Enhancing professional learning and teaching through technology:

a synthesis of evidence-based practice among teachers in higher education

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CONTENTS

Executive summary

Background

This synthesis provides a review of evidence-based practice to learning and teaching with technology in higher education. The evidence was considered in relation to the three levels of purpose of identified in the HEFCE e-Learning Strategy namely: *efficiency*, *enhancement* and *transformation* gains in student learning. A further framework was devised in this synthesis to determine where evidence might be of use and the extent of its impact. This was to support a range of stakeholders (practitioners, educational developers and policy makers) in making the best use of evidence in their particular roles.

Scope

The synthesis is limited to scrutinising the application of technology in learning and teaching. It focused on a demonstration of the use of evidence in the practices of professional teachers in higher education, and how this evidence might change practice.

Method

The synthesis was largely a desk-based study but included some engagement with practitioners. It incorporated reviews of journals articles, case studies, and learning and teaching artefacts. Engagement with practitioners was through seminar attendance and interviews (available via vodcasts).

Findings

This synthesis has shown that that a range of technologies could be used to support a range of educational purposes. These include:

- the use of technology to support flexibility and widened access to the curriculum;

- the support of more mobile and transient learners, those in the workplace, or those geographically remote from a campus.

- the ability to support students with specific learning difficulties who may find aspects of the curriculum difficult to access;

- the ability to engage students in a variety of ways in their learning;

- supporting appropriate assessment and feedback for students;

- supporting students' skills development and professional practice through virtual environments;

- supporting students' revision and reinforcement;

- supporting students' reflection upon learning and personal development;

- developing students' abilities to link theoretical and practical aspects;

- supporting students' interactions with peers and engaging them in collaborative work;

- preparing students for life beyond university by developing their networking and discernment skills.

The defining feature was how the technology was used to achieve learning goals, how it was integrated with the needs of the student, and how the learning and teaching context was accommodated.

In conducting this synthesis we uncovered some issues in relation to the nature of the evidence reported and in finding evidence of changes in practice. Our findings showed that, in general, a weak theory/practice nexus exists. Fundamental issues are related to beliefs about and approaches to teaching. These are linked to how departmental or institutional contexts may constrain practice.

Conclusion

Technology has the potential effectively to support learning and teaching in a number of situations. However, the manner in which the technology was used and aligned with the goals and aspirations of the learner was an important consideration. Practitioners do not appear to be capitalising on existing evidence. More emphasis appears to be placed on generating new evidence rather than evidence driving new practices. Teachers' beliefs and practices are influential in determining how they engage with technology. The context of both the student and the teacher is also influential in determining the successfulness of learning and teaching practices with technology. Academic developers have key roles in supporting practitioners in engaging with relevant evidence while also supporting the development of their beliefs and practices concerning learning and teaching with technology. Policy makers have key roles in determining the integration of technology, as they influence the culture within which practitioners operate and hence their actions.

Structure of the report

This report is intended to have relevance for a range of different stakeholders with an interest in enhancing learning and teaching in higher education through the use of technology. Some parts of the report will interest some stakeholders to a greater extent than others. The table below indicates which sections are likely to be of interest to the three stakeholder groups identified:

Stakeholder	Most relevant sections
Academics/Practitioners	1, 2, 3.2, 6, 7.3, 9.
Academic developers	1, 2, 3.2, 4, 5, 6, 7 (particularly 7.3 and 7.4), 8, 9.
Policy makers	1, 2, 3.1, 3.3, 7 (particularly 7.2 and 7.4), 8, 9.

1. Background

The use of technology for learning and teaching in higher education has increased considerably in the last decade. There has been much funding associated with supporting research, development and practice in this area, particularly by JISC and the Higher Education Academy. This support has enabled the generation of many case studies and reports written about the practice of professionals (i.e. teachers in higher education) and many accounts of research have been published in journals. However, an area that has received limited attention is the use of evidence in supporting what practitioners do when using technology in their own teaching and learning contexts. This synthesis aims to examine the use and generation of evidence in teachers' professional practices in higher education involving uses of technology.

2. Scope

This synthesis incorporates a wide-ranging review of existing accounts of evidence-based practice relating to learning and teaching using technology in higher education. The study draws upon:

- recent research literature about interventions in learning and teaching practices;

- case studies and reports of such interventions available in web-based databases;

- other recent artefacts relating to technology-supported learning and teaching;

- HE practitioners' views through interviews, professional networking and the 2010 Enhancing Learning and Teaching Seminar Series.

Some of artefacts reviewed were not in a form per se that allowed robust examination of the evidence of impact. Hence, where appropriate, the authors have used a degree of inference in examining the nature of the evidence being presented.

The review also includes information gathered from eight interviews with practitioners: http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt . These are available as an open resource in the form of vodcasts for others to view.

3. Timeliness

For a number of reasons this report is very timely. We refer briefly to national polices that affect higher education, changes in the student body, and changes in the environment for graduates.

3.1 National policies

The importance of high quality teaching and e-learning were emphasised in the recent *Higher Ambitions* strategy document (Department for Business, Innovations and Skills, 2010). More recently, the report of the Independent Review of Higher Education Funding and Student Finance by Lord Browne (2010) has argued that the quality of higher education will be driven up by the increased competition that will accompany a fundamentally revised funding structure. Effective uses of technology will help institutions to improve the quality of the learning experience for an increased

number of students. The Review ties a much greater proportion of institutional funding to students and the choices they make, a consequence of which will be demands for better quality teaching and overall learning experience:

> *Increasing competition for students will mean that institutions will have stronger incentives to focus on improving teaching quality. If they are not able to attract enough students, their funding will decrease. Students will also expect that those teaching them have a minimum level of skill in teaching. Teaching in HE is diverse and a one size fits all 'licence to teach' is not appropriate.* (p. 48)

3.2 Changes in the student body

Given that the use of social media/Web 2.0 tools is becoming widespread, particularly with the 'net generation' (Jones & Cross, 2009; Kennedy *et al.*, 2008), we need to understand how such tools can support student learning appropriately for a networked society. The problem appears not to be technological but pedagogical: knowing *why* and *how* to use technologies *effectively* in practice is a complex matter (Bostock, 1997; Kirkwood & Price, 2005; Laurillard, 2002; Price & Kirkwood, 2008). How do academics change their practices and what evidence influences such changes? What evidence is there that changes in teaching practices involving the use of technology have actually enhanced student learning?

3.3 The changing environment for graduates

Beetham and Sharpe (2007, p. 14) have commented upon the changing environment that new graduates now enter:

> *The nature of **work** is changing, not just for the growing numbers of graduates directly employed in the 'digital' industries (est. 1,500,000). An estimated 77% of UK jobs involve some form of ICT competence, requiring updating of skills as technology changes. Global digital networks are also having a profound impact on how organisations recruit the expertise they need. A recent TLRP report on Education, Globalisation and the Knowledge Economy (2008) notes that British graduates are competing for high skills, high value jobs on a global stage, in which graduates from emerging economies have several advantages. As the performance gap narrows rapidly, differences in labour costs are narrowing far more slowly, giving companies greater scope to extract value from highly skilled people in different locations. Thus* 'it can no longer be assumed that even British-based corporations will choose to employ British graduates if the same talent is available at lower cost elsewhere. Colleges and Universities in emerging economies are expanding faster than those in the UK and arguably expanding smarter, learning lessons from other education systems without the same brakes on organisational and cultural innovation.'

If we are going to support the development of the UK economy in a digital age, we need to have graduates who are able to compete on a global stage. This requires universities to understand how to use technology effectively in learning and teaching.

4. Method

When reviewing the literature the following aspects were considered:

- What evidence was being used to drive the intervention?
- What evidence was gathered?
- What evidence illustrates changes in professional (HE teachers') practice?

The criteria for inclusion and exclusion of literature sources are listed in Table 1.

Table 1: Inclusion and exclusion criteria for literature sources

Criteria for inclusion	Criteria for exclusion
• Referred to the use of technology for specific teaching and/or learning purposes in higher education	• Referred to technology interventions in schools
• Illustrated the use of technology for specific teaching and/or learning purposes associated with one or more particular courses/modules or groups of students	• Referred to students' attitudes to and use of technologies in general
• Included some form of evaluative evidence of the impact of the intervention described	• Referred to plans for technology interventions that were yet to be introduced with students
• Included some reference to other work in the field	• Generalised or idealised potential or affordances of technologies in education
	• Only referred to approaches to professional development for teachers' adoption of technologies
	• Only referred to institutional policies relating to the adoption of technologies

Similar to the review by Conole and Alevizou (2010) we found limited reports of robust empirically grounded or longitudinal evidence of technology-enhanced learning. To gain a thicker description of professional teaching practice and to consider some activities that might be useful for practitioners, we widened the criteria to include learning and teaching centred artefacts, particularly cases studies. Although these softer accounts are not countenanced by more standard literature review processes, they can provide useful insights into how technology is being used in professional learning and teaching practices. As Conole and Alevizou (2010) assert they are useful mechanisms for gathering evidence of how the profession is 'practicing what it preaches'.

Artefacts considered of use to *practitioners*, *developers* and *policy makers* are provided in an overview table in Appendix A. Separate resource packs and guides are also available for *practitioners*, *developers* and *policy makers* in order to target specific needs.

5. Why evidence-based practice?

Using technology in education can be a costly business, both in relation to the financial investment for infrastructure and equipment, and in personal investment that staff and students make in using the technology in learning and teaching. Laurillard (2006, p. 29) noted that over recent years most higher education institutions have invested heavily in equipment and infrastructure to support learning and teaching, such that the "**more significant cost driver in the switch to TEL is that teachers,**

support staff and students spend their time differently". How do we know that the increased time spent on educational uses of technology are benefiting students and not wasting their time, or the time that their teachers have invested? This project is all about promoting an evidence-based approach to using technology in learning and teaching so as to inform wise 'investments' by students, teachers and their institutions. The sharing of 'good practice' and 'lessons learned' among members of the higher education community can help teachers and decision-makers to concentrate on effective uses of technology and to avoid the unnecessary duplication of effort and expense. **"The most important benefits, ultimately, are the learning outcomes, the improvements in understanding and skills implicit in the learning objectives"** (Laurillard, 2006, p.30).
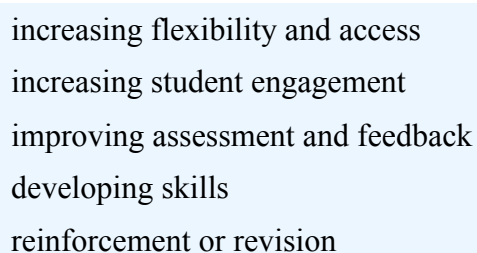
The sharing of 'lessons learned' is also important for constructing a firm evidence base for decision-making. Most of the interventions that take place within higher education institutions are relatively small-scale and it is unlikely that any evaluation or research concerning their effectiveness could be conducted with the rigour of a scientific experiment and produce conclusive evidence. Cumulatively, however, the lessons learned from a number of similar interventions can provide a useful indication of benefits that might be achieved. As Slavin (2003, p. 15) has pointed out:

> Rather than evaluate one large, definitive study, researchers must usually look at many small studies … if these studies tend to find consistent effects, the entire set of studies may produce a meaningful conclusion.

In order to grasp the collective significance and value given the variability in evidence presented, we have developed a framework through which the artefacts can be examined and their impact determined. These are discussed in more detail in section 7.1. This framework is presented in Appendix A and is populated with artefacts we have found that indicate the nature of the evidence and its level of impact.

6. Where technology can inform evidence-based practice

There is now a significant body of research into the use of technology in learning and teaching (Conole & Alevizou, 2010; Kirkwood & Price, 2005), but what can this research tell us about how to use the technology effectively for learning? What does the current evidence tells us? This section summarises the evidence we found and how it has been used in practice to effect change. It has been categorised broadly to relate to the three levels of purpose identified in the HEFCE e-Learning Strategy document (HEFCE, 2009). These include *efficiency*, *enhancement*, and *transformation*. While undertaking our reviews a number of themes emerged that broadly relate to these three HEFCE levels. In our analysis these did not fit neatly into simple categorisations as the contexts varied. However, they did progress on a continuum from efficiency to transformation (see Figure 1).

increasing flexibility and access

increasing student engagement

improving assessment and feedback

developing skills

reinforcement or revision

promoting reflection upon learning and personal development

supporting interaction with peers and collaborative work

supporting links between theoretical and practical aspects

preparing students for their careers/personal lives

Figure 1: Continuum of themes that emerged from the synthesis

Because these categories emerged from the literature and the learning and teaching artefacts we reviewed, the list cannot be regarded as exhaustive. These are considered in turn in relation to what technologies have been used to support these goals. The following sections summarise findings from the research literature, the case studies and other learning and teaching artefacts. They are grouped in sections related to our findings illustrated in Figure 1. Detailed references for these resources appear in Appendix A with links to appropriate websites.

