

Flexible Pedagogies: technology-enhanced learning



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Flexible Pedagogies: preparing for the future

Contents

Section	Page
Executive summary	3
Introduction	4
e-Learning and flexibility	6
Opportunities and challenges with a flexible e-learning approach	9
Enhancing existing provision	10
The blended learning model: flexible delivery	10
Personalised learning: flexible content, delivery and assessment	10
Flexi-level and adaptive testing	11
e-Assessment: sciences versus humanities	12
Assessment choice	12
An 'ideal' flexible e-learning structure?	13
Flexible socialisation	14
Identity and technology	15
Flexible technologies	16
Bring Your Own Device	16
Opening new markets and approaches	17
MOOCs and flexible learning	17
Lifelong learning: engaging the alumni	18
e-Portfolios	18
Social learning and assessment	18
The role of quality and audit	19
Institutional systems	20
Example	20
Summary	21
The future for e-learning and flexible pedagogies	21
Implications and recommendations	21
Need for future work and research	22
Bibliography	23

Executive summary

This report is one of a series within the HEA project 'Flexible Pedagogies: preparing for the future'. It focuses on how e-learning, also known as technology-enhanced-learning, may support flexible pedagogies, and so encompasses a range of topics where technology can enable new choices for learners.

Flexible learning focuses on giving students choice in the pace, place and mode of their learning, and all three aspects can be assisted and promoted through appropriate pedagogical practice, practice that can itself be supported and enhanced through e-learning.

e-Learning is concerned with using computer technologies to support learning, whether that learning is local (on campus) or remote (at home or in the workplace). The use of technology throughout people's lives and particularly in school, college and work environments means that learners expect to encounter technology; technology is no longer innately innovative or new. However, technology can enable new approaches as to how learning is delivered and assessed, and can make certain pedagogic approaches viable and scalable when considered for higher education that otherwise would not be.

The broad set of technology applications to enable learner choice means this report considers a wide range of issues; topics include the move to blended learning, with choice given to the learner about when and where they learn; opportunities for personalised learning with the student finding their own pathway through learning material; and support for a wide range of devices and systems so that learners can choose their preferred platform.

While learning technologies provide new opportunities, they can also create dilemmas for institutions, with fresh issues around collaborative learning, plagiarism and the resource implications of allowing such choices.

From an institutional perspective, e-learning can offer new opportunities for flexibility in learning, with potential for new markets such as distant and part-time learners, and for more flexible schemes to accumulate credits before, during and after a traditional programme of study. The report considers some of these, in particular the prospect of providing lifelong learning in a scalable way.

Introduction

Flexible learning enables learners to choose aspects of their study. This is typically the ‘when, where and how’ of learning (Higher Education Academy, 2013), although there are some broader dimensions, such as being learner-centred (Moran & Myringer, 1999). With the definition of flexible learning, flexible pedagogy may refer to ways of considering approaches to teaching and learning that enable such student choices. Technology-enhanced-learning, also known as e-learning, considers the use of Information Communication and Technology (ICT) in its widest sense to support and improve the learning experience. Thus flexible pedagogies and technology may be considered natural partners – flexible learning can be provided by and supported through technology, while conversely, technology can encourage flexible approaches to the delivery and assessment of learning. They also share the requirement that truly flexible pedagogic approaches and effective use of technology in education (e-learning) call for adaptable institutional systems, staff and students.

e-Learning offers key opportunities for higher education to support flexible pedagogies, with the potential to assist in balancing the need for staff to carry out high quality teaching alongside high impact and significant research while at the same time managing an increasingly diverse student cohort. However, it is important to recognise and address the challenges this creates. Technology can enable approaches that are not viable when done by teaching staff themselves, but also introduces new complexities and decisions for higher education providers. We will consider why and how flexible pedagogies can be supported by and delivered through technology.

This report is one of a set of complementary reports considering different aspects of flexible pedagogies. It focuses on e-learning, but there are significant common areas with the other reports.

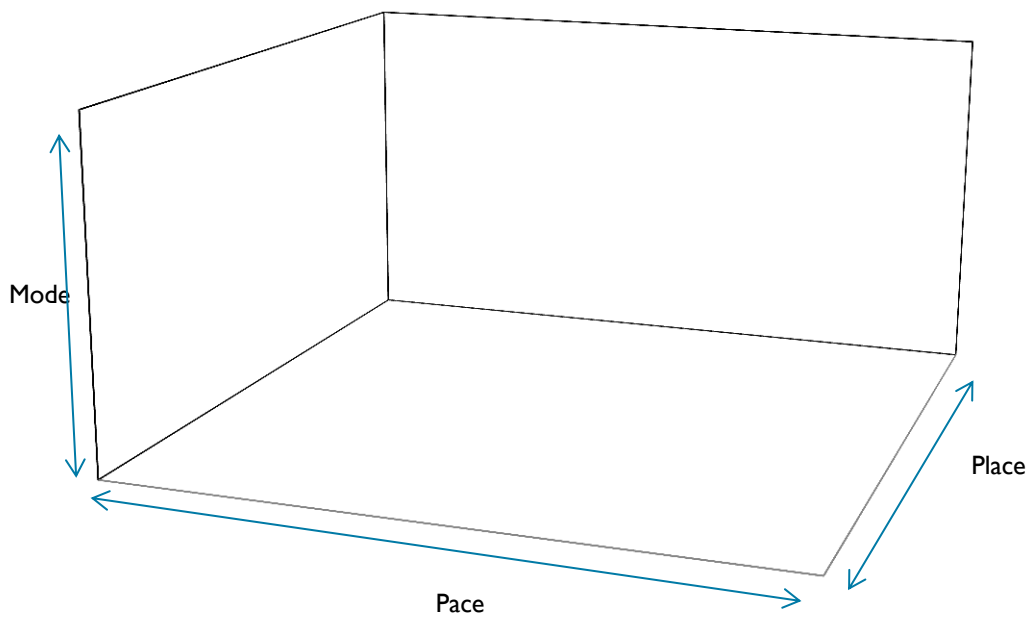
Following this introduction, the report considers the links between e-learning and pedagogy, before looking at the distinct aspects of how e-learning and flexibility can be used to enhance existing provision and then open up new opportunities. The impact on and of institutional systems is then considered, with an example of the interplay between these aspects of learning and teaching. The report finishes with a typology of flexibility enabled by e-learning, with an overall summary of the findings and suggestions arising from the report.

Technology offers a number of opportunities and challenges for higher education, both enhancing existing provision and opening up new potential. The key consideration underlying this report is why and to what extent flexible pedagogies can be promoted and in what ways. In the context of e-learning the answer lies in the way technology naturally enables the provision and delivery of flexible learning and pedagogy. Flexible learning is concerned with the **pace**, **place** and **mode** of learning:

- **pace** typically focuses on different delivery schedules, which may be part-time, accelerated or decelerated, either as complete programmes (for example a two-year Bachelor’s degree) or within a programme (so allowing students to work at an individual pace within broad overall deadlines);
- **place** is concerned with the physical location, which may be work based or at home, on public transport while commuting, or abroad when travelling;
- **mode** covers learning technologies, and blended learning or distance learning. For example, in the context of Technology Enhanced Learning, technology can clearly support flexible schedules, with the options to access online materials outside of prescriptive timetables enabling flexible pace; and work-based learning can be provided and supported via technology, thus offering flexible places of learning. In terms of the mode of learning, learning technologies provide new and flexible approaches to enable distance and blended learning through the wide range of ICT products and upcoming developments.

Thinking of the three variables above, namely pace, place and mode, then a pedagogical approach can be positioned within the three degrees of freedom, ie a three-dimensional space of flexible learning. In the following diagram, the bottom, front-left point being no flexibility in any axis, and increasing levels of flexibility, ie choice, as the space is traversed from left to right, front to back and bottom to top. An individual part of a module, a complete module, or a complete programme can then be positioned in terms of its flexibility profile.

