choose do not lock them in to older technology when major new developments occur. Jisc's own learning analytics architecture has common standards designed to tackle this.

Obtaining student consent for the use of data and allaying their concerns, is also essential. To date, however, this has not been a major obstacle. A survey of students in the UK carried out in 2016 found that 71 per cent would be happy for their university to use information about their learning activities if it helped improve their grades.[24] Objections by students to the use of their data for learning analytics are not widely reported in

the international literature and the National Union of Students (NUS) has been largely positive about developments in this area.[25]

However, as with any set of data, it is plausible that any major data leak could hinder progress by raising questions about privacy. Extensive measures are in place to mitigate the risks of this – including independent security testing of the central learning records warehouse and applying appropriate encryption to the data.

Insights into teaching and learning

The US and Australia have been the world leaders in the use of learning analytics, but the UK has narrowed the gap recently and we have an opportunity to create competitive advantage in this area. Jisc is working with UK universities, further education colleges and alternative providers to set up a national learning analytics service for higher and further education. It is used at 12 universities already, is currently expanding to at least another 20 institutions and will be available as a service to the whole sector from September 2017. Over 100 institutions have expressed an interest in participating.

This is the first time learning analytics have been deployed at a national level anywhere in the world. The UK will have the world's first ever learning analytics big dataset, providing the sector with a unique opportunity to improve its understanding and evaluation of learning and teaching.

There is a growing emphasis on expanding the evidence base on successful approaches in public services – including the establishment of a network of 'What Works Centres' in

health, schools, policing and wellbeing. There has also been increasing pressure to target funding on the basis of evidence and evaluation, although this is a very controversial area in higher education. The advent of learning analytics offers a new opportunity to monitor the achievements of individual students. We urge higher education institutions to think about how this provides new ways of helping individual students from under-represented and underperforming groups, including men.[26]

Analysis of the data generated by learning analytics may provide an opportunity to do just this. The learning records gathered for Jisc's national learning analytics service make up a big dataset. Even at this relatively early stage of the project, when the learning records warehouse contains the data of just 12 universities, the dataset contains more than 300 million lines of data.

With the agreement of member institutions, this data could be used for large-scale educational research, offering the opportunity to evaluate the impacts of educational interventions in near real-time. As learning analytics become more sophisticated, and as bigger datasets are created and pooled at a national level, there is real potential for new data-informed research that models learning and builds our understanding of learning and teaching processes. To make the most of this, the sector should explore how learning analytics data could be used to promote evidence-based practice and data-driven decision making in higher education institutions.[27]

At a sector-wide level, the big dataset created by the UK's national learning analytics service is potentially a huge

new asset for educational research in UK higher and further education, which could help generate new insights into what works in teaching and learning. The sector should now look to make the most of this dataset.

We will shortly begin to engage with the education research community in order to raise awareness of our big dataset and encourage its inclusion in relevant research proposals. We encourage the Research Councils to consider the potential value of this globally-unique big dataset.

Recommendation 3: Institutions that do not currently have learning analytics in place should give consideration to adopting it at the earliest opportunity.

Recommendation 4: Education researchers should consider how the learning analytics big dataset can be harnessed to provide new insights into teaching and learning.

What is rest of the world doing?

It is clear that the UK is at the leading edge of practice within Europe, though countries in north-west Europe in particular, including Germany, are investing heavily to close the gap.

The United States is considered by many to be the world leader in the use of technology-enhanced learning. Individual innovative US institutions are actively adopting the sorts of opportunities identified in this report. US institutions are actively exploring the development of next-generation digital learning environments, while more than 25 per cent of US students take at least one course online.[28]

However, provision is diverse, with different levels of appetite for technology-enhanced learning. State university systems, particularly those operating across multiple campuses, have had the strongest impetus for investment. There are also commercial providers in the distance-learning market and the US has a substantial number of firms backed by venture capital looking to develop student-facing education products on a scale not present in the UK. Large charitable foundations such as the Gates Foundation, the Mellon Foundation and the Hewlett Foundation have also had catalytic effects on the adoption of some technologies in US higher education.