For consistency in reporting our findings, we have used the term *intervention* to refer to any instance where technology has been used to support learning and teaching in higher education. We are aware that this term has a variety of connotations, but so too do other words or expressions that have been used in the research and evaluation reports and case studies we have reviewed.

6.1 Increasing flexibility and access

One of the most important advances that technology has brought to higher education has been an ability to support increased flexibility and access for a wide range of students. This has been particularly important for universities who wish to offer education to students who may not be able to attend an institution in person, or on a regular basis, or who simply want more control over their learning (Price & Kirkwood, 2006). Supporting students' diverse and changing needs requires flexibility, and this in turn requires technology (Collis & Moonen, 2001). The constantly evolving technology is illustrative of the demands of a mobile and globally interconnected society (Conole & Alevizou, 2010). This reflects the expectations of fluidity and mobility in life, and for students includes the ways in which they are educated. In other words a 'liquid lifestyle' where the social world is construed through a mobility paradigm (Bauman, 2005; Urry, 2007). So in what ways does education support these liquid lifestyles and in what ways has technology been used in education to support increased flexibility?

Providing podcasts is one way of increasing flexibility for students. Tynan and Colbran (2006) found that the use of podcasts for Law and Business students enabled learners to 'time shift' and have control over the replay of audio course material. Similarly web-based lectures (WBL) have been used on a variety of courses in four Australian universities in order to support the flexibility needs of students (Woo *et al.*, 2008). The feedback showed that WBL provided both campus-based and non-campus-based students with a high degree of flexibility in accessing lectures. In a similar vein, traditional lectures for a postgraduate course on Human-Computer Interaction were

transformed into problem-based blended learning. By using interactive learning materials, online discussions and other digital resources, the experiment showed that it was possible to reduce lecturing time, support repetition, and support educational differentiation by transforming the modules (Dalsgaard & Godsk, 2007).

Hybrid (blended-learning) courses can increase flexibility for students without any loss in the quality of outcomes. A mixture of traditional and online learning was used with a cohort of Computer Science undergraduates. The findings showed that there was no significant mean difference in effectiveness between the hybrid and traditional courses in students' achievement, retention, attitude and satisfaction in comparison to traditional instruction (Delialioglu & Yildirim, 2008).

A number of the case studies have illustrated how technology has been used in practice to increase flexibility – particularly in relation to off-campus provision. For example, online delivery of MSc Strategic Management enabled the university to provide flexible learning and to offer courses to non-campus-based students in Africa. Computer-based formative learning positively affected achievement rates. However, the impact may differ between the computer-based coursework and final written exam. Results may also be affected by the entry-level skills of students (http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html1). This kind of approach has also proved useful in supporting Law students. An online delivery of a Masters course in Legislative Studies to support part-time students working in or with parliaments, was able to give students a sense of community and allowed the exchange of experiences from around the world. This approach proved useful also in supporting work-based learning. improved student performance was also noted (http://www.jiscinfonet.ac.uk/case-studies/tangible/hull/index_html1/view). Similarly, the Moodle virtual learning environment (VLE) was used to support access to course materials and communications between staff and students in Scottish History courses. The intervention also illustrated an improvement in pass rates and in grades (http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html). The use of a VLE has also proved useful in introducing contemporary resources on 'Drug use in context' for Social Science and Law students. The VLE provided a flexible format for the student and a rewarding and continuously updatable module for the tutor. It has produced improvements in student learning with increased numbers of first and upper second class awards (http://www.jiscinfonet.ac.uk/case-studies/tangible/hallam/index_html1).

Video-conferencing has also been useful in supporting flexibility and access. It was able to provide collaborative teaching and support for shared modules on Masters-level Classics courses offered by Swansea University, the University of Wales and Cardiff University. As these subjects attract small numbers of students, the combined efforts of the universities demonstrated cost-saving benefits through spreading expertise across institutions. Statistical analysis suggests that students enrolled on the modules delivered by video-conferencing were not disadvantaged compared with student studying more traditionally taught courses (http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html1).

Improving access and flexibility for disadvantaged students or for those who have some learning difficulties are important considerations. It is essential for students to have access to the curriculum regardless of their social background, geographic location, or specific learning difficulties (SpLDs). One further education college that has made significant strides to address this issue is Liverpool Community College (Petrie, 2010). After conducting research into the issues associated with SpLDs in their college it was decided that technology could be used to provide a richer set of resources for both staff and students, particularly in recognition and support of dyslexia. The previous set of resources had been text based; that particular format presented accessibility issues for students and staff with dyslexia. The new resources were developed as short video clips where students or teachers discussed aspects of dyslexia. These included addressing myths about dyslexia, circumstances where learning was difficult, confidence issues and simple strategies that could help. This provided a more accessible and more inclusive (non-text-based) learning environment. Students surveyed felt that the project had developed the right approach and the resources alleviated feelings of anxiety and stress for those with SpLDs such as dyslexia (http://www.heacademy.ac.uk/assets/York/documents/ourwork/learningandtech/Liverpool_Community_College_Briefing_Report_11_June_2010.pdf). An interview with one of the project team members, Joel Petrie, regarding this development can be found at: http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#.

Abington College has also had similar success in using technology to support students with SpLDs. Some of these problems, such as poor language skills, note-taking or comprehension skills and dyslexia, often remain undiagnosed and hence compound the difficulties that students face. They found that embedding assistive software as a common learning aid for students proved useful in supporting students with a wide range of learning difficulties. The rapid identification of learning difficulties enabled learners to be more effectively supported (http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-abingdon-pdf).

Technology can provide a means of flexibly supporting students in a range of contexts more suited to their specific personal, social and career choices. It can also provide an effective means of supporting students with a range of specific learning difficulties. However, the needs of the students need to be taken into account for the successful employment of the technology.

6.2 Increasing student engagement

Personal or Audience Response Systems (P/ARS) are increasingly being used to improve student engagement. Lorimer and Hilliard (2008) explored the use of PRS to provide formative assessment and feedback in large undergraduate classes. They found that PRS increased classroom interactivity and that students who performed well in the formative multiple-choice questions were generally among the high achievers in the summative assessment. Kay and

LeSage (2009) reviewed 67 studies of ARS use in large classes and identified the following benefits:

- *Classroom benefits* – attendance; attention; anonymity; participation; engagement;

- *Learning benefits* – interaction; discussion; contingent teaching; learning performance; quality of learning;

- *Assessment benefits* – feedback; formative; comparison with class.

However, there were also a range of (practical and attitudinal) challenges identified that could impact upon effective implementation:

- *Technological challenges* – access to and consistency/reliability of equipment;

- *Teacher-centred challenges* – demands of responding to feedback; coverage; demands of developing questions;

- *Student-centred challenges* – new method; discussion; effort; summative assessment; attendance for grades; identifying students (who want to remain anonymous); negative feedback.

Connolly *et al.* (2007) conducted a study comparing a cohort of online learners (at Masters level in Computing Science) with part-time and full-time on-campus cohorts. The findings showed that online students were more engaged in comparison with the non-online students. The online students consistently performed better than the other cohorts. Additionally, retention was better among the online learning cohort. So engagement not only increased, but retention improved too using this approach.

Electronic delivery of lecture material has also been found to be a useful mechanism for engaging students. However, there are a variety of forms that this can take. The use of synchronised audio and video media were found to be more effective than the provision of separate media items containing the same information. Griffin *et al.* (2009) have shown that using PowerPoint and voice synchronously in podcasts has pedagogical benefits over the two media being presented as separate resources. In post-tests, the synchronous version yielded significantly more correct answers than the separate format (χ^2, P > 0.05). Although participants appreciated this use of technology, they did state a preference for traditional lecturers. However, others have found that students preferred technological equivalents (Tvedten *et al*., 1993) and this raises questions as to whether the lecture model is an outdated approach to teaching students (Honan, 2002).

How and when technology is used also has an impact. Susskind (2005) observed that when PowerPoint multimedia presentations were introduced to accompany lectures they had an affect on motivation. In comparisons between two groups, students appeared to be more motivated when the PowerPoint accompanied the lectures. In the classes where PowerPoint was added later it did not improve student motivation. This may be due to the fact that students do not like changes in course delivery during the course, or that it reflects

anticipation of future expectations. Although in some cases using technology to support traditional lectures was seen as valuable, most of the students agreed that a blended approach should supplement rather than replace traditional lectures (Riffell & Sibley, 2005; Steele *et al*., 2002)

In another study the efficacy of 'virtual lecture', 'e-lecture' and traditional presentations for Biosciences students were compared. The overall test scores for the three types of delivery were similar, but differences were found in depth of learning [using Bloom's taxonomy] (Stephenson *et al*., 2008). Students receiving traditional lectures scored significantly lower marks for comprehension questions. Those who received 'virtual lectures' (structured text-based interactive course material) scored high for knowledge, comprehension and application, but significantly lower for analysis and evaluation questions. Recipients of e-lectures (PowerPoint slides synchronised with audio presentation) scored high for knowledge questions and were the median for all question types except application.

Podcasting is also being used to increase the 'feeling of contact' distance students experience with their teachers. Fernandez *et al*. (2009) found that it supported different ways of working by students and, above all, increased their motivation. Audio podcasts were considered more engaging than 'dry' text material by Law and Business students (on-campus and distance learners). They were also linked with increased engagement with primary material and study guides (Tynan & Colbran, 2006). Similarly, among Economics and Business Studies undergraduates, most students felt that short audio podcasts, designed to support lectures, enhanced their learning and helped them to actively engage (Taylor & Clark, 2010).

Video resources can be used to promote discussion and activities during large group sessions. Among teacher education undergraduates, most found the use of images, movie clips and classroom footage beneficial and they responded positively to the group discussions and activities (Tormey & Henchy, 2008). Digital video (DV) cases produced by on-campus Public Administration students became resources for distance learners to utilise for problem solving. Designing, producing and solving the DV-supported cases were found to promote active and contextual aspects of the students' meaningful learning and also positive emotional involvement in the learning process (Hakkarainen *et al*., 2007).

Others have used different approaches to engaging students. An anonymous consultation tool – Dynamic FAQ Environment [online and SMS] – was developed to provide first-year Information Systems students with anywhere, anytime engagement with learning materials. Students asked questions not only about course activities, but also about how those activities were conducted and administered. Students as well as lecturers responded to questions. The tool became a means for formative evaluation and consequently the pedagogy was continuously revisited (Ng'ambi & Brown, 2009). This approach had the effect of not only increasing engagement and dialogue but, most importantly, staff could identify where difficulties were occurring for students and could subsequently take appropriate action.

Increasingly, learners are directed to online core or supplementary resources for their coursework, but students may not engage with these effectively. Across a large number of courses for distance learners, students' use of online resources (recommended or required use of 'external' websites) was found to be closely related to the pedagogic design and to assessment requirements, not merely to the availability of such resources on the web (Kirkwood, 2006).

A number of the case studies have shown that in practice technology can be used to engage students in using resources. In a Year 1 Physiotherapy course in the behavioural sciences, blended learning was used to contextualise their professional learning. This resulted in significantly higher use of VLE resources. Students were also exposed to a wider range of issues and a broader range of learning activities (http://www.jiscinfonet.ac.uk/case-studies/tangible/bradford/index_html). However, the technology alone is not the defining feature of success. In Business and Economics modules students were provided with a set of online economics texts, but these were supported with online formative exercises in order to drive student engagement. The pass rates and average marks compared favourably with previous modules. Retention rates were also very high and there was improved student access to the resources. In this case the use of formative assessment appears to be key in engaging students. Further, this approach had the added advantage of savings in staff time (http://www.jiscinfonet.ac.uk/case-studies/tangible/exeter/index_html). A further example of the role of assessment in driving engagement is the use of simulations. Business Studies students were able to examine a set of key concepts using experiential learning through a gaming environment. Associated formative activities were linked with the expected learning outcomes of the module. Pass rates improved as well as the average marks. This would suggest that students' performance had improved as much as a result of changing the method of assessment, as from the technology per se (http://www.jiscinfonet.ac.uk/case-studies/tangible/glamorgan/index_html1/view).