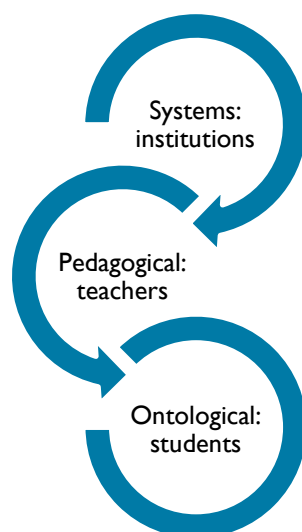
Figure 1: The 3D flexibility space for pedagogy and learning; illustrating the three aspects of teaching and learning where flexibility can be introduced



In the learning and teaching context the principal stakeholders we will consider are students, teachers and institutional managers. Of course, these all interact with and are affected by a wider set of stakeholders, namely future employers, parents and families of learners, regional and national government organisations and the general public. Within the UK, national contexts differ between the different countries, especially regarding student support and institutional finances. Each stakeholder has different but inter-related wants and needs – with a mix of philosophical and practical perspectives, from the general benefits expected from pursuing higher education, through to the pragmatics of how to fund and provide it. We can consider the three principal stakeholders within the following categories of flexibility that sit alongside the three degrees of flexibility detailed above. The categories are:

- ontological - the flexibility of the students themselves, such as how flexible they are to deal with different learning approaches as well as the wider context around them that affect their studies and their future development;
- pedagogical relationship - theories and delivery of learning in terms of the flexibility of the teaching, its approaches and modes;
- systems - how institutional structures and processes allow for flexibility in teaching (pedagogy) and learning (ontology).

Figure 2: The three levels of flexibility



e-Learning and flexibility

This report incorporates e-learning and Technology Enhanced Learning, two concepts that will be used synonymously here. There are a number of related terminologies and concepts under the general approach of utilising technology and electronic media in learning. These incorporate information technology (IT) and ICT; in essence computers and digital devices and software, along with the supporting technologies of telecommunications and online learning.

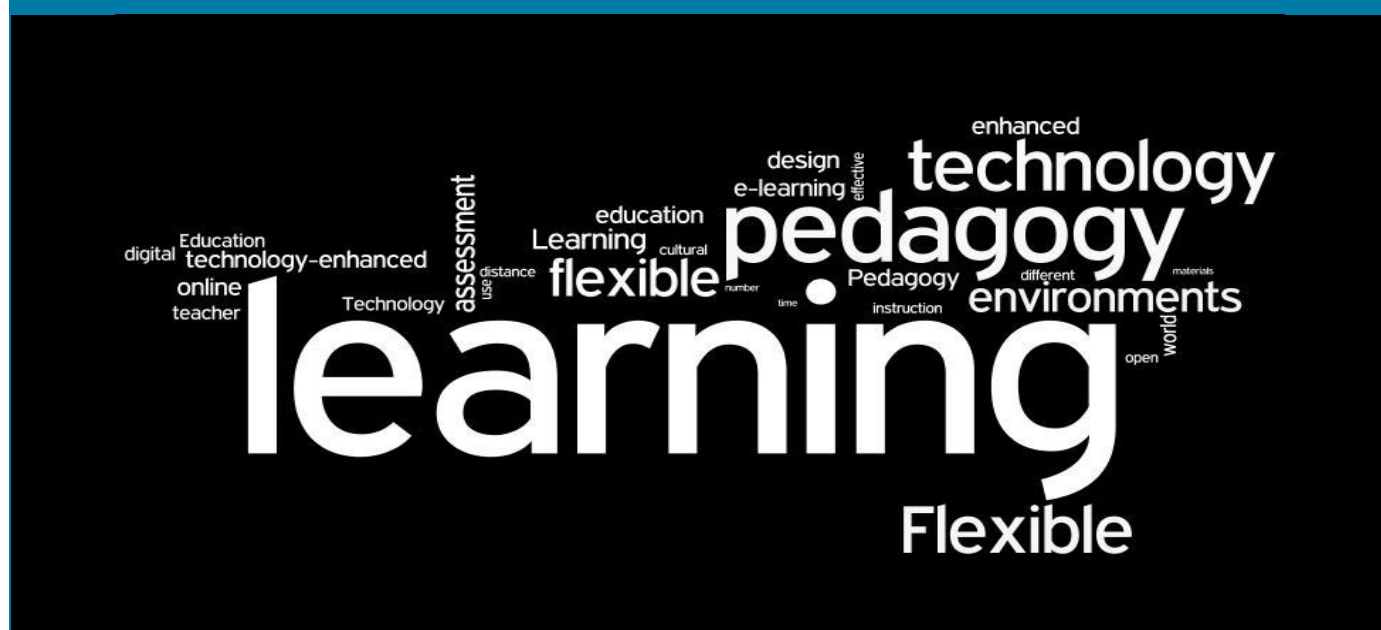
Considering different forms of teaching, learning and assessment that can be enabled through technology, some examples are:

- team projects, group work and peer assessment;
- balancing and utilising formative and summative assessments when using computer aided assessment;
- exploiting adaptive/flexi-level assessment through computer-based testing; this is described in greater detail later but refers to assessment that alters depending on the learner's progress and attainment within the test. Thus a test may ask more complex questions for students who seem to be doing well;
- applying new approaches to engage and motivate students – gamification of learning;
- utilising technology to enhance learning and teaching – especially Web 2.0 technologies with their focus on user-generated content and interaction between users, eg blogs, wikis and social networking;
- adopting e-submission and providing informative and timely feedback through the technology.

Related concepts and terminologies that reflect recent applications and developments in IT and ICT applied to teaching and learning include:

- computer-based/-assisted/-aided learning/training: these forms of teaching emphasise the use of a computer as the platform for delivery and may be intended to educate or train depending on the focus of the material;
- courseware: a form of computer-based learning, typically learning materials delivered through a computer;
- m-learning: a form of e-learning where the delivery platform is a mobile device – eg a laptop, smartphone or tablet;
- virtual learning environments: portals to provide access to learning support, including course information, communication (forums, messaging, announcements), course content (lecture notes and sources), and assessment and feedback;
- immersive learning environments: models (typically 3D) where participants can explore and learn in a simulated environment or virtual world;
- computer-based assessment/e-assessment: utilising computer technology to assess students. These can incorporate multiple-choice testing, parsing of language or comparison of symbolic (mathematical) expressions. They may be diagnostic, formative or summative;
- open learning: sharing of learning resources through open licensing and agreements, eg massive open online courses (MOOCs);
- collaborative technologies: Web 2.0 offers community and user involvement that maps well onto many learning activities.

Figure 3: Wordcloud (Wordle) – developed from abstracts of papers on flexible pedagogy and flexible learning



While e-learning and flexible pedagogies and learning are distinct, a survey of abstracts for flexible learning and flexible pedagogy quickly shows that technology is frequently considered as an enabler for flexibility. Figure 3 shows a word cloud generated from the abstracts of papers that consider flexible pedagogy and learning. The size of the words indicates the frequency of occurrence in the abstracts. Clearly technology and learning environments come out as the most common themes, along with e-learning and technology-enhanced-learning. Technology itself provides mechanisms and tools to allow a number of pedagogic approaches, some of which are considered next.

Pedagogic concepts

The following reflect approaches to learning that are particularly relevant to e-learning, though most are applicable to other forms of teaching too:

- personalised learning: tailoring the learning experience to an individual student's needs and desires. This has the potential to match the mode and learning style to students, a key feature of flexible pedagogies;
- support for synchronous and asynchronous activities, the former representing activities done in real time with immediate interaction, the latter those done with a lag. From a communications perspective, typically synchronous teaching and learning is a traditional lecture or online webinar; asynchronous includes email communications;
- flexible learning: similar to personalised but with a greater focus on how the material adapts to an individual's progress, and may include adaptive/flexi-level testing – providing another form of flexibility especially relevant to pedagogy;
- gamification: the use of game techniques (especially game mechanics) to encourage and motivate activities can be especially relevant to learning. Online worlds provide a virtual environment for learning, with the game models of players logging in, playing and interacting, making progress and then logging off matching some of the needs of flexible learning. Thus gamification supports new pedagogic approaches that allow for flexibility;
- online learning: the use of Internet-based e-learning to deliver content supports the anytime, anywhere characteristics that are key to many approaches to flexible learning;
- blended learning: a mix of physical/real-world interaction complemented by e-learning, this hybrid is especially relevant to introducing elements of flexibility into traditional courses.

The above list, though not exhaustive, indicates areas that can provide [scalable](#) and [pragmatic](#) solutions, characteristics that are key to getting widespread adoption and implementation. While some technology is already well established – such as the use of virtual learning environments to deliver content – the adoption of other technologies, such as automatic testing, is frequently patchy and viewed with suspicion. In this report we consider how e-learning approaches can be used potentially to enhance the student experience of flexibility, as well as providing staff with useful advice about how to utilise such approaches in a practical way, and what changes institutions need to consider in their own processes and practices to enable such approaches.