In Australia, the federal government, through the recently closed Office for Learning and Teaching, pressed universities on innovation. Most responded, if only on

a small scale, leading to a strong mix of online and on-site technology, particularly blended learning. As in the UK, Australian universities are looking at learning spaces that support blended learning, notably the University of Technology Sydney, which is spending AU$1.2 billion on a new campus with no conventional lecture spaces. Australian institutions have also been in the lead on the use of learning analytics, including the use of non-conventional analytics, for example analysis of student social media interactions.[29]

Within Europe, the German higher education sector is investing heavily in an effort to catch up with its European neighbours, with the German federal government putting resources into two large programmes to fund the technology-based delivery of vocational and academic education. This has included the development of new Open University-style distance learning provision.

The UK is not the only higher education system looking to capitalise on the opportunities the digital revolution provides. As Professor Chris Husbands, Vice-Chancellor of Sheffield Hallam University, has argued 'we are competing with universities worldwide' and so need to be looking for sources of competitive advantage.[30] The UK is in a strong position to use its leading position and previous investments to maintain and increase its competitive advantage in technology-enhanced learning.

Technology and the TEF

With a new focus on measuring teaching excellence and identification of areas for improvement, the TEF will focus the attention of university leaders on the opportunities presented by technology-enhanced learning. As one sector leader participating in a recent parliamentary roundtable convened by Jisc and Lord Willetts recently put it, 'the need to get this right is there in a way now that it wasn't three years ago'.

Technology and the dimensions of quality

The TEF has three components: teaching quality; learning environment; and student outcomes. Digital technology can contribute in all three areas.

Firstly, **teaching quality**, defined by government as 'teaching practices which provide an appropriate level of contact, stimulation and challenge, encourage student effort and engagement, and which are effective in developing the knowledge, skills, attributes and work readiness of students'.[31] The core metrics for this dimension are the National Student Survey (NSS) questions on teaching, assessment and feedback.

As discussed above, well-designed technology-enhanced curricula increase active learning. Students working on digital assignments relevant to employment and discipline practice show high levels of effort and engagement, as well as building their work readiness. E-portfolios help students reflect on their learning and placement experiences and develop professional attributes. The Manchester Metropolitan University case study highlighted earlier shows the impact systematic wide-scale technology-enhanced curriculum design has on NSS scores.

The assessment and feedback questions in the NSS have rightly given many institutions cause for concern over the last few years, but most institutions are now moving towards electronic management of assessment, such as online submission, marking and feedback. Effective institution-wide implementation of these systems has been well-received by students and tends to improve student satisfaction. Technology can also be used in broader ways to improve students' experience of assessment and feedback, from more frequent low-stakes formative assessment, through modelling and smoothing student assessment workload across module combinations. Given most staff can speak much faster than they type, we also expect to see much greater use of audio and video feedback that allows teaching staff to give much richer feedback in the same time that it would have taken to provide written feedback.

To improve teaching quality constantly, universities need to examine what makes the most difference to students' learning. Learning analytics can furnish teachers with information on the quality of the educational content and activities they are providing, and on their teaching and assessment. This enables both in-year and year-on-year improvements in teaching and learning on individual programmes, and supports institutions to track the impact of changes.

Measures derived from learning analytics engagement data could become part of an institutional submission for the TEF, providing a simple and efficient way to demonstrate engagement. Analytics may also offer the potential to provide more personalised paths through learning activities and

resources, increasing the stimulation and challenge for those learners who are ready.

The second component is the **learning environment**, defined by the Government as 'the wider context for teaching which includes the effectiveness of resources designed to support learning, maximise completion, and aid the development of independent study and research skills.' (The longer version of the definition explicitly includes 'use of technology'.) This will be measured by the NSS questions on academic support together with an institution's non-continuation rate.

There is clear evidence that effective use of learning analytics has led to a reduction in non-continuation rates in early adopter institutions. But learning analytics can also make a substantial contribution to the broader package of support offered to students, allowing institutions to provide more appropriate support at an earlier phase, more effectively targeted at those students who need it most. Indeed, this has already been recognised by the inclusion of 'use and effectiveness of learner analytics in tracking and monitoring progress and development' in the Government's list of indicative additional evidence for institutions to provide.[32] The support made available to students through access to resources is also a key component of the learning environment.

Jisc has developed a student digital experience tracker to enable institutions to gather reliable evidence on this. Currently in its second year of piloting, the survey is being used by 45 higher education institutions in 2016/17 to assess student satisfaction with the digital experience and environment and identify areas for improvement. The survey offers institutions a way to make

and evaluate improvements to the digital environment and data from it could potentially be included in a TEF submission as additional evidence. The survey is particularly effective as a starting point for discussion and engagement with students on their digital experience.