Technology is also helpful in engaging students in topics that require clear guidance or benefit from visual displays of information. Podcasts have been used to enhance work-based learning experiences for Masters-level students studying remotely. The podcasts provided students with clearer and more detailed instructions and guidance. They also provided students with reassurance and enabled learners to think ahead. During this activity tutor/student relationships were strengthened. Overall the podcasts supported flexibility and mobility in learning (http://www.heacademy.ac.uk/assets/York/documents/ourwork/learningandtech/Leicester_Briefing_Report_3_March_2010.pdf). In supporting access to visual information, video podcasts were provided for Archaeology students. This enabled them to see a series of images of archaeological sites or objects, and to listen to an 'expert' commentary made in the field. Students felt that they were engaging with the fieldwork, including the sites and artefacts, in a more meaningful way (http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html).

In order to engage medical students in a 'regional' Medical school, a VLE was used to provide learning resources. In the first instantiation the learning resources were freely available and the course was unstructured. In the second

phase the course was restructured with the learning materials developed around learning activities linked to the medical programme. This system allowed both students and staff to identify what learning outcomes were being met. The redesign of the course significantly improved student learning in the areas of assessment performance, pass rates, retention and student access (http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html1).

> The research and the case studies indicate that the technology per se is unlikely to be the defining feature in engaging students: context, course design, and variations in students' perceptions and experiences are likely to be highly influential in its acceptance as valuable.

6.3 Improving assessment and feedback

Improving assessment and feedback is a key strategy to supporting the development of student learning. This may include the use of formative or summative assessment in an 'e-assessment' environment. Formative e-assessment was introduced in Year 1 Economics to reduce failure rates among full-time students and to improve self-regulating learning through computer-based formative private study. Compared with previous cohorts there was a positive effect on retention, learning, exam results, student personal development, student and staff satisfaction with e-learning and staff personal development (http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html).

Similarly formative assessment was used with Law undergraduates replacing paper-based assignments. These were delivered through the VLE. The quizzes were accompanied by guidance on the module examination in the form of sample questions, model answers and marking schemes. Learners who had taken the quizzes performed significantly better in all aspects of the examination compared with those who had not used them. This included the development of higher order skills such as evaluation and synthesis (http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-oxfordbrookes-pdf).

The use of summative computer-assisted assessment in Applied Technology and Finance has proved useful in supporting student development. It was used to provide quick feedback to students, to introduce them to HE assessment processes and to reduce staff marking time. There was also a notable fast turnaround of exam marks achieved (three hours): timely feedback is important for student development (Gibbs & Simpson, 2004). The delivery of tests every two weeks gave rise to improved attendance and mean student marks improved. Savings in staff time were also accrued due to the increased use of reusable learning objects and question banks (http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html).

e-Assessment can be useful in supporting virtual clinical practice as this is an expensive resource for universities to support. e-Assessment was introduced to replace face-to-face clinical practice assessment for Year 3 students of Medicine and Veterinary Medicine. The new procedure aimed to reduce possible student collusion, reduce the costs of face-to-face clinical practice,

provide a system-based standard for marking, reduce complex assessment administration and provide assessment that accurately reflected students' ability. This proved to be very effective. High quality assessment was achieved with efficiency savings in relation to examinations and assessment marking and in the development of assessment questions. However, part of the importance of this development was in the nature of the structuring of the assessment that supported students in clinical practice (http://www.jiscinfonet.ac.uk/case-studies/tangible/edinburgh/index_html).

Providing feedback on assignments in the form of audio files can increase personalisation for individual students and result in them engaging with the comments and advice provided to a greater extent than with written feedback. A senior member of the Faculty of Health and Wellbeing and an academic developer discuss the use of audio feedback with Nursing and Health students at Sheffield Hallam University (Middleton & Walder, 2010; see vodcast at: http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#).

> While the use of technology is advantageous in supporting some high quality assessment achievements by students, the significance of the design of the assessment is a crucial part of that activity.

6.4 Developing skills

For university students learning a foreign language, technology offers opportunities but also presents some challenges. In a course supporting students learning English as a foreign language, technology-assisted learning had a positive impact on students' acquisition of vocabulary, but a negative effect on their listening comprehension. An interactive, multimedia website was specifically designed to support university students' learning of the fundamental aspects of the English language: reading, speaking, listening, vocabulary and writing. A control group used face-to-face learning exclusively, whereas the experimental group received a combination of face-to-face and technology-assisted learning over a whole semester. However, the perceived course learnability, effectiveness and learning community support all served as significant positive predictors of learning satisfaction (Hui *et al*., 2007). So in relation to developing skills there is a balance with regard to what particular skills are to be developed and how that can best be achieved using specific technologies.

For Science students, developing laboratory skills is important. However, this can often be an expensive component of the course. Laboratories are expensive to build and support, and hence time within the labs is a precious resource to be used wisely. It's also a difficult resource to provide for students studying at a distance. Virtual laboratories offer an opportunity for students to develop these skills without the complications typically associated with accessing physical laboratories. A virtual environment was designed to prepare distance learners on a first-year Chemistry course for real laboratory work. Although users of the virtual laboratory (only 29% of cohort) found it generally helpful, students' anxiety related more to understanding chemistry concepts than to their lack of familiarity with a real laboratory (Dalgarno *et*

al., 2009). In contrast Swan and O'Donnell (2009) used a virtual laboratory to supplement lab skills development with large first-year Biology classes. However, the system also included the opportunity for students to check their understanding by providing immediate feedback. In this case the use of the virtual laboratory was advantageous in relation to better course performance, especially in the laboratory practical exam. Students believed that it enhanced their experience in real laboratory activities. The ability for students to check their skills within this virtual laboratory had a positive impact.

Similar outcomes were found in a case study at De Montfort University. They developed an online multimedia laboratory skills resource to prepare Year 1 Bioscience students for laboratory work. The virtual laboratory enabled students to gain knowledge of laboratory skills before entering the Bioscience laboratory. Most students found the virtual laboratory experience useful as a foundation to entering the laboratory (http://www.bioscience.heacademy.ac.uk/ftp/casestudies/VRolfe.pdf).

A case study into a virtual laboratory for Bioscience students at the University of Manchester also illustrates the value of this use of technology to support skills development. Students were assigned group projects as a method of developing their laboratory skills. It proved useful in supporting students who wished to work away from the laboratory, as well as to alleviate pressure on staff to supervise relatively large numbers of students with limited resources. Annual evaluations over three years demonstrated consistently high student attendance at face-to-face sessions and participation in the online course, as well as a high level of satisfaction with the programme overall. Over 80% of students liked being a member of a project group, and found that working in project groups was helpful (http://www.bioscience.heacademy.ac.uk/ftp/TeachingGuides/studentresearch/wakeford.pdf).

Developing writing skills for university students is another area that has come under scrutiny in higher education. Wheeler and Wheeler (2009) investigated the use of wikis to develop initial teacher training students' writing skills. They found that the wiki aided the development of critical awareness, particularly in relation to the citing of sources and the nature of intellectual property. Most students considered that they had raised their skill level in academic writing.

Digital storytelling (DS) is another means by which skills development can be supported. Jenkins and Gravestock (2009) reviewed the use of DS in 22 different discipline areas. They provide helpful links to sites where software or free material may be accessed. They argue that one of the challenges in higher education is developing students' skills in 'accepted forms of academic presentation'. These are traditionally textually and verbally constructed and may not suit the learning needs of students. Jenkins and Gravestock assert that digital storytelling enables students to learn in a variety of ways through emerging technology such as small personal cameras and platforms such as YouTube and Facebook. It enables students to 'tell their stories' without being constrained by limitations in their skills in more traditional academic forms of presentation. This allows for the development of the student's

understanding while also being able to build confidence and foster development in more traditional forms of academic presentation.

> Using technology to support skills development is an important activity. However, skills development needs to be designed within a context that allows students to purposefully use the technology in order to achieve a specific and clear goal.

6.5 Reinforcement or revision

In order to support students' understanding in their learning development, reinforcement and revision is often necessary. However, finding meaningful and engaging ways of doing this is often challenging. Cramer *et al*. (2007) made recordings of 'live' lectures available online for students. This was to support an introductory course in Psychology. Although only 20% of students viewed the recordings, the impact was notable. The greater the use students made of the resources the higher their grades on the mid-term assignment. So using the technology in this way supported reinforcement and revision while also having a positive impact upon grades.

For some students, using technology is a preferable means of reinforcement. Marine Science students preferred audio and video podcasts of supplementary lecture materials rather than printed resources. The majority used these for revision or preparation for assessments (Copley, 2007). Similarly, podcasts of lecture material at a large US university were most frequently used for reviewing concepts and issues presented in lectures already attended (Lonn & Teasley, 2009). There also appear to be some efficiency gains using this approach. First-year Business and Management students found podcast revision lectures to be efficient, effective, engaging and easily received learning tools for revision purposes (Evans, 2008). Equally, Economics and Business Studies undergraduates found that short audio podcasts designed to support lectures were useful for assignments and revision – particularly if English was not their first language (Taylor & Clark, 2010).

Other approaches to using technology to support reinforcement and revision include computer gaming. A Year 3 Mechanical Engineering course was redeveloped to include an active video/computer game to teach numerical methods. Findings showed that students in the game-based course learned the material at a deeper level than students taking a 'lecture and textbook-based' course. The game-based students were found to have invested more time in their work and viewed the course content as more valuable (Coller & Scott, 2009).

> Using technology, such as audio and video podcasts and computer gaming, appears to offer a useful and efficient means of revision and reinforcement for students. Many prefer this approach and for some there are improvements in learning outcomes.

6.6 Promoting reflection upon learning and personal development

As part of ongoing development, universities strive to engage students in personal reflection and in driving their own personal development. This can be a challenging activity as students do not always see the point of this activity. Xie *et al*. (2008) engaged first-year Political Science students in reflective thinking skills through the use of weblog journals. This improved students' reflective thinking skills over time. The higher a student's reflective thinking level, the higher the course grade achieved. Students involved in solitary blogging showed a significantly higher level of reflection over time compared with those who provided and received peer feedback.

Blogging has also been used to promote reflection, knowledge sharing and collaboration among distance learners taking Masters-level education modules. Blogging can be appropriated by students to meet a range of personal learning needs, not always as a collaborative/communication tool (Kerawalla *et al*., 2009). Blogs have also been used as personal diaries to support reflective professional development during postgraduate teacher training. Hramiak *et al*. (2009) found positive evidence that the blogs are useful tools for recording reflections and developments throughout the year for a majority of each of the cohorts (of two universities). Tutors were able to access trainees' reflective development and provide support as required – not previously possible with paper-based systems.

The use of e-portfolios can be important activities to help students store and reflect upon their achievements and plan for new development. Herman and Kirkup (2008) found that mature students were able to use an e-portfolio effectively for personal and professional development. It helped students plan and aid their re-entry to employment in the fields of science, engineering and technology.

A number of case studies also illustrate the advantages of using e-portfolios and blogging in practice. At Newcastle University, e-portfolios were developed as a method to help foster a reflective approach to evidencing the achievement of both module-specific and programme learning outcomes in Medicine. 80% of students found it to be a useful learning experience and 72% said it influenced their approach to learning. 93% said it led them to reflect following the end of the placement. 70% of students found it useful and 58% said it would influence their learning in the subsequent year. e-Portfolios also reduced printing, copying and other administrative costs (http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html).

e-Portfolios have also been useful in supporting practice-based learning. Postgraduate Nursing and Midwifery students used e-portfolios to share experiences and gain feedback. Students were highly positive about their experiences and staff commented that they knew their students better as a result. This model has been adopted by staff at another centre that reported greater awareness of student difficulties and hence are more responsive to student needs (http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html). Similarly, e-portfolios and blogging have been used to support in-practice Teacher Education students (PGCE). The case study examined the impact of e-portfolios on the affective,

social and conative aspects of the student experience, in contrast to the conventional focus on the cognitive. The use of e-portfolios and blogging enabled writing to be shared with other students and tutors and for feedback to be given. This approach to supporting in-practice teachers benefited learning most effectively when considered as part of a joined-up teaching and learning approach, rather than as a discrete entity (http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html1).