We should also question whether technology offers anything new in terms of pedagogy and learning: there are clearly new opportunities with tools to find and use sources and data; there are new possibilities to interact with students at distant sites. However, the fundamental activities are not altered – learning can be considered as accessing concepts and ideas, assimilating these through practice and ultimately demonstrating mastery. What technology offers is scalability, flexibility and new ways of learning. In a large cohort each student normally gets the same lecture and the same assessment. With computer-supported and -mediated learning there are opportunities to offer flexibility of [pace](#), [place](#) and [mode](#); for example, pacing can be controlled by the student accessing material within a wider or more flexible window of availability than is normally viable; the place of learning – accessing lecture presentations, notes and resources - can be anywhere with Internet connections; progress can be monitored with [individualised](#) assessments.

Opportunities and challenges with a flexible e-learning approach

When considering flexible pedagogies enabled through technology a number of issues arise. These can be considered from the main stakeholders' perspectives, namely:

- learners: technology offers potential flexibilities in what is learned, how it is learned, and where it is learned. It can provide numerous ways to access resources and information and to interact with teaching staff and fellow learners. However, such flexibility can create potential confusion, especially around deciding what, where and how to study; it can create information overload – with too many resources to handle and too many references to follow; as the location of learning becomes a choice – at the institution, at home, at work, or on the move – the learner faces a new challenge of choosing a suitable location; understanding what to do and carrying out the necessary work;
- teachers: technology allows teachers to plan for a range of different learners, to provide a wide range of material tailored to different learning styles and contexts, with new media and interactions becoming possible. However, difficulties for teachers then arise, such as: how to identify, select and adopt pedagogic practices that benefit from e-learning that give flexibility and enhance the discipline aims, and how to develop their own skills to utilise these;
- for educational institutions new opportunities include new types of learner and the potential to share resources with other institutions. Barriers for organisations include: how to develop quality processes and support systems to plan for and cope with flexible learning and the impact on student behaviours and demands.

So issues to address when developing flexible pedagogies with e-learning become:

1. Flexible students: how well can students prepare for the nature of flexible e-learning, especially when/if the focus of control moves from staff to student?
2. Flexible staff: to what extent can staff be aided in managing the wide array of technologies and resources, and more importantly to develop approaches to teaching to utilise these effectively?
3. Flexible institutions: how can institutions plan to cope with the variety and flexibility required to support flexible e-learning?

Enhancing existing provision

The blended learning model: flexible delivery

Blended learning aims to mix TEL with more traditional forms. The rise of virtual learning environments (VLEs) as a ubiquitous platform for hosting and delivering support materials means that for most students some minimal experience with blended learning is likely to already be the norm, at least in the context of UK education. However, where the VLE is purely used to host copies of lecture notes this may be considered as little other than a more flexible and accessible library; students can access course materials anywhere but there is little value added. In terms of designing effective learning activities the provision of lecture slides and/or support notes remains contentious – it is argued that the availability of such material can cause students either not to attend or to become disengaged in lectures. Approaches to ameliorate this, such as leaving gaps in lecture notes to be completed, can be effective but then move the course towards a traditional rather than blended approach.

Where blended learning can be more effective is when some lecture or workshop style activities are replaced with online material – whether media clip or other engaging content – and this is developed through either traditional seminars or some form of computer-mediated discussion or assessment. This flipped classroom style offers the benefit of being a more student-focused approach to teaching and learning. In terms of flexibility, students must be able to access equivalent content purely through the online material – a challenge to institutions where the campus experience is a key part of the educational experience.

With the different approaches to blended learning a mechanism to think about is offering the following, each being considered as a subset of the next:

- enhancements to traditional lecture courses through stand-alone online material – where flexibility is provided in some modules within a programme;
- opportunities for part-time provision – the timetabling and staffing issues around evening or weekend provision mean that a blended-learning approach, where material is delivered electronically with a restricted requirement for real-time (and possibly on site) interaction;
- distance learning – taking the part-time provision model but with the minimal amount of real-time requirements.

Distance learning – whether as part of blended delivery or as a stand-alone module or programme has particular potential for parts of the UK with geographically-isolated learners and the potential to allow institutions to share teaching materials, and for learners to aggregate content from across a set of co-operating institutions.

Personalised learning: flexible content, delivery and assessment

In the blended-learning approach considered above, typically all students would have access to the same set of resources. One of the more exciting opportunities with technology is for content to be personalised to the student – allowing for flexibility in content according to a student's desire or need.

These approaches are gaining in ground – with the concept of flexible learning pathways, personalised learning and flexi-level or adaptive testing (Lord, 1971). The key requirement here is that material can be organised into a hierarchy of complexity, allowing students to choose what they access at a certain level, but possibly with points where progress is assessed and there is some kind of check in place to stop them accessing other material. This type of approach can be considered as providing a flexible learning pathway. Managing such diverse pathways is not usually tenable within a traditional teaching context – at least for large cohorts – but computer-mediated learning offers mechanisms to manage this, with the software controlling the release or not of material based on the progress (eg VVen et al 2012).

Flexible delivery is concerned with providing student choice in how and where to access learning materials by offering a suitable range. Replacing a lecture with a media clip that must be watched at a certain time does not provide much choice, although it is flexible in terms of location. Providing a selection of materials that a student can choose from, particularly if those materials reflect different learning styles, offers true flexibility but comes at an increasing staff cost in terms of preparation. One solution is the exploitation of features and technologies such as the semantic web. This involves an expansion of Internet technologies to include information about the meaning and use of web content. Descriptive data of this web content enable machine-understandable documents to identify material thus enabling the automatic collation of such resources in the foreseeable future (Berners-Lee & James, 2001). The concept here is of computer-mediated learning. Intelligent systems use descriptive (semantic) information to provide individual learners with material tailored to their needs in terms of content, learning style and potentially other facets of flexibility. Such technologies are not yet generally available, but elements already exist, eg adaptive technologies. Frameworks and requirements are being developed so it's highly likely that practicable solutions will be available within the next decade.

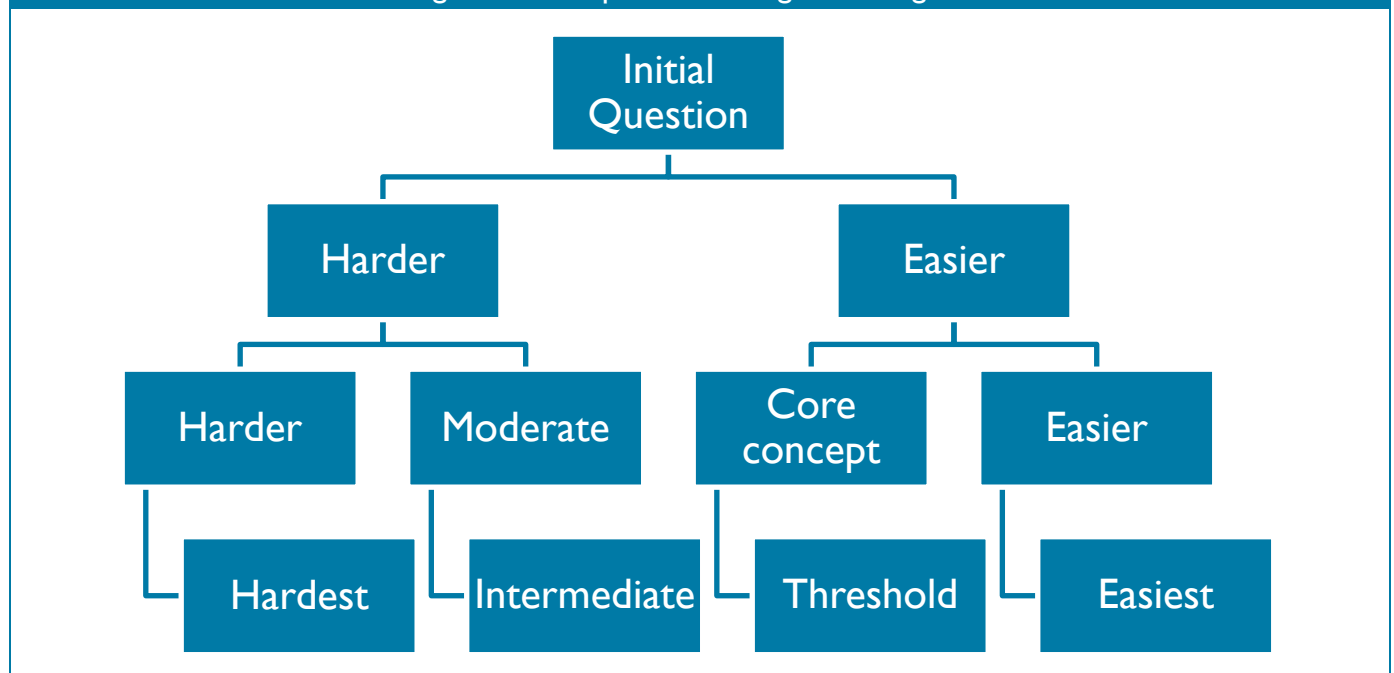
The assessment process is one way of controlling access to the next level of material, and computer-generated and assessed tests provide an opportunity to allow flexibility in the timing and content of tests. Flexi-level and adaptive tests offer a student-based assessment: depending on the student's progress within a test, simpler or harder questions or assignments can be given.