We expect digital technologies will also play a substantial role in research-informed and practice-informed teaching. Many disciplines and professions are being changed by the power of data and technology, particularly by the use of big data and the use of digital technologies to reach audiences and provide services.

Technology can also play a key part in initiatives to support the third section of the TEF on **student outcomes and learning gain**. The core metrics here are measures of graduates' employment destinations.

It is widely recognised that digital capabilities are a key component of graduate employability. In 2014, the House of Lords Select Committee on Digital Skills urged that, for the country to stay competitive globally, 'the UK must ensure it has the necessary pool of (highly) digitally skilled graduates and others … to support and drive research and innovation throughout the whole economy.' It concluded that 'changing demands from firms, consumers, students and communities mean that apprenticeships, vocational qualifications and degrees need to deliver more general — and also specific — digital capabilities'.[33]

In order to develop graduates' digital capabilities, universities need digitally-skilled staff with digitally-enabled experience,

with specific support available where necessary. The formal recognition of students' digital capabilities is also important. Technology can make it easier to develop authentic learning experiences that are relevant to the labour market and help students demonstrate their skills to employers. Technology-enabled activities can also boost employability by helping students build relationships with employers, develop their digital identities and showcase their skills. In time we also expect learning analytics to be used to help measure learning gain.

Innovation and the TEF

However, it will also be crucial that the introduction of the TEF does not create disincentives for institutions to innovate. It would be if a disaster if the TEF had the effect of freezing current practice and teaching methods by increasing risk-adverse behaviour in institutions and dissuading institutions from using new technology-enhanced approaches that could improve teaching and learning in the medium term.

The Government and the TEF panel should avoid being unnecessarily prescriptive in identifying what excellent teaching looks like. The inclusion of 'impact and effectiveness of innovative approaches, new technology or educational research' in the list of indicative evidence is therefore a welcome step.

We would also like to see institutions use the TEF to help shape the discourse in the sector around technology and teaching. Universities should consider including information on how they are improving teaching through the use of digital technology

in the narrative section of their TEF submission, rather than focus solely on more traditional information.

Recommendation 5: Digital technology should be recognised as a key tool for higher education institutions responding to the TEF. Providers should be expected to include information on how they are improving teaching through the use of digital technology in their submissions to the TEF. The Department for Education (DfE) and the TEF panel must ensure the TEF does not act as a barrier against institutions innovating with technology-enhanced approaches.

Realising the opportunity

In order to realise the digital opportunities in full, universities will need digital leadership, staff with the appropriate digital skills, the right infrastructure and enabling strategies and policies in place. In some ways, this is the most difficult area to get right but also the most critical.

Leadership

Institutional leaders need to recognise the impact digital technology can have on their universities' teaching activity. We have come a long way since technology in universities was the sole domain of IT managers. The opportunities and risks offered by digital technology need to inform the full range of institutional strategies and be embedded into each institution's core mission.

Strong digital leadership is a key feature of effective educational organisations and its absence can be a significant barrier to progress. The digital agenda is therefore a leadership issue, ultimately owned by the vice-chancellor and governors. Universities should recognise this shift and ensure the digital agenda is being led at senior levels within the institution.

This might include designating a member of the university's executive to be responsible for the strategic leadership of digital direction within the institution, and/or including digital leadership and digital awareness competencies in the selection criteria when appointing senior leaders.

Academic leads for learning and teaching should embrace technology-enhanced learning and the digital environment as a core part of their brief, and recognise the inter-relations with other aspects of teaching and learning enhancement.

Leaders need to be confident in their own digital capabilities and able to model at least some of the digital behaviours they want their staff to display. They should have a vision for digital technology within the organisation and confidence to trust other people who have the technical and specialised expertise to implement these plans.

Jisc is helping build this capability through our digital leadership programme for higher education leaders. But university leaders themselves need to reflect on the current level of digital capability in their institutions and what strategies they can put in place to increase this.