Integrating reflection and personal development within the curriculum is an important activity. Blogging appears to offer an effective means to engage students in reflection. While e-portfolios offer students the opportunity to gather their activities together and reflect on them while supporting future development needs. For mature students a supported environment in which they can reflect and then build an e-portfolio can be a life-changing experience that can enhance employability. However, this does need to been integrated into the course as a whole and not seen by students as an unconnected and separate activity.

6.7 Supporting interaction with peers and collaborative work

Developing proficiency in interaction and collaboration with peers is important for students' success in the workplace. These skills are not always easy to develop, particularly among those who have entered university directly from the school system. Secondary school exam systems tend to favour individual autonomous contributions and hence tend to inhibit the development of interaction and collaboration skills. Downing *et al*. (2007) attempted to promote early interaction in online discussion environments among first-year Psychology students. It was underpinned by the design of a simple yet appropriate socially formative assignment. However, the timing and handling of the group summative assessment task clearly interfered with the continued establishment of a supportive and nurturing online community. Students gradually disengaged, taking a pragmatic approach based upon the requirements for summative assessment. Discussion was sustained only as long as students perceived there was value to be derived. Similarly, discussions among distance learners do not automatically become interactive and collaborative simply by virtue of being conducted in an asynchronous medium. Highly structured, planned, confrontational and demanding activities that include directed roles and responsibilities for students are key elements to moving them to higher levels of understanding and critical discourse (Kanuka *et al*., 2007).

In online discussions involving teachers in training (distance learners), evidence was found of participants sharing experiences, seeking solutions to problems, sharing values and knowledge. However, social sharing and knowledge construction did not happen online naturally – they resulted from careful planning of learning activities and facilitation during the learning process (Chen *et al*., 2009). Likewise, various instructor immediacy strategies were found to be helpful at different stages of online group work involving postgraduate Healthcare students (Melrose & Bergeron, 2007).

Designing a programme of study in such a way that the activities drive the interaction and collaboration are key factors to developing these skills among students. Thorpe (2008) found that having structured online tasks for Environmental Studies students enabled distance learners to co-operate and collaborate positively. Computer-mediated interaction (of various kinds) provided a highly structured context that successfully engaged students and supported their achievement of key skills and assessment goals, notably problem solving, team work and tackling unfamiliar problems. The nature of the task and the wording of the initial prompts are also important factors. McLoughlin and Mynard (2009) found that with on-campus Education students the nature of the course, the type of task and the wording could all affect the type of higher-order thinking processes in an online discussion.

Wikis too can be used to support collaboration effectively, particularly in the development of collaborative report writing skills. In feedback provided by Year 1 Statistics students, those who used the wiki to write a practice report gave higher ratings on 'engagement with other students' and 'cognitive engagement' than the students who wrote the practice report individually. Collaborative engagement with other students was enhanced, but not performance on assessment (Neumann & Hood, 2009).

Language learning has also made use of wikis to support collaboration and interaction. Effective language learning among Sociology undergraduates in Slovenia was facilitated through the use of collaborative wiki interactions. The wiki promoted peer and student/teacher interaction. Equally, students' interactions with hyperlinked resources and the software provided was also beneficial in supporting collaboration. However, as students could meet face-to-face, much of the peer-to-peer communication and co-construction of knowledge could take place 'live' or via the phone or Messenger (Zorko, 2009). Hence this affected the amount of collaboration that took place online. The tutor/teacher role in supporting collaboration in the wiki environment is also crucial. In the context of postgraduate level Business courses, students' engagement with wiki-based collaborative learning activities was found to be directly proportional to the quality and frequency of tutors' feedback and the clarity of the underlying learning and teaching process (Cubric, 2007).

Group projects are always difficult to handle among students, both in practical and assessment terms. Elgort et al. (2008) used a wiki to address this problem. It was used for conducting assessed group projects on postgraduate modules in Information Management for on-campus and distance learners. Wikis were found useful for arranging information and sharing knowledge. However, their use in and of themselves does not promote high-level intellectual engagement. Elgort et al. contend that scaffolding is likely to be required to help a student prepare for assessed collaborative work. They argue that attitudes to group work are mixed and use of a wiki per se is not sufficient to improve those attitudes.

It appears that the role of a wiki or blog needs to be carefully designed within a course or module in order for it to be used effectively. Hemmi et al. (2009) explored the use of wikis and blogs for collaborative activities on a range of courses (undergraduate and at Masters level). They found that for blogs, it was the wider context of the course design and the embedding of programmes of

study within particular institutional contexts that determined how students negotiated and interacted with these new writing and learning spaces.

In order to support peer interaction and collaborative work a learning space, such as a blog or wiki, is characterised by genuinely collaborative writing and collective meaning-making. Hence it is necessary to nurture among students the ability to edit, amend and challenge each other via direct manipulation of each other's text. Equally the nature of assessment and its timing in relation to activities are important considerations in promoting, and not interfering with, interaction and collaboration development.

6.8 Strengthening the links between theoretical and practical aspects

Helping students develop links between theoretical and practical aspects of a domain is an aspiration of higher education. However, this is not an easy task. Even within our own field of higher education, practitioners struggle to apply educational research to best practice in the classroom.

One of the challenges is in providing a 'safe space' where students can reframe and reinterpret new and existing knowledge, values and beliefs. Cooner (2010a) attempted to address this issue by providing a blended learning approach for first-year Social Work undergraduates. The thrust of this was an activity-led preparation for enquiry-based learning. Students had the flexibility to access recorded lectures 'on demand' and to control the pace of learning. They also had the opportunity to watch video clips of case studies. This allowed time to consider the material in more depth – an important activity to allow students to reframe and reinterpret their views on the material. Students were then required to present their findings. Compared with previous years, the presentations demonstrated evidence of better reflective analysis and deeper theoretical understanding of the issues. One crucial aspect of this is the change in assessment practice. When technology-enhanced processes are used, then the assessment methods must also be adapted to reflect the changes in order to capitalise on the enhancement for students.

Another approach to developing students' abilities to link theoretical and practical aspects is the use of scaffolding. Demetriadis *et al*. (2008) used technology-enhanced case-based learning with third-year Computer Science students. Scaffolding questions were used to activate cognitive processes and to help develop thinking between abstract theoretical computing concepts and more pragmatic issues associated with writing computer programmes. Computer-based question prompts were found to effectively scaffold learners in the process of linking theory and practice in problem solving in ill-structured domains. The approach helped activate their context-generating cognitive processes and guided them to reflect on the effect of contextual pragmatic constraints on an abstract problem.

A case study at Leeds Metropolitan University illustrates how technology can be used to help students develop links between theoretical and practical aspects of the course. A blended approach was adopted for developing multimedia design skills in Business Information Management. In order to

integrate theory with practical application, lecture time was reallocated to lab time. Although student achievements, in their assessments did not appreciably increase, students reported a positive learning experience (http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html1).

Developing students' abilities to link theoretical and practical aspects is a challenging activity. The use of technology can help support students in this endeavour by providing safe spaces for examination and reflection on material at their own time and space. Equally, the use of scaffolding helps students develop these links by providing them with the most support when they are most vulnerable (at the beginning of their learning journey), and then easing off the support as they grow. However, what has to be noted is how the curriculum in each case is designed to achieve these goals. In these cases different forms of assessment, summative and formative, were used to good effect to provide students with a challenging activity as well as appropriate feedback when needed.

6.9 Preparing students for their careers/professional life

The ultimate goal of higher education must surely be to prepare students for life after university, whichever direction that takes them in. For most students we *hope* their experience at university will have been a transformative life-changing experience, but we *expect* it will at least prepare them for their future careers. It is this transformative goal of higher education that provides the greatest challenges to educators. Some of this involves providing a safe place for idea generation and exchange while in others it involves the development of critical skills.

Lee *et al*. (2008) found that learner-generated podcasts enabled first-year Information Technology students to engage in idea generation, collective problem solving and reciprocal dialogue, as well as in the exchange and revision of ideas. Others have found that multimedia instruction can be used to support training and assessment of oral presentation skills for Business Administration undergraduates. Oral presentation performance increased significantly and students appreciated the feedback as a key feature of the instructional format. They also considered oral presentation skills as critical and important skills to be developed (De Grez *et al*., 2009).

Mobile tools too have been useful in supporting students for their careers and professional lives. Nurse practitioner students from two US universities used personal digital assistants (PDAs) to support mobile and co-operative learning while dispersed on clinical placements. The PDAs were found to be useful reference tools in the clinical setting and all students benefited from using them. Connecting students with classmates and other nurse practitioner students at distant universities created a co-operative learning community providing additional support and knowledge acquisition (Wyatt *et al*., 2010). Asynchronous communication has also been used in medical fields to promote critical thinking. While on work placement, medical students used PDAs to discuss science topics. The model was successful in establishing a dialogue among a group of students and an expert during work placements at different locations. The 'practical inquiry' model was useful in facilitating a sustained on-topic discourse involving critical thinking (de Leng *et al*., 2009).

24

However, the advantage of technology in supporting students for their careers and future lives has some limitations. Sorensen *et al*. (2007) investigated the use of the internet by postgraduate science teachers in training from five HE institutions. They explored competence, attitudes, barriers, etc. during practical placements in schools. They found that internet use remained fairly limited and there was not a clear understanding of what constituted a good use. Implementation in schools appeared to be variable and in particular there was a lack of clarity in relation to good pedagogical practice.

In preparation for professional practice, Social Work students are encouraged to reflect upon their existing attitudes, values and stereotypes in relation to various communities with which they might work. The Associate Director of the Centre for Interdisciplinary Mental Health at the University of Birmingham describes how students develop their capacities for critical thinking and reflection in relation to diversity in social work practice through the use of asynchronous discussion forums (Cooner, 2010b; see vodcast at: http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#).

An interview with a principal lecturer in Health at Staffordshire University revealed how using blogging (with restricted access) can make practice-based learning come alive for students (Pardy-McLaughlin, 2010; see vodcast at http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#). The blogging was initiated by a 'mystery' blogger, who was a member of staff or in social care practice, who posted an issue in relation to a case that they were currently working on. This enabled the students to see how 'professionals' where dealing with real cases and how they were integrating the theory that was taught in the classroom with the real, live pressure of day-to-day practice, even down to completing appropriate forms on risk assessment. The students were encouraged to give advice based on both theoretical aspects as well as issues that could be encountered in practice. The students were also assessed on their contributions to the blog. Follow-up interviews with students six months after the course was completed showed that they felt better prepared for going into practice as social workers.

A less structured and more open approach to developing students for their future careers was adopted by a senior lecturer in the School of Biological Sciences in Leicester University (Cann, 2010; see vodcast at http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#). The goal was to use existing publicly available social tools in order to engage students in developing their own discipline networks. This was to develop their skills in information acquisition, storage and engagement with peers using existing tools and software that might be of use to them in their future chosen career. One of the goals was to amplify staff effort and to engage students in their own personal development. A shift was also made from 'teaching' students through lectures to having the core information available electronically so that 'contact time' instead could be spent in discussion and dialogue with students in the labs or in relation to specific issues in the biological sciences. That had the effect of breaking down barriers between teachers and students, where the latter became more engaged autonomous learners. Similar approaches have been adopted at The Open University in supporting students in their aspirations for the future

(Weller, 2010; see vodcast at:
http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#). While the approach may not be for all students, many develop lifelong links and networks that support them in their future careers. A crucial factor appears to be the context in which the technology is used. Conole (2010) argues that the key to effective use of technology is in good learning design (see vodcast at:
http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#).

> Good uses of technology to prepare students for their careers and professional lives appear to be underscored by a match between the needs of the students, the goals of the task and the technology that best meets the constraints of the environment in which the students and teachers have to operate.