Such testing is particularly applicable in certain disciplines, eg mathematics and computing, where identifying a suitable hierarchy of material and automating assessment is often easier, especially where symbolic or numeric evaluation means student answers can be parsed and compared. In this context, parsing by the computer means that the content can be assessed against model and preferred answers. With a symbolic statement, such as the expression $2x=4y+6$, the expression can be compared to check that it means the same as equivalent expressions like $x=2y+3$, or $4x-8y=6$, etc. Such symbolic manipulation and parsing is supported by numerous tools which can be integrated with VLEs to provide assessment facilities. Writing free text has been problematic as the interpretation of natural language is more complex; however, some of the new tools such as the EdX automatic essay evaluation system, provide the means for these approaches to be developed for other disciplines.

Flexi-level and adaptive testing

As mentioned, flexible assessment can be enabled by technology. Traditional approaches to assessment typically focus on a single set of questions, and thus lend themselves to closed book, individual assessment tasks where learners do not know the questions in advance nor do they have access to resources. Automatic generation of test data or questions can enable opportunities for open book and even discussions during assessment, since the test material is bespoke to a particular individual, and so reduces problems with plagiarism or use of published solutions. Such generated test data also allows for multiple attempts at times and places convenient to the student. But this also raises new challenges. The current external examining and quality processes typically ask for samples of work; in the context of computer-generated tests, this may mean there is no single assessment to confirm. With flexi-level or adaptive testing, students may have quite different tests. Mapping these onto learning outcomes and endorsing the outcomes becomes even more of a conundrum; the adaptive nature means a student may never try certain material and so it becomes essential to ensure that learning outcomes are achievable through meeting the minimal set of material for a pass mark.

Figure 4: Example of a testing branching tree

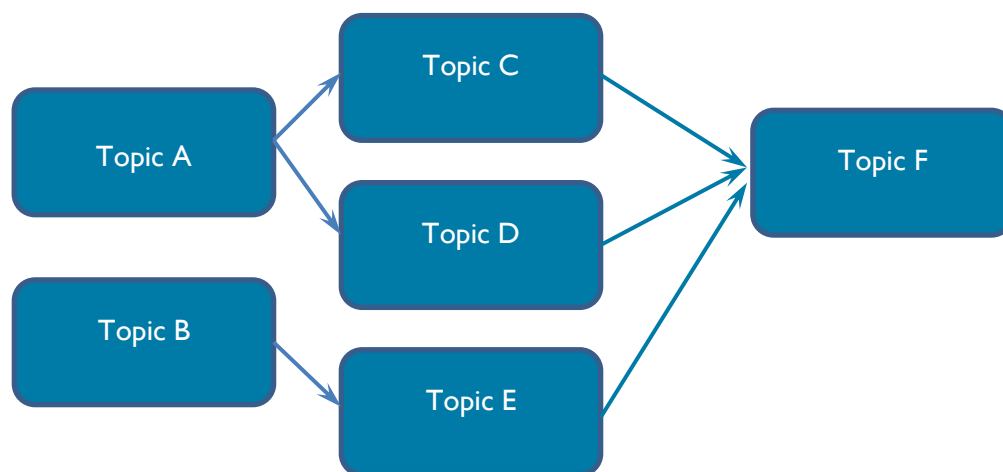


The above figure illustrates how adaptive testing can be configured, in a fairly straightforward way. Following the initial question, students are asked harder or easier questions according to their initial answer. This is followed through the tree until the students answer the final question. This can be used to create a profile of what the student seems to know. More complex knowledge network approaches mean there could be cross links, so if a student manages to answer the first easier question correctly they could then be asked the moderate question. This approach can be used to manage assessment itself in terms of what level or complexity students are asked, as well as to control the links between units of material, see Figure 5, with assessments used to manage access to other material, which could be either more complex, or simpler. The knowledge network in Figure 5 illustrates such a set of linked material. Topics C and D rely on topic A, while topic E is dependent on topic B. Topic F is based on topics C, D and E, and thereby also on A and B. In a learning scenario, a student may know A already, so just needs to learn C, D and B and E. How they manage that can be one aspect of flexibility. Knowing which topics to do can be identified and managed by a testing tree, such as that in Figure 4.

Another existing flexible learning approach that is close to the above is the Universal Design for Learning (UDL: Rose & Meyer 2000). This often focuses on supporting special needs but core to this method is providing multiple representations of knowledge, allowing for a variety of demonstrations of attainment and utilising a variety of mechanisms to encourage engagement. In this methodology, students may be provided with a range of representations of information, eg they may be given a written description, an audio narrative or some other way to present the ideas. The selection of the particular

representation may be made by the teacher, taking into account the learner's needs. Similarly, there should be a variety of ways for the student to demonstrate their understanding through a format deemed suitable for that learner. The final element for UDL is that of engagement, which should consider options for encouraging and inspiring students, such as providing suitable environments and opportunities for students to feel able and want to pursue their learning. These ideas of providing a variety of pedagogic approaches fit with concepts of flexible pedagogy and learning, though the issue of by whom and where the choices are made means this is not necessarily flexible pedagogy. Another relevant model is the Flexible Programme Delivery model (Normand, et al., 2008) which provides an approach to assess how technology can support flexible learning. This arose from an initiative in Scotland but has wider applicability. This model provides an approach enabling course teams and individuals to consider the flexible delivery of programmes at different levels, namely institutional (strategic), operational (implementation of strategy) and the teaching-learning itself, so that teaching and learning are delivered within the context of the institutional approach. The model allows for the analysis of provision within an institution, in terms of to what extent and how consistently programmes are flexible.

Figure 5: Knowledge network



For large cohorts – we consider MOOCs later – where automated assessment is not suitable, the possibility of computer-mediated peer assessment offers great potential. Allocating assessment to groups – potentially of a higher level (eg level 5 assessing level 4) students – could provide a robust assessment of students, with staff moderating samples to ensure the questions and corresponding assessment guidance are viable. This follows a similar model to that used for school assessments where exam boards pass work out for assessment.

e-Assessment: sciences versus humanities

There are some discipline-specific characteristics that mean certain subjects are more suitable for e-assessment, and thereby to computer-mediated testing and personalised learning. Science generally, and mathematically-based topics in particular, are especially suitable for developing the knowledge dependencies identified above, although aspects of other disciplines can also be amenable to such approaches, for example the concept of chronology within history. In general, provided that distinct levels can be characterised, a knowledge tree or network such as that in Figure 4 can be developed. Tests can be either multiple choice or textual, but it can be more difficult to automate marking of narrative answers. However, technologies are already developing that offer that potential.

Assessment choice

Another potential for flexible assessment - perhaps the most flexible approach - is to allow students to choose how they are assessed; for example offer them the choice of selecting from a set of assessment options. In some cases options such as a presentation to a class or recording a short filmed presentation on a piece of research could be considered as equivalent, provided the learning outcomes were couched in suitable language. Other options are computer-based tests and assessments, and human-managed assessment. Thus flexibility here requires planning at the module design (or redesign) stage, with support potentially provided by the management system.

An 'ideal' flexible e-learning structure?