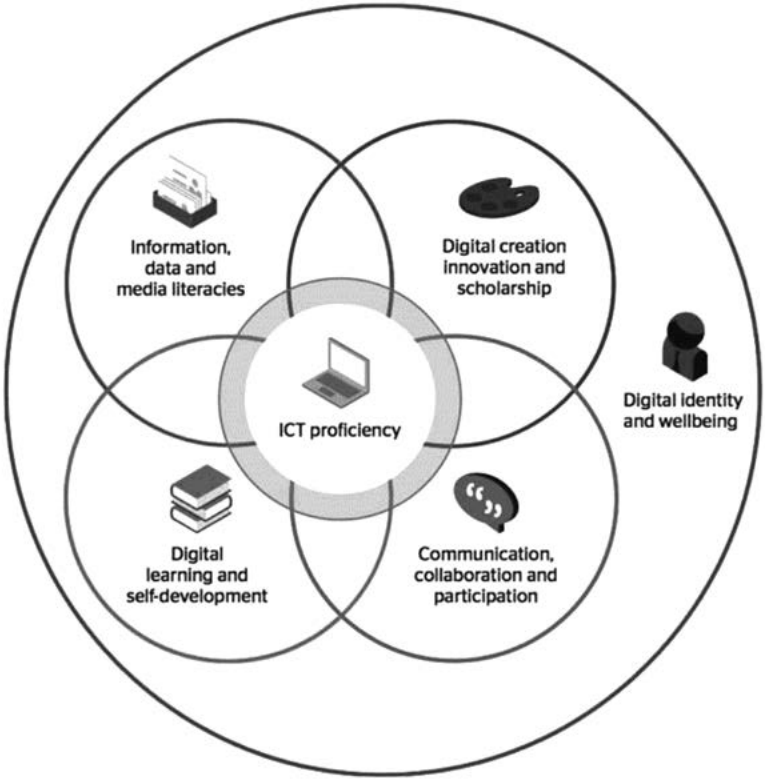
Staff capabilities

The success or failure of the opportunities described in this paper are dependent on the actions and attitude of the staff body. The digital capability of staff has an impact on a university's ability to deliver a high-quality, technology-enhanced learning experience for students – from staff who model cutting-edge digital research practices, open scholarship and effective online activities to staff who understand, for example, how policies and processes might need to change to enable authentic digital assessments.

To build such digital capabilities, universities need to discuss and understand what digital capabilities are required at their institution. In 2015, a Jisc study identified the key

digital capabilities that – to varying degrees – staff in today's universities need:

Digital Capabilities Framework[34]



Institutions with a commitment to develop a digitally-skilled workforce will need to embed digital capabilities into recruitment, staff development, appraisal, reward and recognition. Previous projects in this area have shown the effectiveness of a baseline. The findings from this can be used

to target staff development, and highlight aspects of the digital strategy that need additional attention or which depend on staff development.[35]

Recommendation 6: Higher education institutions should ensure the digital agenda is being led at senior levels – and should embed digital capabilities into recruitment, staff development, appraisal, reward and recognition.

Recommendation 7: Academic leads for learning and teaching should embrace technology-enhanced learning and the digital environment and recognise the relationship with other aspects of learning and teaching.

Rebooting learning for the digital age

As more institutions embrace the benefits of digital technology, we are confident that the opportunities outlined in this publication will begin to reshape how UK higher education is delivered.

The focus off this paper has been near-team opportunities, predominantly in campus-based education. Further out, there are opportunities for technology to deliver more profound changes. Online distance learning is likely to continue growing, particularly to reach international students in new ways. Recent developments with FutureLearn, most notably the announcement that the University of Leeds will accredit some MOOC achievements, are giving learners more choice. This brings us closer to delivering on some of the early promise of MOOCs and other open learning opportunities as ways to lower the obstacles to learning at a higher level.

Recent developments in vocational higher education (particularly the emergence of degree apprenticeships) will make the ability to respond quickly to employer and learner need even more critical. Although technology is enabling variation in the pace, place and mode of study for learners, much of this flexibility has been within fairly narrow parameters. As well as the use of technology to deliver learning, the use of effective technology-supported and data-driven processes to design, pull together, validate and schedule new courses will be an enabler of more responsive provision.

Traditional higher education is facing a multitude of challenges. There is growing competition within the sector – including

from new entrants and other countries. Home students are increasingly demanding value for money while international students face growing uncertainty. Technology is a key tool for UK institutions when meeting these challenges.

So the questions every institutional leader should be asking are clear. How can technology help my institution achieve its mission? How can we innovate to help students? What do I need to do to reboot learning for the digital age?