7. Promoting evidence-based practice

Our review of the research literature and teaching and learning artefacts sought to identify examples of technology use that generated some form of evidence of improved practice that could be shared among the academic community to inform good practice. In undertaking this review we have identified a number of issues that that need to be considered in relation to sharing good practice. Namely that the accounts of interventions vary considerably in what forms of evidence they presented and what purpose they sought to achieve. Further, the particular context of individual interventions needs to be understood in order to evaluate the potential for generalising findings and for appreciating of the range of contextual factors that impinge upon the successful uptake of technology for learning and teaching. The issues can be summarised as follows:

> - the nature of evidence and its usefulness to different audiences and stakeholders;
>
> - what purpose(s) do the identified examples of interventions serve?;
>
> - the problem of generalisation to other situations and contexts;
>
> - factors other than 'evidence of technology-enhanced learning' that influence university teachers' practices.

We consider each of these issues in the following sections.

7.1 The nature of evidence and its usefulness to different audiences and stakeholders

The concept of evidence is a contested issue in the field of student learning in higher education. In understanding what counts as evidence it is important to also consider the context within which it will be used.

We have developed a framework in order to accommodate the variation of views about evidence and the context within which it will be used. This provides a lens through which the artefacts can be characterised and as a means to direct different stakeholder groups (i.e. practitioners, developers, managers and policy makers) to areas in the literature that might be relevant to them. Within the framework, evidence can be characterised in two ways: first, in relation to the type of evidence provided; and second in relation to its potential impact.

7.1.1 Types of evidence

These are divided into three main groupings:

1) **Accounts of interventions**
   These are descriptions of how technology has been used in higher education. The evidence provided is typically of a less formal nature such as anecdotes, observations and questionnaire data, including measures of student satisfaction.

2) **Lessons learned**
   These are accounts of learning and teaching with technology where lessons have been learned from their use. They include formal and/or informal forms of data collection, including both qualitative and quantitative data. The data will also range in nature from weak to robust data collection methods.

3) **Changes in practice**
   These provide good examples of how evidence has been used to drive an investigation into interventions in technology in learning and teaching, followed by an evaluation of its effectiveness for student learning. This evidence is then used to drive changes in practice.

7.1.2 Impact of evidence

These are also divided into three main groupings:

a) **Micro**
   These changes are usually confined to a level local to the teacher or classroom or a particular course.

b) **Meso**
   These changes are usually within a department, faculty or institution and will have impact on more than one course or programme of study.

c) **Macro**
   These changes impact on more than one institution at national level and may also have impact on institutions in different countries at an international level.

The framework can be represented in the form of a matrix or grid (see Figure 2).

Type of evidence	Impact of evidence		
	a. Micro Local changes, i.e. within a classroom or course	**b. Meso** Changes within an institution, i.e. affecting more than one course or class	**c. Macro** National or international changes, i.e. changes that affect more than one institution and possibly in more than one country
1. Accounts of interventions Accounts of technology use in education			
2. Lessons learned Evidence of 'enhanced' student learning			
3. Changes in practice Evidence being used to enhance practice			

Figure 2: *Framework for scrutinising evidence-based practice*

This framework was used to identify varying kinds of evidence. This is reported in Appendix A. Examining evidence-based practice of learning and teaching with technology is a complex issue. It has been important to draw attention to this so that a simplistic review of the area is not adopted.

7.2 What purpose(s) do the identified examples of interventions serve?

Technologies can be used to enhance learning and teaching in higher education in a variety of ways. Some can have direct impact upon specific aspects of learning and/or teaching, while others relate to the educational environment more generally. The revised HEFCE strategy for e-learning (HEFCE, 2009) reflected **"a more general, problem-based approach to institutional change as opposed to a technologically determined approach"** and emphasised **"the enhancement of learning, teaching and assessment, and how technology might be able to support that focus"** (p. 5). It also recognised that technology-supported interventions could aim to serve a number of purposes and that **"benefits may be felt at three different levels,**

depending on the type of intervention". We have shown in our review in Section 6 (see also Figure 1) that in practice the range of themes overlap and expand some of these categories. What is important to note is that there are a range of purposes for which technology has been employed and these do not all specifically relate to the improvement of student learning per se. In many cases these are aimed at efficiencies for the institution. Hence this makes comparison between interventions difficult.

7.3 The problem of generalisation to other situations and contexts

Underpinning the sharing of *good practice* and *lessons learned* within the higher education community is the notion that findings can be generalised from one situation to others. However, to what extent is it possible to generalise findings to other contexts? Although accounts of interventions may refer to the application of a technology (e.g. podcasts, wikis, etc.) to learning or teaching situations, there are often multiple ways in which a particular technology can be used. Just as a novel, a dictionary, an anthology of poems and a technical manual are all 'books', there are many ways in which specific technologies can be exploited for educational purposes. Use of a particular technology in one context may be very different from another use of the same technology in a different context. Often specific details about the context are insufficiently described in order to make generalisations possible. Research and evaluation reports and case studies about the use of technologies in higher education are often presented in relation to a particular technology adopted. However, what has actually been studied and reported is often considerably more complex in relation to the educational design. Studies may refer to certain technology uses that encompass:

- particular courses or modules;

- specific discipline or subject areas;

- particular pedagogical approaches (instruction, collaboration, enquiry, etc.);

- particular outcomes or purposes (product or process; assessed or non-assessed);

- particular cohorts of students (full- or part-time; on- or off-campus, etc.).

Thorpe (2008, p. 57) has argued that it is often difficult to generalise findings from one educational context to another:

> *... research might have increased value if it provided more information about the design of the teaching and learning interactions associated with its findings. This would enable the findings reported to be interpreted in relation to the way in which the technology was implemented, and the context of the implementation, rather than to the technology as an abstract concept such as 'computer mediated communication'.*

Another concern is the under-utilisation of theoretical models as a means to examine technology enhancements in student learning (see, for example, Means *et al*., 2010) and as a method of generalising results. On the contrary, some studies using models of learning for examining enhancements have illustrated that learning *does not* appear to be enhanced by technology (Price *et al*., 2007; Richardson & Price, 2003).

7.4 Factors other than 'evidence of technology-enhanced learning' that influence university teachers' practices

The factors that determine whether teachers in higher education employ technologies to change their teaching practices and/or the learning practices of their students are many and complex. The availability of evidence from research and evaluation studies about the particular contributions that technologies can make to educational processes represents only one influence upon teachers' decision-making.

There are differences in teachers' attitudes to the adoption of technology in professional learning and teaching practices. The Adoption of Innovations model proposed by Rogers (1995) suggests that there are different rates at which innovations are embraced within a population. These range from *innovators* and *early adopters,* who are the first to use any innovation, to those who are often resistant to change. *Innovators* are driven by intrinsic interest in the innovation and are willing to take risks and invest time and energy working with the innovation. The *early majority* are also interested in the innovations, but are more attracted to what the innovation can do for other areas of their lives rather than the innovation per se. *Diehards* (sometimes referred to as *confirmed traditionalists* or *resisters*) may never adopt the innovation willingly.

HE teachers also exhibit differences in their *conceptions of* and their *approaches to teaching* (Kember & Kwan, 2000; Samuelowicz & Bain, 1992, 2001; Trigwell & Prosser, 1996). This means that what they believe teaching to be will affect how they actually go about their teaching. Some will adopt transmissive approaches to teaching while others will adopt transformative student-centred forms of teaching. Technology can support a variety of teaching approaches, but using technology in a way that supports student learning requires a different skill (Laurillard, 1993). This is highly significant as it impacts upon the approach *to learning* adopted by students (Lindblom-Ylänne *et al*., 2006; Trigwell *et al*., 1999). Hence less transformative conceptions of and approaches to teaching become more visible in a technologically rich learning environment where teachers' pedagogical practices are open to scrutiny. Promoting increased use of technology does little, if anything, to improve student learning. It is only by attending to higher education teachers' conceptions of teaching and learning with technology and supporting change in this area that significant progress will be achieved (Kirkwood & Price, 2011).

The teaching practices *actually* adopted by individuals are not solely determined by their conceptions and beliefs; social and contextual factors are also highly influential. The practice of teaching represents a compromise between a teacher's academic and social contexts (Trigwell *et al*., 1999). Teaching practices tend to reflect the departmental and/or institutional environment in which they are conducted, even if these differ from the beliefs about teaching held by individual teachers (Norton *et al*., 2005). The institutional and departmental contexts often fail to support learner-centred teaching. Hockings (2005) reported institutional barriers that caused an innovative teacher to revert to teacher-focused approaches. Hence policy makers and leaders influence the quality of teaching and learning and have a role in changing departmental cultures (Ramsden, 1998).

HE teachers also have to contend with the competing demands of discipline-based research and administration. Historically, teaching reaps fewer rewards than research (Boyer, 1990). There are demands upon individuals to enhance their research profile.

The outcomes are highly significant in relation to the funding and status that is derived from the process for future research within disciplines and institutions. Other competing goals relate to the administrative demands that teaching brings. Many HE teachers find that they have to cope with large class sizes and there is much administration associated with this. This has been accompanied by accountability requirements associated with the Quality Assurance Agency and the demands this places on institutions. A department's or institution's response to this will determine the context and hence influence the practices of academics.

National demands and expectations relating to the whole higher education sector too place burdens on HE teachers. This determines the professional context within which practitioners operate. All UK higher education institutions are required to formulate and publish an explicit statement of their approach to learning and teaching. While the importance of high quality teaching and e-learning have been emphasised in the recent *Higher Ambitions* strategy document (Department for Business, Innovations and Skills, 2010), UK universities are also obliged to address a range of other issues. These include widening participation, strengthening research capacity and increasing the contribution of higher education to economic recovery and development. These demands bring added pressure to practitioners; hence solely attending to 'evidence' when developing interventions with technology in teaching and learning becomes a constrained activity due to time pressures.

8. Learning and teaching with technology: changing practices

Despite much debate about the 'transformative' or 'disruptive' potential of technologies for teaching and learning, there is little evidence of university teachers' practices being changed greatly by the use of technologies – in fact, non-transformation (Blin & Munro, 2008; Roberts, 2003) might be more commonly found (Price *et al.*, 2007). Hiltz & Turoff (2005, p. 60) claim that the evolution of online learning is linked to a transformation in higher education. They suggest that:

We are in the process of moving:

from: face-to-face courses using objectivist, teacher-centred pedagogy, and offered by tens of thousands of local, regional, and national universities;

to: online and hybrid courses using digital technologies to support constructivist, collaborative, student-centred pedagogy, offered by a few hundred "mega-universities" that operate on a global scale.

This line of thought confounds at least three different types of change in higher education and implies that each is bound up with the others:

- the first type of change is **conceptual** and concerns the nature of knowledge, teaching and learning processes (epistemology, learning and pedagogy);

- the second type of change is **practical** and refers to the means by which the teaching and learning take place (face-to-face or technology-mediated);

- the third type of change is **organisational** and relates to the technology and infrastructure processes that support the organisation (an issue that we do not address in this synthesis).

These first two changes are often conflated in higher education policy documents and in accounts of interventions aimed at changing teaching and learning in universities. However, we suggest that these changes are *not* inextricably linked: it is quite possible for changes to take place in one area (for example, the means by which teaching and learning take place) without being accompanied by any significant change in another area (the approach to teaching and learning and associated pedagogy).

A common focus for change in incorporating technology in teaching and learning practices is the focus upon development activities for individual teachers. It would seem that the way to improve the effective use of technology in HE is to develop teachers' own understanding of their teaching and its impact upon students. However, the situation appears to be more complex. Ho *et al*. (2001) found that while it is possible to change a teacher's conceptions of teaching, it is not always possible to change their approach to teaching. They described a professional development programme that sought to change teachers' frameworks for conceptualising teaching and learning. Although many of the teachers who started with relatively unsophisticated conceptions of teaching showed enhanced conceptions after the programme, only a few of those teachers introduced changes in their teaching practices. Hockings (2005) argues that it is not enough to change the practices of one teacher; systemic and systematic changes are required at departmental level so that learner-centred teaching practices are not eroded. Hence changing the practices of individual teachers may be difficult because their approach is mediated by their working environment (Gibbs & Coffey, 2004; Knight & Trowler, 2000). So even if professional development programmes are successful in changing teaching beliefs, changing practices may be difficult because of their institutional or disciplinary context.