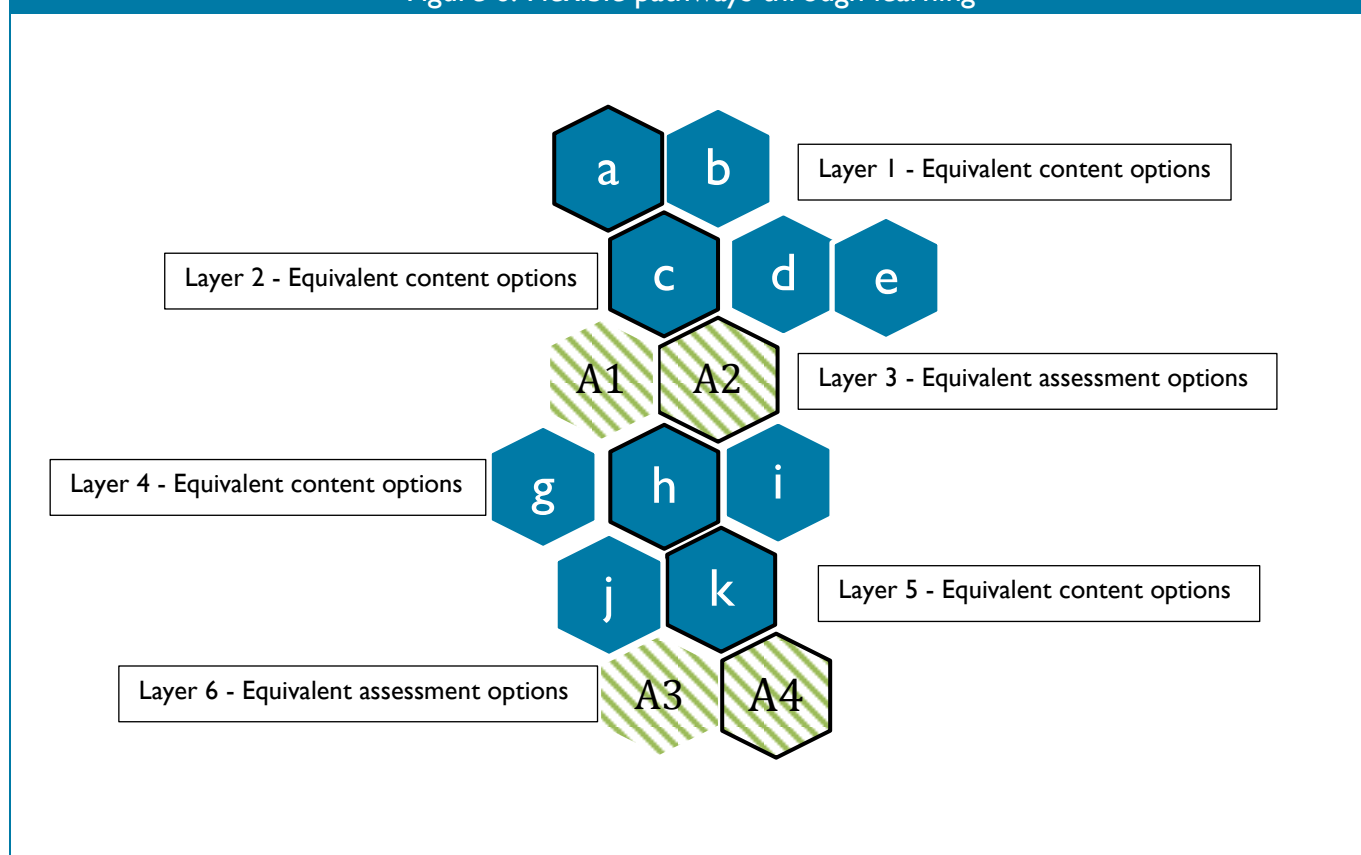
Based on the above discussion, an idealised flexible e-learning system may allow students to select a set of modules over a period of their own choice, with each module providing a set of materials to choose from reflecting their own learning preferences, all with 24/7 support, and with the opportunity of deciding how and when to be assessed in each.

Figure 6 illustrates a model for a module, each shaded (blue) hexagon represents a learning activity: this may be directed reading, attending a lecture or set of lectures, or perhaps a group discussion (in person or computer-mediated); the diagonal striped (green) hexagons represent assessments: assessing the material and learning outcomes that should have been covered in the earlier material. So hexagons a and b represent equivalent content, but may support different learning styles or be of a different nature. For example, a could be a lecture and b an online learning resource. Similarly, c, d and e represent equivalent material. A1 and A2 are equivalent assessments, for example an exam or a coursework submission. A1 and A2 should assess learning outcomes from layer 1 and layer 2. The learning activity could be configured so that layer 4 is only accessible once layer 3 has been passed so that assessments 1 and 2 act as catches or gates to control progress. Assessments A3 and A4 should assess the remaining learning outcomes and the material between the two groups of assessments. In practice this may cover all of the material for this learning unit, and all learning outcomes.

A complete pathway (eg a, c, A2, h, k, A4; not necessarily connected if the material at a level is truly equivalent) through the network of hexagons provides a complete course. Students wishing or needing to try different approaches to learning could try a subset of content at a particular level, eg a and c, or a and b, or all three, as well as trying different assessments. The assessments may be traditional-style exams, possibly hosted at trusted and certified sites, or computer-generated tests using parameterised variables, or peer assessment. The assessment blocks may be considered as the submissions dates for coursework carried out alongside the learning. Overall timing constraints could still be applied, so that, for example, A3 or A4 must be completed by a date in June to enable credit in that academic year.

Support for such learning pathways, with control via assessment, within a VLE is currently limited. Many such systems allow a pathway of learning material but control of access to material based on assessment is not supported, something that would be a useful feature in future developments of VLEs. Standards that enable tools to connect and interact, such as the Learning Tools Interoperability (LTI) consortium (IMS Global, 2013) provide a mechanism to extend VLEs and allow this type of functionality.

Figure 6: Flexible pathways through learning



Selecting a pathway by choosing blocks in the above figure can be understood as choosing the study route; it is similar to how some games are constructed. This approach to choosing a pathway may target the programme (qualification) level, where content blocks correspond to modules or courses, and assessment blocks to checks on the requisite number of credits or achieving the requisite thresholds. In a recursive manner, the pathway could be considered as a model for an individual

module, with content blocks representing module sections and the assessment blocks comprising the module's assessment methods. On another level, the pathway could be a particular set of material within a module; with assessments targeting much more focussed pieces of learning content. This last approach fits well with the concept of open educational resources (OER), so the sub-module elements could be pieces of focused content with assessments designed to deliver one or two specific learning outcomes. Selecting an appropriate set of OERs makes a module and a set of modules a degree programme. The challenge to this sort of approach lies in how to ensure a cohesive and stable set of material that offers a sensible learning programme and thereby an acceptable and accepted qualification.

This model can be applied to a programme, with blocks representing modules within a programme, or to a module where the blocks are sub-module elements. The module itself consists of a set of core learning concepts with different but equivalent delivery methods at each level. Such flexible pathways could be supported by technologies such as work-flow systems (where the work flow is really a learning flow) with activities completed and signed off, before beginning the next one.

With the flexible learning pathway an analogy can be made to travel. MOOCs and large courses may offer the scale and efficiency of the underground system and provide for the mass transport of individuals from start to finish. However, support within that system is limited and individuals can pass through the system with little context awareness, knowledge of what they are passing under or over, or engagement with others. The outcome - evidence that they have arrived at the destination point - may be the only certified outcome. More traditional approaches can be considered similar to a mini-bus service with smaller scale, individual support and the opportunity for interaction and to get an individual report related to the traveller from the driver. The challenge for institutions is determining what level of resource to put into courses versus students, and whether to try supporting either models, or a hybrid of the two.

Flexible socialisation

Since the turn of the millennium web technologies have enabled more user content and user interaction through a range of Web 2.0 developments, in particular around the area of social and mobile computing. From a pedagogic and learning perspective these offer new opportunities to enhance or replace some aspects of higher education assimilation and familiarisation. Such developments can - and typically do - require yet more resource, potentially infrastructure and most definitely staff time.

Examples of enhancements include virtual pre-arrival activities. While posting out preparatory materials is not unknown, the difficulties in maintaining contact addresses and in getting material out in a timely manner, especially for the significant number of students placed in the clearing period, means such approaches are limited. Virtual welcome groups on Facebook or other social media, including bespoke VLE groups, offer the chance to introduce and support pre-arrival content in a flexible way. Such activities are often about socialisation, with the aim of improving early engagement and thereby retention for new students. The virtual nature means such provision is usually distance based but with a time-limited context.

Social media also offers opportunities to provide flexible peer-to-peer interactions for students, enabling them potentially to benefit from their wider learning community in a way that fits with their lifestyle and commitments. Whether social media, email discussion lists, computer-mediated forums or bespoke discussion groups within a VLE, these can provide a flexible approach that replicates aspects of social interactions that are valued, though not necessarily achieved, in traditional education.

These technologies can be particularly effective in supporting team-/group-work activities where finding the time and place for meetings may be impractical for campus-based provision, and impossible for part-time or distance learning.

Institutions and staff need to decide on the appropriate format for such provision; the very flexibility in modes of communication, and, in particular, the non-moderated and potentially uncontrolled discussions that can develop mean that using non-institutional provision has potential pitfalls, such as the unintended sharing of personal information and cases of bullying or harassment. However, restricting the technology to a particular platform, especially if it is one provided through a VLE, limits the aspect of flexibility of choice that some students value. The decision about the use of platform is thus one to be taken in light of decisions on responsibility and liability: of the institution, its staff and the students themselves.