Endnotes

1 PA Consulting, *The Innovation Race*, 2015.

2 See for example, Arun Karnad, *Student Use of Record Lectures*, 2013, London School of Economics.

3 The technology-enabled activities students reported having undertaken in a six-week period included: finding information online (96 per cent); producing work in a digital format, including presentations, web pages, infographics and animations (79 per cent); and working online with others on discussion boards, shared documents, and social media (63 per cent), with a minority having created a personal online record of their learning (35 per cent).

4 Tabetha Newman, Helen Beetham and Sarah Knight, *Student digital experience tracker 2016: results from the pilot project*, Jisc, 2016 http://repository.jisc.ac.uk/6436/2/Student_digital_experience_tracker_pilot_report_-_June_2016_FINAL.pdf

5 See the similar definition used by the US National Center for Educational Transformation in its paper *An overview of course redesign*: 'Course redesign is the process of redesigning whole courses (rather than individual classes or sections) to achieve better learning outcomes at a lower cost by taking advantage of the capabilities of information technology. Course redesign is not just about putting courses online. It is about rethinking the way we deliver instruction in light of the possibilities that new technology offers.' http://www.thencat.org/Articles/An%20Overview%20of%20Course%20Redesign.pdf

6 See for example the TESEP principles (Napier University, 2007), available from http://www2.napier.ac.uk/transform/rethinking_tl_1.htm, and the quality-related findings of the US National Center for Academic Transformation's Course redesign programme: Carol Twigg, 'Improving Learning and Reducing Costs: Fifteen Years of Course Description', *Change: The Magazine of Higher Learning*, 47(6), 2015, pp. 6-13.

7 Liz Austen, et al , *Digital capability and teaching excellence: an integrative review exploring what infrastructure and strategies are necessary to support effective use of technology enabled learning (TEL)*, QAA 2016

8 Sara Perry (2015). Changing the Way Archaeologists Work: blogging and the development of expertise, Internet Archaeology 39. http://dx.doi.org/10.11141/ia.39.9

9 This could be captured through the use of learning design: an approach to educational design which makes the design process more explicit and the resulting designs more sharable. It aims to enable teachers to design courses and activities which are pedagogically informed and make effective use of appropriate resources and technologies. (Definition adapted from Grainne Conole *Designing for Learning in an Open World*, New York: Springer, 2013)

10 Peter Chatterton, *How do you change the learning landscape? Challenges in the strategic use of technology to support the student experience*, Jisc, 2015. http://repository.jisc.ac.uk/5891/1/JR0018_CLL_REPORT_6.0.pdf

11 Nottingham Trent Univeristy, SCALE-UP: Student-Centred Active Learning Environment with Upside-down Pedagogies https://www4.ntu.ac.uk/adq/teaching/scale_up/scale_up_at_ntu/index.html

12 https://can.jiscinvolve.org/wp/case-studies/

13 David Nicol and Steve Draper, 'A blueprint for transformational organisational change in higher education: REAP as a case study', in Terry Mayes et al (eds), *Transforming higher education through technology-enhanced learning*, Higher Education Academy, 2009.

14 Mark Stubbs, '5 top tips to enhance your students' experience', Jisc, 2013 https://www.jisc.ac.uk/blog/5-top-tips-to-enhance-your-students-experience-11-mar-2013

15 Carol Twigg, 'Improving Learning and Reducing Costs: Fifteen Years of Course Description', in *Change: The Magazine of Higher Learning*, 47(6), 2015, pp. 6-13.

16 Ellie Bothwell, 'Moocs can transform education – but not yet', *Times Higher Education*, 21 July 2016 https://www.timeshighereducation.com/features/massive-open-online-courses-moocs-can-transform-education-but-not-yet

17 Stephen Ehrman and MJ Bishop, *Pushing the Barriers to Teaching Improvement: A State System's Experience with Faculty-Led, Technology-Supported Course Redesign*, William E. Kirwan Center for Academic Innovation, 2015 http://www.usmd.edu/cai/sites/default/files/USMCourseRedesignReport-Sept2015.pdf

18 Graham Gibbs, *Dimensions of Quality,* Higher Education Academy, 2010 https://www.heacademy.ac.uk/system/files/dimensions_of_quality.pdf

19 Niall Sclater, Alice Peasgood and Joel Mullan, *Learning analytics in higher education: a review of UK and international practice,* Jisc, 2016 https://www.jisc.ac.uk/reports/learning-analytics-in-higher-education