Clark (2010) argues that for policy makers to drive institutional change they need to take a broad perspective of a wide range of issues that will impact upon any technological changes that are implemented. These are not confined to enhancements in student learning, but what underpinning infrastructure will be required to support it, what changes in processes are required, and what changes in the skill sets of staff will be needed. In order to underpin successful implementation of technological interventions at institutional level it is important to draw upon good evidence and, in particular, case studies and experiences of other institutions. For successful implementation a large investment in time is required to gather good evidence to make good decisions (see vodcast at: http://podcast.open.ac.uk/oulearn/education/educational-technology-and-practice/podcast-elttt#).

Haynes *et al*. (2004) argue that a social approach to learning is necessary in order broaden attention from the actions of individuals to the social system and the surrounding institutional practices. They contend that a holistic account must be taken of the educational system due to the interrelatedness of many factors. Hence a change

in just one aspect of a system is unlikely to bring about a substantial and transformative change to the whole educational enterprise, with or without technology. A holistic view that draws on good evidence is required to make good choices, whether within a course or programme, or across a whole institution.

9. Conclusions

The documents and artefacts reviewed cover a wide variety of interventions, in many discipline areas, spread across a range of countries. Various research approaches had been used, from quasi-experimental to case studies and reports via interviews. While many of the interventions were designed to replicate or supplement existing teaching practices, some others were focused on new ways of working – either for students or teachers.

Earlier in this report we presented findings from the reviews we conducted. These are broadly in relation to the three levels of purpose identified in the HEFCE e-Learning Strategy document: *efficiency*, *enhancement* and *transformation* gains in student learning. We reported the findings of this synthesis by educational purposes based on the premise that reporting by technology type may reinforce a technological deterministic view.

The use of technology to support flexibility and access has made valuable contributions to supporting students' ability to gain access to the curriculum. This enabled the support of more mobile and transient learners as well as those in the workplace or those geographically remote from a campus. It also had the ability to support students with specific learning difficulties who may previously have found aspects of the curriculum more difficult to access. Technology has also been useful in engaging students in a variety of ways in their learning. This was also supported with appropriate assessment and feedback to students, which helped drive their learning.

An important area for skills development has been the use of virtual laboratories to stimulate the acquisition of laboratory skills. Given that laboratory time is an expensive resource the use of virtual environments to provide students with these skills has advantages. Students can replicate the same activity several times to allow them to develop skills at their own pace, as well as offering cost savings for the institution. Virtual environments are also valuable in clinical settings for similar reasons: they offer increased access and availability to practice at no increased cost. This is linked with supporting revision and reinforcement: necessary activities in the support of student development.

The use of e-porfolios and blogging are advantageous in supporting reflection upon learning and in students' personal development. They offer students the opportunity to concretise their learning experiences and activities and to appreciate how they fit together into a whole profile that collectively represents their experience. These are also useful commodities for future employers as 'real' examples of students' skills and proficiencies.

Technology has also been useful in developing students' abilities to link theoretical and practical aspects. In social care the use of blogging enabled students to experience the issues that a professional might face in day-to-day practice. In relation to career development, technology has also been useful in supporting students' interactions with peers and in engaging them in collaborative work: necessary skills

for most careers. Preparing students for life beyond their university education is an ambition most universities aspire to. Here again we have illustrated that technology is useful in helping students develop networking and discernment skills that will support them in their life beyond the university.

This synthesis has shown that that a range of technologies can be purposefully used to support a range of educational purposes (see, for example, JISC's *Tangible benefits of e-learning* project report, Ferrell *et al*., 2007). However, in the interventions reviewed it was not the technology per se that was the defining factor; it was how the technology had been used to achieve learning goals and how it was integrated with the needs of the students and the context within which the learning and teaching took place. This reflects previous research regarding the role of pedagogy in the effective utilisation of technology (Beetham & Sharpe, 2007; Conole *et al*., 2008; Kirkwood, 2009; Price & Kirkwood, 2008).

In conducting this synthesis we uncovered some issues in relation to the nature of the evidence reported and in finding evidence of changes in practice. In a considerable number of cases limited time was spent investigating initial problems before interventions began. Insufficient articulation of the pedagogical issue meant it was difficult to determine whether a satisfactory solution or enhancement had been achieved. In other words, little use was made of existing evidence. Much of the evidence gathered tended to focus on accounts of technology use and were confined to particular local contexts. Some evaluations of interventions were either missing or lacked robust data collection. Seldom was evidence used to illustrate how practices had changed for academics. Our findings showed that, in general, a weak theory–practice nexus exists. In other words, theory (and research evidence) appears to be having partial impact upon practice. There is a role here for academic developers to act as a conduit for advice about evidence-based practice and in locating exemplars to support 'time-poor' academics.

However, even if pedagogic issues are considered first, the adoption of technology may make little difference to student outcomes. More fundamental issues are related to beliefs about teaching and whether teachers are engaged in knowledge transmission or learner transformation. However, even the most reformed and innovative teacher can be constrained by the departmental or institutional context. This is often evident in professional development programmes that institutions adopt that focus primarily on teaching 'how-to' approaches with technologies, as opposed to engaging teachers in examining their beliefs about and approaches to teaching. Using technology to enhance learning and teaching practices requires more than an adopting of good evidence; it requires a holistic approach to impacting change on the whole educational enterprise.

10. Further research

One of the observations of this synthesis is the underuse of current evidence in teaching practice. However, there may be other more fundamental issues related to teachers' beliefs about teaching, their competence in using and generating evidence, or their role within their institution. Although we have alluded to some of the barriers that currently exist, in relation to added time pressures that may distract practitioners from adopting a more evidence-based approach, investigating practitioners' perspectives in everyday life might be advantageous.

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Web links

Vodcasts (video interviews)

Joel Petrie, 'Developing Resources for Dyslexia Staff and Students'

Martin Weller, 'Using new technology in new ways'

Alan J. Caan, 'Using technology in the Biological Sciences to support blended learning'

Lee Pardy-McLaughlin, (Typo in original name) 'Using technology to support Social Work practices with vulnerable children'

Grainne Conole, 'Learning innovations in technology for teachers'

Paul Clark, 'Developing policy to support learning and teaching with technology'

Tarsem Singh Cooner, 'Developing reflective analysis with Social Work students'

Andrew Middleton & Pete Walder, 'Developing audio feedback in assignments'

University of Derby, Online delivery of MSc Strategic Management in Africa, http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html1

University of Hull, Teaching Legislative Studies Online http://www.jiscinfonet.ac.uk/case-studies/tangible/hull/index_html1/view

University of Glasgow, Supporting History courses via Moodle http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html

Sheffield Hallam University, Use of a VLE to introduce contemporary resources on 'Drug use in context' http://www.jiscinfonet.ac.uk/case-studies/tangible/hallam/index_html1

Swansea University, Collaborative teaching and video-conferencing in Classics http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html1

Anselm Burke, Ann Johnson, Bronek Kram & Joel Petrie, Liverpool Community College (July 2010), Developing an E-learning Dyslexia Resource http://www.heacademy.ac.uk/assets/York/documents/ourwork/learningandtech/Liverpool_Community_College_Briefing_Report_11_June_2010.pdf

Abingdon and Witney College, Embedding assistive software as a common learning aid for students http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-abingdon-pdf

University of Bradford, Promoting the patient perspective: Blended learning in practice-based courses, http://www.jiscinfonet.ac.uk/case-studies/tangible/bradford/index_html

University of Exeter, Online Economics texts: Using online formative exercises for several modules, http://www.jiscinfonet.ac.uk/case-studies/tangible/exeter/index_html

University of Glamorgan, Experiential learning through simulation gaming, http://www.jiscinfonet.ac.uk/case-studies/tangible/glamorgan/index_html1/view

Armellini, A. & the Beyond Distance Research Alliance team, University of Leicester (May 2010), Podcasting in Assessment: New Technology in Higher Education Research (PANTHER), http://www.heacademy.ac.uk/assets/York/documents/ourwork/learningandtech/Leicester_Briefing_Report_3_March_2010.pdf

Swansea University, Enable students to engage with archaeological in the field.

http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html

Newcastle University, Use of a VLE to deliver a 'regional' medical school,

http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html1

University of Derby , Formative e-assessment in Economics, http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html

Oxford Brookes University, Using technology enhanced formative assessment, http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-oxfordbrookes-pdf

Leeds Metropolitan University, Use of summative computer-assisted assessment in Applied Technology and Finance, http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html

University of Edinburgh, e-Assessment: specifically to replace clinical practice previously executed face to face. http://www.jiscinfonet.ac.uk/case-studies/tangible/edinburgh/index_html

Dr Vivien Rolfe, A virtual analytical laboratory, http://www.bioscience.heacademy.ac.uk/ftp/casestudies/VRolfe.pdf

Carol Wakeford and Ian Miller, University of Manchester, A virtual laboratory for Bioscience e-learning projects, http://www.bioscience.heacademy.ac.uk/ftp/TeachingGuides/studentresearch/wakeford.pdf

Newcastle University, Use of e-portfolios to develop a reflective approach in Medicine, http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html

University of Wolverhampton, Use of e-portfolios to support Nursing and Midwifery, http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html

University of Wolverhampton, Use of e-portfolios and blogging in Teacher Education, http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html1

Leeds Metropolitan University, Use of WebCT in a blended approach to developing multimedia design skills, http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html1

Appendix A: Overview of table of resources

Studies of evidence-based technology-enhanced learning and teaching in higher education: an overview

This is a resource that provides an overview of studies that have been examined in relation to an evidence-based approach to investigating technology use in learning and teaching. A framework has been developed in order to accommodate and interpret variation in views about evidence-based learning and teaching with technology. This provides a lens through which artefacts can be characterised and as a means to direct different stakeholder groups to areas in the literature that might be relevant to them. Within the framework, evidence is characterised in two ways: first, in relation to the type of evidence provided; and second in relation to its potential impact.

Types of evidence

These are divided into three main groupings:

1) **Accounts of interventions**
   These are descriptions of how technology has been used in higher education. The evidence provided is typically of a less formal nature such as anecdotes, observations and questionnaire data, including measures of student satisfaction.

2) **Lessons learned**
   These are accounts of learning and teaching with technology where lessons have been learned from their use. They include formal and/or informal forms of data collection, including both qualitative and quantitative data. The data also range in nature from weak to robust data collection methods.

3) **Changes in practice**
   These provide good examples of how evidence has been used to drive an investigation into interventions in technology in learning and teaching, followed by an evaluation of its effectiveness for student learning. It also illustrates how the evidence is used in changing practice.

Impact of evidence

These are also divided into three main groupings:

a) **Micro**
   These changes are usually confined to a level local to the teacher or classroom or a particular course.

b) **Meso**
   These changes are usually within a department, faculty or institution and will have impact on more than one course or programme of study.

c) **Macro**
   These changes impact on more than one institution at national level and may also have impact on institutions in different countries at an international level.