The flexible pathways and flexible spaces described above can liberate students, but they also mean that tracking individual student's progress and identifying students at risk of falling behind or of leaving a course become more challenging. Technology can offer solutions with the increased interest and developing use of learning analytics. Learning analytics is concerned with the analysis of data typically collected within a virtual learning environment which provide information on how students are studying. This can include data on how students navigate the learning spaces and potentially identify behaviour patterns and highlight students displaying traits that are consistent with underperforming or dropping out of their study. The very flexibility in selecting tools and resources to provide a learning environment does make this more difficult, so a community approach within higher education to determine what data are needed and how to share that would be useful, although with non-learning-specific tools such data are likely to be more limited. There is a growing body of evidence (eg (Arnold, 2010), (Ferguson, 2012)) on the value of such learning analytics in identifying at-risk students, including analysis of discussions and email, whether on institutional or public social media sites; privacy settings and concerns mean that even within an institutional VLE there is a balance to be found between support and intrusion (Swain, 2013).

Modern technologies can offer choice and flexibility in traditional contexts too. While essential for online courses, many lecturers now utilise Twitter feeds or text walls within traditional lectures to aggregate and respond to questions from, or even during, lectures for students who prefer that mechanism for questions to asking out loud. Webinars and media clips (podcasts, narrated screen capture or full video of lectures) can all provide resources that students can access. However, adopting such flexible approaches for staff raises issues around the reliability and stability of resources. A YouTube video, iTunesU content or online Open Educational Resource may be deleted or have been fundamentally altered, as exemplified by the 'edit wars' (Sumi, et al., 2011) on Wikipedia, where different contributors may edit content to reflect their own perspectives. This problem means that the content changes depending on the time it is accessed, whether in a lecture, or more problematically when accessed by students at a time of their own choice, sometimes only a matter of a few hours after a lecture. The ability to download and host such content, or to tie a link to a particular version, would be welcome and analogous to a library holding copies of certain editions of a book. In the absence of that, this aspect of flexible pedagogy remains a challenge when designing and delivering planned learning content.

Identity and technology

One impact of the Internet has been a changing notion of the individual. Online interactions can become different and distinct from face-to-face interactions, with people adopting different personalities and personas, or even different genders or races, when within a virtual world. This offers opportunities as well as challenges for education. An example of both is whether students think of themselves as learners in a virtual world, and what the implications and responses might be if they do and if they don't. Ensuring responsible and professional attitudes and behaviours can be problematic, especially when individuals adopt uncharacteristic conduct when feeling secure behind the apparent anonymity of the Internet. Requiring students to sign up to professional codes of conduct such as learning contracts, and ensuring that identities are real or easily traced to real accounts can reduce this, but the audit and permanence of computer-mediated communications is still ignored by many students. Increasing students' (and teachers') digital literacies may help, but where courses move to majority or entirely online provision the chance to explore digital conduct outside the digital environment is lost: the only version of an individual's personality is the online one.

Flexible technologies

When considering technology as the delivery and support mechanism for learning, another facet of flexibility to take into account is the learning platform. The institutional choice of the VLE, as well as the preferred hardware and operating system by which material is delivered and supported, has an impact on learners, who may have their own preferences if given a choice. While the institutional VLE - Moodle, Sakai and Blackboard are common examples - is typically a strategic decision, the practicalities of providing infrastructure support for user devices also influences the choice of an institutional computer platform: for example, whether to use commercial systems such as Microsoft Windows or Apple, or open source solutions possibly based on Linux. This choice of the VLE and user-operating system, with associated user interfaces, has an impact on some of the learning resources and tools that are available for use. The inter-dependence of platform, software and approach to learning means the choice of platform and devices has an impact on pedagogy. An on-going tension for institutions, in common with commercial organisations, is the level of support and allowance for individuals (staff or students) to use their personal mobile device (eg a smartphone) - the so-called Bring Your Own Device dilemma (Ackerman, 2013) - where organisations have to balance the flexibility and ease for users of having access to institutional computer systems and data through using their own mobile device, with security and compliance requirements.

Bring Your Own Device

Standardisation of systems, from Wi-Fi connectivity to email accessibility, calendars and data across a range of devices, means that students and staff may want to use their own devices. The benefit of this to individuals is the familiarity with the interfaces and the software; it also allows material (emails, current work as well as resources) to be accessed conveniently and any time. However, resourcing the support systems to ensure there is advice on how to connect and access material, and to provide assistance when things go wrong is a major budget decision for institutions. Moreover, the very flexibility in choice can make this difficult from a teaching perspective. Preparing hand outs and guidance, especially for teaching scenarios where individuals may be off campus, is problematic if different versions of software or entirely different platforms are used. One solution is to offer a standard platform with all resources developed around it but with recognition and some support for others.

The increasing prevalence of hand-held devices with maturing capabilities challenges the concerns and advanced planning that institutions adopt. While institutions scrutinise and many invest in lecture-capture technologies - often at significant cost though not always with significant benefits - students who wish to review lectures afterwards can easily capture audio and video with their mobile phones, tablets or laptops. The issue of IPR is then effectively side-stepped as students take material and share it with others who missed the session.

Technology to capture activities, such as field trips and once-expensive data capture devices, can be equally replaced with everyday mobile technologies that also enable sharing of results and discussions regardless of whether the lecturer planned or allowed for that.

Opening new markets and approaches

While distance learning is a well-established and supported model of teaching and learning, types of provision can vary between different types of institution as well as between disciplines within institutions. The flexibility offered by technology means it becomes easier for distance provision to be offered by anyone with little need for specialist resources. Thus one form of new market for many is true distance learning rather than the blended learning referred to earlier; however, such provision still has the potential to be labour-intensive and it is not sufficient simply to offer content without appropriate academic learning and pastoral support; the support offered is the value added for an institution and is where the real longer-term benefits and costs lie. In this way the technology - providing the (virtual) learning environment and tools for peer supported and assessed work and tutor interaction - is providing flexibility to all the stakeholders involved.

Flexible provision here allows for distance learning of credit-bearing content, be it entire programmes, modules or sub-module level materials. The key requirement is for a mechanism that allows for assessment and thereby allocation of credit. In the context of new markets this could be a much more flexible credit aggregation scheme where students acquire small chunks of credit rather than having to take full (and currently typical) 10, 15, 20, 30 or 40 credit modules. The challenge for teachers and institutions in such a model is how to ensure cohesive and coherent material that can be sensibly aggregated towards a larger qualification, assuming the target is an award.

The dimensions of flexibility vary depending on what choices are available, and who has the decision-making power: the institution, teacher or the student. For example, replacing physical lectures with video recordings, narrated slides or other content limits the choice for students. As they can no longer choose to go to a lecture their choices become merely where to consume the provided materials. The decision on the most appropriate form of delivery may be best made by the teacher, though institutions' policy decisions may limit their range of choice.

MOOCs and flexible learning

Massive open online courses (MOOCs) have been in the headlines in recent years and are identified as a potential game changer for education, with the possibility of opening up education and offering a wide variety of choice. The concept of the MOOC resonates with the rise of true mass education, with a wide variety of learning needs and scenarios. There are still a number of challenges for these and it is early days in terms of their development and impact. The current offerings of free content, with some form of supported provision, have enabled many tens of thousands to explore and experiment with learning in new ways. However, for the traditional HE student in the UK there is little sign of direct impact yet.

MOOCs do offer some new areas and potential:

- widening access to HE for students;
- widening access to prestigious institutions;
- providing motivational content for pre-university students;
- providing CPD materials.

Course completion with MOOCs tends to be low, and with the large number of graduates who choose to take them the question of how much this is really widening access to education is an important one.

MOOCs can offer flexibility in the different dimensions we are considering. For both institutions and staff they provide a way of accessing different markets (local and distant, full-time and part-time, small course and large course). For students, they offer the potential to study material from a range of institutions, to select courses that a single institution may not offer, and to try different approaches to the same material. Their online make up clearly provides choices for the place of delivery. However, the nature of such courses does limit support and many still use a rigid over-arching timetable framework. Mechanisms for reliable and robust assessment are still evolving, though models where third parties provide invigilated formal assessment environments, with identity checking and policing against unfair means, can offer a degree of trust in the outcomes.