20 Emilie Sundorph and William Mosseri-Marlio, *Smart campuses: how big data will transform higher education*, Reform Research Trust, 2016 http://www.reform.uk/wp-content/uploads/2016/09/Smart-campuses-WEB.pdf

21 Hobsons, Youngstown State University: Connected Support Results in Improved Course Completions, 2016 http://www.starfishsolutions.com/client/youngstown-state-university/; unpublished data supplied by Hobsons; Jisc, *Learning analytics and student success – assessing the evidence*, 2017 https://repository.jisc.ac.uk/6560/1/learning-analytics_and_student_success.pdf

22 Niall Sclater, Mike Day and Ed Foster, *Case Study 1: Predictive analytics at Nottingham Trent University*, Jisc, 2016 https://analytics.jiscinvolve.org/wp/files/2016/04/CASE-STUDY-I-Nottingham-Trent-University.pdf; Universiteit Leiden, KU Leuven & Nottingham Trent University. Report: research into students' experience of the transition into higher education at the partner institutions. 2016. http://www.ableproject.eu/wp-content/uploads/2016/07/O4-Report-Research-into-students-experience-of-transitions-into-Higher-Education.pdf'

23 Higher Education Commission, *From Bricks to Clicks: The Potential of Data and Analytics in Higher Education,* Policy Connect, 2016 http://www.policyconnect.org.uk/hec/sites/site_hec/files/report/419/fieldreportdownload/frombrickstoclicks-hecreportforweb.pdf

24 https://www.jisc.ac.uk/news/grades-not-fees-biggest-concern-for-university-students-25-feb-2016

25 National Union of Students, *Learning Analytics: A guide for students' unions*, 2015

26 Nick Hillman and Nicholas Robinson, *Boys to Men: The underachievement of young men in higher education – and how to start tackling it,* HEPI, 2016, p.48

27 What Works Centres aim to provide robust research evidence to guide decision-making on how public money should be spent. See https://www.gov.uk/guidance/what-works-network for further information.

28 Elaine Allen et al, *Online Report Card: Tracking Online Education in the United States,* Babson Survey Research Group and Quahog Research Group, 2016..

29 Niall Sclater, Alice Peasgood and Joel Mullan, *Learning Analytics in Higher Education: A review of UK and international practice,* Jisc, 2016 https://www.jisc.ac.uk/sites/default/files/learning-analytics-in-he-v2_0.pdf

30 https://www.theguardian.com/higher-education-network/2016/oct/25/we-are-competing-with-universities-worldwide-and-we-are-going-to-lose

31 BIS, *Teaching Excellence Framework Technical Consultation for Year Two*, 2016.

32 Department for Education, *Teaching Excellence Framework: year two specification*, 2016.

33 House of Lords Select Committee on Digital Skills, *Make or Break: The UK's Digital Future,* 2015 http://www.publications.parliament.uk/pa/ld201415/ldselect/lddigital/111/111.pdf

34 Jisc, *Building digital capability*, 2015 http://repository.jisc.ac.uk/6239/1/Digital_capabilities_six_elements.pdf

35 Jisc, *Developing digital literacies*, 2011-14; HEFCE, *Changing the learning landscape*, 2012-14.

Trustees

Professor Sir Ivor Crewe (Chair)
Sir David Bell
Dame Sandra Burslem
Professor Sir Peter Scott
Professor Dame Helen Wallace

Advisory Board

Professor Janet Beer
Professor Sir David Eastwood
Professor Dame Julia Goodfellow
Professor David Maguire

Partners

BPP University
Ellucian
Elsevier
Higher Education Academy
Jisc
Kaplan
Mills & Reeve LLP
Pearson
Times Higher Education
Unite Students
UPP Group Limited
Wiley

President

Bahram Bekhradnia

This publication shows where digital technology can support higher education leaders and policymakers to boost student outcomes, increase teaching quality and enhance the student experience.

It identifies some of the most promising practice from the UK and around the world, and sets out the key opportunities to make the most of developments in education technology.

HEPI was established in 2002 to influence the higher education debate with evidence.
We are UK-wide, independent and non-partisan.
February 2017 ISBN 978-1-908240-24-8

Higher Education Policy Institute
99 Banbury Road, Oxford OX2 6JX
Tel: 01865 284450 www.hepi.ac.uk

Printed in the UK by Oxuniprint, Oxford
Typesetting: Steve Billington, www.jarmanassociates.co.uk