Studies of technology-enhanced learning and teaching in higher education

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Blended learning/e-learning/hybrid courses							
Hui, Hu, Clark, Tam & Milton (2007) DOI: 10.1111/j.1365-2729.2007.00257.x **2b**	Comparing computer-assisted and classroom-only groups of learners	Year 1 university students of English as a Foreign Language	Is learning effectiveness associated with technology-assisted learning contingent on target knowledge?	438 on-campus students	Hong Kong, China	Pre- and post-study tests; self-reported assessments; questionnaire	Technology-assisted learning has a positive impact on students' acquisition of vocabulary but a negative effect on their listening comprehension. Perceived course learnability, effectiveness and learning community support serve as significant predictors of learning satisfaction.
Bailey & Card (2009) DOI: 10.1016/j.iheduc.2009.08.002 **3b**	Effective pedagogical practices of online teaching	Various	Effective pedagogical practices of online teaching	15 experienced e-learning instructors	USA	Individual interviews	Effective practices identified through interviews related to: fostering relationships; engagement; timeliness; communication; organisation; technology; flexibility; high expectations.
Delialioglu & Yildirim (2008) DOI: 10.1016/j.compedu.2007.06.006 **2a**	Course content, interaction and communication provided in an online environment.	Computer Science	To investigate the effectiveness of a hybrid course in relation to students' achievement, retention, attitude and satisfaction in comparison to traditional instruction.	50 on-campus students	Turkey	Pre-test/post-test control group experimental design. Achievement test and attitude survey.	There was no significant mean difference in effectiveness between the hybrid and traditional courses.
Dalsgaard &	VLE - interactive learning materials, online discussions &	Postgraduate course on Human-Computer	Reducing lecturing time by transforming traditional lectures into	20 on-campus	Denmark	Questionnaire; an achievement test; log of VLE activity; assessment	The experiment showed that it was possible to reduce lecturing time, support repetition and

48

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Godsk (2007) DOI: 10.1080/02680510601100143 2a	other digital resources	Interaction	problem-based blended learning	students		of student assignments.	support educational differentiation by transforming the modules.
Stephenson, Brown & Griffin (2008) DOI: 10.1016/j.compedu.2006.08.007 2a	Electronic delivery of lectures	Undergraduate Bioscience	Comparing the efficacy of 'virtual lecture', 'e-lecture' and traditional presentations	58 on-campus students	UK	MCQ assessment – with Qs related to Bloom's taxonomy; questionnaire on attitudes and preferences.	Overall test scores for three types of delivery were similar, but differences found in depth of learning (Bloom).
Cramer, Collins, Snider & Fawcett (2007) DOI: 10.1111/j.1467-8535.2006.00598.x 1a	Virtual Lecture Hall - electronic delivery of lectures	Introductory course in Psychology	Making available online recordings of 'live' lectures	165 on-campus students	Canada	Utilisation log; survey of students' perceptions and attitudes to VLH.	20% of students used the resource. Greater use of VLH corresponded with higher grades on mid-term assignment.
Arbaugh, Godfrey, Johnson, Pollack, Niendorf & Wresch (2009) DOI: 10.1016/j.iheduc.2009.06.006 **General literature review**	Online and blended learning	Business & management disciplines	Comparison with classroom-based courses	Various	International	Literature review	Results from the comparison studies generally suggest that online courses are at least comparable to classroom-based courses in achieving desired learning outcomes, while there is divergence in findings of comparisons of other course aspects.

Accessing the studies

To access journal articles use the DOI as a universal locator by pasting the DOI into the search box in a web browser. To access reports, hold down the control button and click on the link highlighted in blue.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Connolly, MacArthur, Stansfield & McLellan (2007) DOI: 10.1016/j.compedu.2005.09.001 **2b**	Online courses	Masters courses in Computing Science	Comparison of online, part-time and full-time cohorts	3,619 full-time, 796 part-time and 269 online students	UK	Interviews; questionnaires; student records; enrolment data.	Online students consistently performed better than part-time and full-time on-campus students. Students and tutors liked online delivery and dropout was lower than for the on-campus cohorts. No significant differences found in performance in theoretical and practical components.
Sorensen, Twidle, Childs & Godwin (2007) DOI: 10.1080/09500690601137676 **2c**	Use of the internet by student-teachers	Education – postgraduate courses for science student-teachers	Exploring use of the internet (competence, attitudes, barriers, etc.) during practical placements in schools. Developing pedagogical and support models.	Almost 600 students at five HE institutions	UK	Longitudinal and mixed methods. Focus groups, questionnaires, case studies.	Use remains fairly limited and there is not a clear understanding of what constitutes good use of the internet. Implementation in schools is variable. There is lack of clarity in relation to good pedagogical practice.
University of Bradford, Promoting the patient perspective http://www.jiscinfonet.ac.uk/case-studies/tangible/bradford/index_html **1a**	Blended learning in practice-based courses	Year 1 Physiotherapy students	To enhance the student learning experience and to contextualise professional learning in the behavioural sciences.	48	UK	Comparison of VLE course statistics with an equivalent course.	Significantly higher usage: 6,539 'hits' as against 3,990. It exposed students to a wider range of issues and broadened the range of learning activities.
University of Central Lancashire http://www.jiscinfonet.ac.uk/case-studies/tangible/lan	Accessible online diabetes training for Health Care professionals	Heath Care Level not specified	To facilitate the implementation of the National Service Framework (NSF) for Diabetes. The philosophy encompasses	Not specified	UK	Not specified	This case study illustrates staff satisfaction with e-learning, a positive effect on recruitment, use of resources, and an effect on social equality.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
cashire/index_html 1a			constructivism theories.				
University of Derby http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html 1a	Formative e-assessment in Economics	Economics Year 1	To reduce failure rates among full-time students through improving self-regulating learning through computer-based formative private study.	Approximately 250 to 350 over two years	UK	Comparison of dropout rates and grades with previous two years and use of formal and informal feedback.	This case study illustrates a positive effect on retention, learning, exam results, student personal development, student and staff satisfaction with e-learning, and staff personal development.
University of Glamorgan http://www.jiscinfonet.ac.uk/case-studies/tangible/glamorgan/index_html 1a	Phased online summative assessment in undergraduate Accounting	Business Studies Year 1	To improve students' poor performance, lack of participation in the learning process and superficial engagement in the topic area.	60	UK	Not specified	Improved student engagement in double-loop learning: better integration between theory and practice. Also better engagement in both tutor-led and private study.
University of Derby http://www.jiscinfonet.ac.uk/case-studies/tangible/derby/index_html1 1a	Online delivery of MSc Strategic Management in Africa	Business Administration Masters	To meet university requirements to provide flexible learning and to offer courses to non-campus-based students.	306	UK/Africa	Changes in the distribution of outcome values were examined using the mean scores for summative assessments and examinations over a period of three years.	Computer-based formative learning positively affected achievement rates. However, the process by which formative assessment affects achievement may differ between computer-based coursework and final written exam. It may also be affected by entry-level skills.
University of Glasgow http://www.jiscinfonet.ac.uk/case-studies/tangible/gla	Supporting Scottish History courses via Moodle	History Years 1 and 3	Improving accessibility to course materials Improving communications	Not specified	UK	Not specified	Improvement in pass rates and in grades.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
sgow/index_html 1a			between staff and students Reducing photocopying costs.				
University of Glasgow http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html2 1a	Use of Moodle in Divinity	Theology and Religious Studies Years 2 and 3	Move from a paper-based distance education course to a VLE version.	Not specified	UK	Not specified	Students grades compared with the paper-based version were the same. However, the course was discontinued due to the increased costs.
University of Glasgow http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html3 1a	Use of Moodle to support active learning in Classics To integrate online and face-to-face learning	Classics Year 3	Encouraging students to take an active role in learning and to become critical thinkers.	Not specified	UK	Not specified	No tangible benefits per se – but has provided grounds for future development.
University of Glasgow http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html4 1a	Use of Moodle in Multimedia analysis and design at Humanities Advanced Technology Information Institute (HATII)	Humanities Honours	To support constructivist approaches to learning and teaching.	Not specified	UK	Not specified	Enabled doing the same thing better. No grade or pass rate improvement.
University of Hull http://www.jiscinfonet.ac.uk/case-studies/tangible/hul	Online MEd in e-Learning programme	e-Learning Masters	To ensure access to remote students and to exploit the added value which the VLE offered.	Not specified	UK	Not specified	No previous course to compare to, but supported a symbiotic relationship between study and work contexts.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
l/index_html 1a							
University of Hull http://www.jiscinfonet.ac.uk/case-studies/tangible/hull/index_html1 1a	Delivery of MA in Legislative Studies Online (MALSO)	Legislative Studies Masters	To support wide-ranging student needs: staff working in or with parliaments; mature students with work and family commitments; improving access.	Not specified	UK	Not specified	Supports distance students. Brings together students who have wide-ranging and unique parliamentary experiences. It allows the exchange of experiences from around the world. Supports work-based learning approach. Improved student performance; some is of publishable standard.
University of Hull http://www.jiscinfonet.ac.uk/case-studies/tangible/hull/index_html2 1a	Use of a VLE to support placement students on Westminster Hull Internship Programme (WHIP)	Politics and International Studies Undergraduate	To support students in their internship who may be in the UK or in Brussels.	30	UK	Not specified	Better communication with and feedback to students.
Leeds Metropolitan University http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html 1a	Use of summative computer-assisted assessment in Applied Technology and Finance		To provide quick feedback to students; to introduce them to HE assessment processes; and to save staff marking time.	350	UK	Discussions with students	Fast turnaround of exam marks (three hours). The delivery of tests every two weeks gave rise to improved attendance. Mean student marks rose from 53% to 63%. Students less apprehensive of taking Finance subject as they get regular feedback. Savings in cost and time due to increased use of reusable learning objects and question banks.
The University of Nottingham	Moving from optical mark recognition (OMR) to computer-	Medicine	To reduce time pressures of increasing cohort	~ 1,900	UK	Not specified	Easy to accommodate students with some disabilities. Students have also reported that they

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
http://www.jiscinfonet.ac.uk/case-studies/tangible/nottingham/index_html 1b	based assessment (CBA) for summative exams in Medicine	Undergraduate	sizes' marking and to create more realistic questions.				found the online exam cleaner. Students can change their answer selection as many times as they choose until finally submitting the form. Only one option can be selected for a multiple-choice question, thus avoiding problems with mistaken multiple answers.
The University of Nottingham http://www.jiscinfonet.ac.uk/case-studies/tangible/nottingham/index_html 1a	Disability support in computer-based assessment		To enhance an online assessment system to afford accommodations for those with disabilities. The aim was to focus on assessing understanding rather than a students' ability to interact with a particular assessment format.	30	UK	Informal	No formal research has been conducted. However, informal discussions with students highlighted the acceptability of the customisation approach.
University of Wolverhampton http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html2 1a	The 'Religions in Wolverhampton' web environment	Religious Studies	To offer students an experiential encounter with religion through a synchronic and diachronic study of religious communities.	Not specified	UK	Not specified	The students reported increased motivation and competence, and the web environment allowed for empowerment through the sharing of individual reports on visits.
Oxford Brookes University	Using formative assessments (replacing paper-based assignments), through a series of	Law Undergraduates	To address unsatisfactory learner performance from a law course employing traditional teaching	Not specified	UK	Using the VLE tracking facilities.	Learners who had taken the quizzes performed significantly better in all aspects of the examination compared with those who had not used the

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-oxfordbrookes-pdf 1c	online assessments delivered through the VLE. The quizzes were accompanied by guidance on the module examination in the form of sample questions, model answers and marking schemes.		methods (weekly lectures and seminars), which was disappointing. Student feedback illustrated a gap in understanding course expectations.				quizzes. This included the development of higher order skills such as evaluation and synthesis.
Fermanagh College http://www.youtube.com/watch?v=K3C7I--iktk http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-fermanagh-trans 2a	Using blended learning to support any time any place learning	FE college 16 + academic and vocational courses	To develop course materials that could be accessed outside of class time in the support of students from a rural community.	Not specified	UK	Not specified	Success of this intervention has spread to other areas in the College.
University of Sheffield Using technology to improve student engagement and learning 2a	To provide examples/evidence of student engagement that encourages colleagues to adopt technology to enhance their teaching	Various	Harnessing technology to enhance teaching and learning practices.	Various	UK	Quantitative and qualitative feedback from students, using standard module questionnaires, questionnaires and focus sessions. The evaluations span from 2004-present.	Students report - regular assessment kept them working; less pressure than exams and hence more pleasant; allowed them to build up confidence in the topic.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Kingston College Different pedagogical uses of VLEs with different learner groups **3a**	This case study reviews the impact of Blackboard on teaching and learning at Kingston College.	Various	To enhance the quality, range and reach of curriculum delivery in the College and to improve the productivity of teaching staff.	Not specified	UK	Not specified	Highlights the need to match technology closely with learner needs. Too little attention had been given to the 'past'. The emergence of a model for distinguishing between different curriculum contexts based on the level of learning has provided a helpful framework.
Loughborough University Closing the feedback loop in Web_pa - Peer Review of individual students in group projects **3a**	Creating an open source online peer assessment tool for students.	Various	To provide automatic feedback to individual students against the assessment criteria chosen.	Various	UK	Various	Students reported a rich experience.
University of Reading Moving Forward Through Feedback: Enhancing Feedback Provision in the	'Enhancing Feedback Provision in the Digital Age'	Various	Exploring a range of tools and methods for giving rapid and timely feedback to stimulate and support students' learning in the 'digital age'.	Various	UK	Various	Technology can have a positive impact in delivering clear and accessible feedback (and feed-forward). It can enhance students' engagement with feedback.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Digital Age 1a							
University of Sheffield Embedding feedback and feed forward through curriculum design 1b/2b	Embedding opportunities to feedback and feed forward into curriculum design	Engineering Year 1	Using a holistic approach to the curriculum delivery, evidence supported development of appropriate assessment strategy and appropriate infrastructure or technology to deliver the curriculum.	Not specified	UK	Action research	Students perceived the programme to be more coherent.
University of Chester E-learning and Professional identity 2c	Examining the links between e-learning and the development of a professional identity in students.	Various	Examining the style of learning on socialisation to a professional identity: implications for future employers and professional bodies.	Various	UK	Interviews/ phemenographical	Students need to be given the opportunity to develop identities online similar to those developed face to face.
Sheffield Hallam University Enhancing Student Engagement with Feedback	This seminar considered how evidence from a 12-month funded research project could be used to enhance and	Various	To promote strategic thinking for senior managers around enhancing student engagement with feedback	Various	UK	Literature review and semi-structured interviews	Students perceived that the ability to publish grades and feedback online enabled staff to return their feedback more quickly, thus keeping the feedback and grades in close proximity to the assessment activity.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
3a	transform feedback.						