There are other levels of flexibility that can be developed with MOOCs. For example, institutions could adopt MOOC content and provide local support (tutorials, workshops and assessment) for MOOC-based courses. This model may well become significant as the growing number of free universities - organisations and groups offering university-level learning without charging fees, sometimes based on co-operative models - could adopt MOOC material with the inherited prestige of the originating institutions, while offering low-cost access to education.

For traditional institutions, with existing complex franchise and accreditation networks, the rise of MOOCs and other shared online provision may provide wider adoption of federal or associate colleges' structures. Such models may be particularly relevant to areas of the UK with wide geographic populations and limited provision. HE providers in Wales have utilised and benefitted from such approaches as student groups can be combined across different physical sites and through technology take part in shared learning processes. The closure of specialist departments across the UK, as rationalisation of provision has taken place in the last 20 years, means that opening up access to different course options or entire courses makes sense and

becomes viable, something that is familiar in schools in similar geographic areas but has been limited for HE because of the larger physical distances.

Lifelong learning: engaging the alumni

One area which UK HE lags behind some other markets (notably the US) is engagement with alumni. The use of email lists and social media to maintain and develop relationships with graduates is improving but beyond occasional reunions or conferences such contacts can seem to be little more than fundraising activities for institutions. However, the MOOC model offers potential here if the value added to alumni from maintaining contact with their institution lies in on-going access to materials relevant to their original course of study, as well as to their CPD. As lecture courses are updated, allowing graduates to access online lecture notes and even to see sample assessments, this would potentially be of both interest and practical value to alumni. Furthermore, the MOOC approach, with a suitable level of backing - perhaps provided by current students - and assessment (likely computer-based assessment to avoid impact on teaching staff resource) supports education as a lifelong activity. An annual registration fee to institutions would emphasise the on-going commitment of the graduate as well as providing useful new income for institutions. This would also potentially encourage more generous and regular donations from graduates, something envisaged in the Browne review of HE (Browne, 2010).

e-Portfolios

While MOOCs, or other online courses can provide access to materials and assessment, the aggregation of credits and award of qualifications is still typically focused on awarding institutions; this can reduce flexibility to the learner in terms of their choices to create their own profile. Given the wider CPD-style framework and associated flexibility considered in the previous section, e-portfolios can offer a valuable solution as a mechanism to collate evidence of achievement and to share this with tutors, professional mentors and ultimately with potential employers. For on-campus, in-course learning, portfolios can seem to have limited direct use beyond being an additional way to evidence activity and potentially supplementary assessment evidence. However, as a resource for professional development portfolios and as a way to log and collate professional practice, portfolios, and especially e-portfolios with their greater flexibility, have much to offer whether as a formal assessment tool within a course, or as a way to evidence and support extra-curricular activity and attainment.

Within courses enabling and encouraging students to collate evidence of their skills through assessment-related evidence, as well as more general portfolio material, can help them prepare for the workplace. Providing e-portfolios that can be exported or used after graduation means this particular university-initiated resource could be on-going. With potential linking from a VLE, MOOCs or other online assessment, the e-portfolio can be automatically updated to reflect a student's on-going development of their knowledge and skills.

Providing automatic and user-managed links between e-portfolios, VLEs and social media is a way of encouraging an on-going learning community. Personal development planning (PDP) can be supported by such e-portfolios, and many professional bodies provide these as well as those that institutions adopt. The e-portfolio can also support the capture and evidencing of extra-curricular activities and experiences, also known as lifewide learning. Many universities already recognise - or plan to recognise - such development through a variety of awards and sometimes credit-bearing certification. As students take ownership of their own personal development such facilities become more valuable and can enhance the students' personal profiles and thereby their potential employability.

Social learning and assessment

It can sometimes be difficult to reconcile the desired outcome of individual learning and improvement with collaborative methods of teaching and learning, whether that takes the form of on-campus traditional learning, off-campus distance learning, or in the context of a MOOC-based course. Since assessment is highly individual (and as such seems best achieved through individual tests or exams, or through the submission of a single piece of coursework such as a report or essay), team and group work, which involve group learning and producing a team deliverable, are often limited to academic level (typically first year/certificate stage, where the results do not affect individual's degree classification) and frequency. This means the flexibility for teachers to use group work and for individuals to experience it is reduced. Team work can offer some flexibility to students, where team activities allow for students to negotiate what they do and when they do it, two of our dimensions of flexibility. Furthermore, the lack of formal team work limits the potential for students to demonstrate evidence of working with others in their portfolios, and thereby weakens their employability.

With the growth of social media, the game has changed. Students can (and do) set up ad-hoc online groups to discuss courses and assessment. For coursework, this means that the distinction between collaboration and support becomes fuzzy. Furthermore, where students choose to collaborate for the benefits such approaches offer, the question for institutions and teachers is how they recognise the benefits and by what means they regulate or limit their use. Plagiarism detection tools, whether commercial or bespoke, general or specialised, or the use of search technologies can all assist in identifying work submitted elsewhere. However, legislating and penalising such behaviours ignores the trend towards shared knowledge and social media. Concerns around this issue have led to policies in certain areas that reduce the use of coursework. In the context of HE, where one of the key underlying aims is to prepare students to contribute to society (and work or other activities are not done under exam conditions) then the use of coursework as a way to carry out independent learning is

perhaps more acceptable. Adopting technologies such as Wikis for submission, which allow for collaborative work and provide an audit of contributions, is one way in which teachers and institutions can respond to this particular flex. The question of whether to provide a single team mark to a group or to attempt to interpret the evidence log and to provide marks to individuals remains, however. Variants on the latter option include having team or individual interviews to provide a rationale on which to allocate a weighting for the relative contributions. Another approach for team work is to use web technologies that enable students to provide their views of relative contributions; one such technology is WebPA (Gordon, 2010), which enables students to provide their own scores on the relative contributions, and hence provide a weighting factor to assign individual marks based on the original group mark for the team's deliverables. Whatever options are chosen, this does raise the issue of quality and assessment process.

The role of quality and audit

The adoption of new technology-enabled approaches to learning and assessment introduces issues around quality and the auditing of activity. As a minimum, any technology should provide for institutional requirements for second marking and of archiving of assessed work etc. however, archiving a Wiki site or a Facebook discussion can be a challenge. Marking online may not easily allow multiple staff to share marking and/or to allow the second marking process. Another point to consider is whether the use of the alternative technology alters the learning activity, and in particular its assessment, so much that the planned learning outcomes may not be demonstrated to have been achieved.

Quality processes and checks, such as the external examiner process, also raise the question of the extent to which some flexible approaches can be introduced. For example, to allow the use of distinct forms of assessment some evidence would be needed to show that the forms of assessment were of equivalent quality and required an equivalent workload. This may be through stating that a certain module is assessed by a 4000-word essay or by a presentation. Assuming a rapid speaking rate of 150 words per minute, that equates to a 26-minute presentation. In terms of a Wiki, how many words should be present to indicate a similar workload? All three forms have different levels of preparation and differing impacts on the assessment process, with differing amounts of time to digest and mark each. While it may be stated that some piece of work is equivalent to another, perhaps through word counts, validating this is another matter.

Ensuring that learning outcomes are assessed by the assignments is one aspect of quality; the challenge of to what extent different forms of assessment can be archived, compared and reviewed is a different one with particular relevance to flexible pedagogies. With adaptive testing there may be no samples of work to review. With team exercises, it can be more difficult to evidence why one student did better than another.

Institutional systems

The planning and delivery of learning and teaching is dependent on the institutional systems that support it. Academic calendars and assessments can sometimes work against flexible delivery. For example, while technology offers potential flexibility for learners this is restricted to timetable freedom; assessment schedules are still often built around academic calendar structures and students' assessment data are needed for exam boards and graduation which take place on dates set months and years in advance. Moreover, the current UK fee model still assumes annual fees. Providing true flexibility to the learner requires institutions to consider how much freedom and choice they can provide within both the funding context and the pragmatics of having some notion of finishing a degree or an award-bearing course.

There can also be a tension between offering students genuine choices, and requirements made both by and of institutions. For example, consider retention and success rates, both of which are key elements of the UK Key Information Sets (KIS) data and are used in a variety of league tables. The apparent correlation between attendance and retention and success has led to many institutions and staff adopting more rigorous and inflexible attendance requirements, such as making some or all lectures compulsory. This results in a restriction on students' options in terms of deciding when and where to study. Study data analytics may offer a solution here; this permits tracking of student engagement with a block of material, whether in lecture, online or via some other auditable route, the resulting data is then used to validate that the student had attempted this work. This illustrates one of the conflicts within the modern UK HE context: students who desire flexibility in what and when to attend, but such flexibility may run contrary to the attendance requirements for their course, where non-attendance can lead to formal warnings, course termination and/or the loss of the right to take reassessments.

The diversity of region-specific market demands across the UK, alongside the internal (UK) and global market context of fees, visas and approaches to education, can also be an issue. One key challenge is visa regulations; a flexible approach to learning, allowing for variable periods of study, is not compatible with current UK visa requirements for very specific periods of study.

Flexible learning and delivery also has a number of embedded resource implications. As an example, we consider the following scenario.

Example

Within a medium-sized module comprising around 150 students, a traditional sequence of two one-hour lectures informs students of material they need to cover and at a later point demonstrate their understanding and ability to apply the knowledge through an assessment. The teaching of these lectures may be supported by lab work, workshops or seminars in smaller groups, generally led by a tutor or demonstrator. Assessment is via a test (perhaps multiple choice questions to assess threshold concepts) with an end of module exam to assess student performance (ie their grade).

Considering the time element of the teaching resources required for these two lectures. Delivery is two hours per week with an estimated two hours of preparation. So the teacher would have spent four hours preparing and delivering the lectures, with potentially another four or five hours of teaching support provided by tutors or demonstrators (e.g. five workshops). Replacing the lectures with a selection of online materials (perhaps a screencast or a video) supplemented with small class tutorials, eg groups of 10, means there would be around 17 hours of time for the lecturer (15 groups of 10 students x one hour plus preparation time of the online material and for the seminar).

If the tutorials are replaced or supplemented by online interaction, the time involved in moderating and engaging with individual students becomes even greater. If that were to be pursued then institutions have to look carefully at what their unique selling point might be, and what the added value for students is.

This raises the more fundamental question of when automation and virtualised delivery is appropriate. Many things can be automated but should they be? Technology can enhance what people do but that is different from replacing it. Enhancing university learning through supporting learning is a different prospect from replacing it. However, as illustrated here enhancement has significant resource implications.

Summary

The future for e-learning and flexible pedagogies

The printed book offered a way to mass produce and to disseminate knowledge in a form that students could learn from. Over the last few centuries universities have become places where students congregate and are directed in what books to look at, with the opportunity of accessing staff who can assist them in understanding and then demonstrating their skills with the material. The rise of lectures as an efficient way to provide such guidance en masse, with assessment through written exam, can be seen as a consequence of technological development, pedagogic adaptation and pragmatic solutions to expanding provision. In the same way, the current provision is adapting to utilise online material, though the issue of whose online material provides a question for the long-term viability of existing university models. However, as with books, the value added by attending university is in the opportunity to observe how experts manage to handle such data, and in interacting with them. Reducing lectures in favour of blended learning multi-media could lead to smaller-class interactions requiring much greater staffing cover, thus raising the financial cost to institutions in terms of staff time as well as requiring extra small-room teaching capacity so adding to facilities and estate costs.

Flexible learning also offers the potential for pre-university study of online courses, so students could already have some university credits as they begin their course, allowing those who wish to only take a small number of credits to do so, hence offering more time for study or even part-time work. For those who are not able or choose not to take credits before they begin, an alternative approach to offering flexibility is to allow them to extend the length of the degree or possibly to defer credits. This requires more structured and definite decisions on pre-requisites and post-requisites for modules, and can be more challenging in disciplines with very linear structures as is common in many science subjects. Funding regimes can also affect this, with the different countries of the UK having different fee and support regimes. The common feature is the assumption, and thereby requirement, of three-year (England, Wales and Northern Ireland) courses in general, or four-year in Scotland. Allowing students to extend their studies by moving modules around does not fit well with annual student fees and loans. Allowing fees for modules/credits would provide a more flexible structure, making accelerated degrees more viable from institutional financial perspectives, and also making the spreading of degrees over a 4+-year period a more realistic prospect.

Implications and recommendations

As described above, an idealised flexible e-learning system may allow students to select a set of modules over a period of their own choice, with each module providing a set of materials to select from in accordance with their own learning preferences, all with 24/7 support, and with the opportunity to choose how and when to be assessed in each. Such a flexible framework appears impractical on many levels, though with the increasing number of online courses (especially MOOCs), and with free universities and the potential for peer support (social media) it is not impossible. For current higher education providers, the challenge is selecting how much of this flexible offering to adopt and provide. The added-value of a university education, with a designed programme of modules leading to a defined and timely qualification is likely to remain the gold standard for some time. The university college model could rise again if institutions adopt others' e-learning provision, essentially providing the mechanism to authenticate assessment and credit accumulation. Maintaining international competitiveness, brand identity and managing this within the different UK higher education fee and funding models is likely to be the key challenge for flexible learning in universities over the next decade.

In terms of the three main stakeholders, future short-to-medium-term implications include:

- learners: taking more responsibility for their own learning, choosing and taking advantage of technologies that can improve their own learning, with advice from their teachers;
- teachers: identifying opportunities for flexibility in delivery, with a growing emphasis on managing the learning process rather than being the primary provider of learning material;
- institutions: allowing for flexible systems, where students can enrol and select learning. The role of institutions becomes that of providing systems and frameworks, as well as providing the quality checks to award credits and degrees.

Wider implications mean that funders (government organisations) recognise different approaches and provide support mechanisms - primarily funding - to allow such developments. This combination of institutional and government (QAA, HEFCE) structures and support to recognise flexible delivery and assessment is dependent on flexible funding to allow students to step outside of the current degree structures. Without such support, flexibility is liable to remain focused on options within programmes or modules.

In the longer term, developments in platforms such as Futurelearn (Future Learn, 2013) and EdX (edX, 2013) have the potential to widen access to education, and to put new pressures on institutions in terms of how they justify the cost of courses. As students take online certified courses there will be a growing expectation for institutions to recognise this, and to allow for accredited prior learning (APL) for entry or possibly to provide exemptions from some modules in their courses, with corresponding course fee reductions. One option here is for institutions to adopt general degree structures, with

flexibility on credit analogous to that currently used by many institutions for ordinary degrees and kept distinct from more specialised and structured honours degrees in specific fields.

Need for future work and research

There are a number of developments in virtual learning environments and other learning technologies that could aid flexibility, beyond the typical features of current VLEs. The key ones that follow from suggestions in this report are:

- support for personalised learning pathways within a VLE, so that learning material can be organised into structures that allow the learner to choose their own pathway. Dependencies between material would be identified, with clauses used to potentially control some of the learners' choices and access;
- flexi-level and adaptive assessment support in VLE-based assessment tools or available via standardised interfaces, such as the LTI standards;
- development of learning analytics to support flexible access, eg engagement data to replace attendance data;
- further research into the effectiveness of online, distance and flexible approaches compared with more traditional ones, with a particular focus on the retention and success data when compared with traditional approaches. The growth of MOOCs and blended learning offer opportunities to develop further work addressing questions such as to what extent engagement and attendance correlate, and whether online provision of resources encourages squirrel-like (collect and store) behaviours, rather than accessing and engaging. Existing VLEs and the new MOOC platforms offer the potential for large data sets of student learning behaviours to enable informed decisions on implementing new learning approaches.

In terms of collaboration and flexibility in credit, this requires the national funding bodies' support and the encouragement of flexibility through credit-based funding and loans systems. Recognition of credits from online courses such as MOOCs is another area for policy development. For MOOCs and other online resources, long-term successful adoption is likely to require some form of guaranteed Service Level Agreement type mechanism or mirroring systems so that when planning learning pathways any online resources are known to be both stable and available for the planned teaching period. This could be part of the role of 21st-century libraries: arranging provision of materials, tools and resources, where the library becomes the learning resource centre, a local repository and conduit of media and knowledge.

Funding and government policy remain a constraint on flexibility. For example, the impact of KIS data can be that universities are obliged to use formal contact time to remain competitive. A recognition that structured directed learning is equally valid contact time, as distinct from unstructured self-directed learning, could assist institutions wishing to adopt flexible approaches. Whether bespoke to module/sub module or utilising MOOCs or OERs the directed material has validity, but from a pedagogic perspective still needs questioning in the context of whether that can really replace or just complement in-class interaction.

The role of lectures and lecturers is still open to debate. If lectures provide directed learning and lecturers provide role models and exemplars, then a blended approach should protect and encourage students to attend and benefit from the value added of the campus experience. If there is evidence that such experiences are not valuable from a learning perspective then the age of campus-based education could be ending, but the current evidence of the effectiveness of distance and massive online learning is mixed, so for the medium term the best approach has to be utilising technology to enhance the student learning experience by enabling greater flexibility.

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