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Audio/podcasts							
Griffin, Mitchell & Thompson (2009) DOI: 10.1016/j.compedu.2009.03.011 **2b**	Electronic delivery of lecture material. Podcasting by synchronising PowerPoint and voice.	Various degree courses in faculties of Science and Social Sciences	To provide – at low cost and minimal disruption to existing practices – learning advantages in relation to flexibility of place, pace and learning process.	90 on-campus students	UK	Comparison of 'synchronised podcast' and 'separate audio and visuals' recorded lectures. MCQ (quantitative) test of efficacy of presentation and online survey of students' attitudes and preferences.	Empirical evidence that synchronised audio and video media are more effective than the provision of separate media items containing the same information. Evidence from attitudinal survey that the synchronised approach was the favoured one, and that students appreciate the benefits of e-learning, particularly when revising material (though overall preferring traditional approaches).
Lonn & Teasley (2009) DOI: 10.1016/j.iheduc.2009.06.002 **2b**	Use of podcasts (via iTunes U) at a large university – mainly lecture material	Various	Views of and use of podcasting within the university	879 students and 22 instructors	USA	Online survey	Most frequent use was for reviewing concepts and issues presented in lectures already attended. Only 9% of students listened to podcasts on a portable audio device.
Fernandez, Simo & Sallan (2009) DOI: 10.1016/j.compedu.2009.02.014 **2a**	Podcasting (audio only and audio enhanced with PowerPoint slides)	Year 1 Information Systems Management (Industrial Engineering)	Specific issues: Increased student numbers = reduced staff-student contact time. Time needed to cope with large quantity of module documents.	60 distance learners (but with some face-to-face time)	Spain	Questionnaires about attitudes and expectations at beginning and end of module; emails; interviews; discussion forum	Podcasting a powerful tool to complement traditional course resources. They increase motivation through the feeling of permanent contact between students and teachers, and through respect for diverse students' talents and ways of learning.
Lee, McLoughlin & Chan (2008)	Learner-generated podcasts – scripting and creating	Year 1 Information Technology	Dissemination of learner-generated	Five on-campus students	Australia	Focus groups	Students engaged in idea generation, collective problem solving and reciprocal dialogue,

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
DOI: 10.1111/j.1467-8535.2007.00746.x 2a	educational podcasts for their peers		content				as well as in the exchange and revision of ideas.
Murphy & Ciszewska-Carr (2007) http://www.ascilite.org.au/ajet/ajet23/murphy.html 2a	Synchronous audio using *Elluminate Live* (voice and text exchanges)	Education, Nursing, Social Work – mainly postgraduate	To gain insight into instructors' experiences with web-based synchronous communication within asynchronous distance courses.	Eight instructors	Canada	Semi-structured interviews. Grounded theory approach to analysis – categorisation of emerging issues.	Voice and text exchanges = instructors need to divide their attention simultaneously between technical, social and pedagogical aspects of learning. Varying levels of audio participation by students requires strategies for encouraging responses. Differing patterns of interaction (instructor-student-student) depended upon how the instructor ran the sessions. Only technical training had been given – pedagogical training might have focused on strategies or best practices for promoting more student participation in this type of communication environment.
Tynan & Colbran (2006) http://www.ascilite.org.au/conferences/sydney06/proceeding/pdf_papers/p132.pdf 2a	Podcasting – m-learning for large student groups	Students of Law courses	Does podcasting present a new learning opportunity? Does it impact upon study habits?	1,244 Law and Business students (on-campus and distance learners in cohort)	Australia	Qualitative, mixed methods – survey and online focus groups	Increased flexibility – students able to time shift and have control over the replay of auditory course materials. Increased engagement with primary materials and study guides. Audio more engaging than reading 'dry' texts.
Evans (2008)	Podcast revision	Business &	Podcasts for revision by learners after their	196 Year 1 on-	UK	Online questionnaire	Students find podcasts to be efficient, effective, engaging and

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
DOI: 10.1016/j.compedu.2007.09.016

2a | lectures | Management | lecture course had finished (supplementary) | campus students | | | easily received learning tools for revision. Most (80%) listened via a PC, i.e. did NOT use a mobile audio player. |
| Taylor & Clark (2010)

http://www.ascilite.org.au/ajet/ajet26/taylor.html

2a | Short audio podcasts to support lectures | Economics and Business Studies | What different podcasting approaches are used by teaching staff? Does approach impact on student use? Perceived benefit for L&T? Do students and lecturers like academic podcasts? | 1,780 on-campus students and their lecturers | Australia | Quantitative (surveys) and qualitative (interviews and focus groups) | Three broad approaches identified: reframed, complementary and supplementary.

Most students felt that podcasts enhanced their learning (71%) and helped them to actively engage in learning (65%). Useful for assignments, revision and learners whose first language was not English. A relaxed, informal tone of voice is motivating. |
| Copley (2007)

DOI: 10.1080/14703290701602805

2b | Audio and video podcasts of supplementary lecture materials | Year 1 and Year 4 Marine Science courses | Providing supplementary material for on-campus students | 84 (52 Year 1 and 32 Year 4 students) | UK | Questionnaire survey; download data | Students preferred podcasts to printed supplementary materials. Majority used podcasts for revision or preparation for assessments. |
| University of Glasgow

http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html1

1a | Use of podcasting in Philosophy | Philosophy

Year 3 | Not specified | Not specified | UK | Informal feedback | Positive feedback from students. |

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
University of Leicester Podcasting in Assessment: New Technology in Higher Education Research (PANTHER) **2a**	'Podcasting in Assessment': an opportunity for the discussion and dissemination of the research findings of the JISC-funded curriculum delivery DUCKLING project	Masters level: work-based learning	Enhancing work-based learning experiences for students studying remotely.	Various	UK	Action research, semi-structured interviews and cognitive mapping	Podcasts enhanced students' learning experiences: built tutor-student relationships; provided clearer and more detailed instructions and guidance; provided reassurance; enabled learners to think ahead; increased flexibility and mobility in learning.

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Video resources/lectures/games							
Tormey & Henchy (2008) DOI: 10.1080/13562510802045337 2a	Video resources to promote discussion and activities during large group sessions	Philosophy in Education	To reconcile large group lectures with commitment to in teaching that is "student-centred, relational and socially and politically transformative".	Phase 1: 170 Teacher Education undergraduates. Phase 2: Focus groups and observations	Ireland	Quantitative (survey) and qualitative (focus groups and non-participant observation)	Most students found the use of images, movie clips and classroom footage beneficial and responded positively to the group discussions and activities.
Hakkarainen, Saarelainen & Ruokamo (2007) http://www.ascilite.org.au/ajet/ajet23/hakkarainen.html 2a	Digital video cases produced by on-campus students became resources for online students to utilise for problem solving	Public Administration	Improving problem-solving skills through the use of video case-based learning	Eight on-campus students and 33 distance learners	Finland	Content analysis of students' production diaries and questionnaires	Both designing and producing, as well as solving the DV-supported cases, promoted active and contextual aspects of the students' meaningful learning and positive emotional involvement in the learning process.
Woo, Gosper, McNeill, Preston, Green & Phillips (2008) DOI: 10.1080/09687760802315895 2c	Web-based lectures	Various across four universities		702 on-campus and 113 distance learners; 155 teachers	Australia	Surveys (students and staff); interviews (students and staff)	Student feedback largely positive – WBLT has provided both internal and external students with a high degree of flexibility in access to lectures.
Coller & Scott (2009) DOI: 10.1016/j.compedu.2009.05.012	Use of a video/computer game to teach numerical methods	Year 3 Mechanical Engineering	Redeveloping a course to use an active game-based model	86 (concept map) and 58 (survey) on-campus students	USA	Analysis of the concept map constructed by each student. Survey after completion of course.	Students in the game-based course invest more time in their work and view the course content as more valuable. They learn the material at a deeper level than students taking a lecture and textbook-based

63

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
2a							course.
University of Glamorgan http://www.jiscinfonet.ac.uk/case-studies/tangible/glamorgan/index_html **1a**	Simulation gaming in Business	Business Studies	To allow students to examine a set of key concepts using experiential learning through simulation gaming.	150	UK	Quantitative and qualitative student feedback.	Pass rates improved as well as the average marks. Evidence that students' performance has improved as a result of changing the method of assessment.
Sheffield Hallam University http://www.jiscinfonet.ac.uk/case-studies/tangible/hallam/index_html2 **1a**	Use of video case studies to highlight issues in Qualitative Research Methods	Social Science Masters level	To integrate video texts examples which illuminate issues in Qualitative Research Methods	Not specified	UK	Not specified	General increase in the interest in visual methods. Students are better able to recognise agendas presented through visual representations of issues. The video sequences have applicability in other courses. Development of a more active research culture. The resources have universal appeal.
Swansea University http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html **1a**	To enable students to see a series of images of archaeological sites or objects, and to listen to an 'expert' commentary made in the field.	Archaeology Undergraduate and postgraduate	Focused on student-centred learning, encouraging a collaborative and reflective learning experience by using podcasting to present material from archaeological sites and public collections.	Not specified	UK	Not specified	Students felt that they were engaging with the fieldwork. Students seem to engage with the sites and artefacts in a more meaningful way.

Study/form of evidence	L & T intervention	Subject /discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Swansea University http://www.jiscinfonet.ac.uk/case-studies/tangible/swansea/index_html1 **1a**	Collaborative teaching and video-conferencing in Classics	Classics Masters level	Video-conferencing was used to support and deliver modules for Swansea University, the University of Wales and Cardiff University in Ancient History Classical Culture.	Not specified	UK	Not specified	There are cost-saving benefits in spreading expertise across institutions. The statistical analysis suggests that students enrolled on modules delivered by video-conferencing are not disadvantaged.

Accessing the studies

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Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Multimedia tools							
De Grez, Valcke & Roozen (2009) DOI: 10.1016/j.compedu.2009.01.005 **2a**	Multimedia instruction to support training and assessment of oral presentation skills	Year 1 Business Administration	Effectiveness of multimedia instruction and practical activities and feedback in developing students' skills.	73 on-campus students	Belgium	Pre-test, post-test quasi-experimental design. Expert assessment of oral presentations and questionnaires.	Oral presentation performance increased significantly. Students appreciate feedback as a key feature of the instructional format. They also consider oral presentation skills as critical and important skills to be developed.
Leeds Metropolitan University http://www.jiscinfonet.ac.uk/case-studies/tangible/leeds/index_html1 **1b**	Use of WebCT in a blended approach to developing multimedia design skills	Business Information Management, Year 2	To integrate theory with practical application. Lecture time was reallocated to lab time.	Not specified	UK	Not specified	Student achievement did not appreciably increase. However, students reported a positive learning experience.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Virtual laboratory/fieldwork							
Dalgarno, Bishop, Adlong & Bedgood (2009) DOI: 10.1016/j.compedu.2009.05.005 **2b**	Virtual environment to prepare distance learners for real laboratory work (supplementary)	Chemistry Year 1	To familiarise students and enhance their confidence prior to working in a real laboratory	95 distance learners (28 users)	Australia	Questionnaire and interviews	Although users of the virtual laboratory (only 29%) found it generally helpful, students' anxiety relates to understanding chemistry concepts and carrying out mathematical calculations to a greater extent than their lack of familiarity with a real laboratory.
Swan & O'Donnell (2009) DOI: 10.1080/14703290903301735 **2a**	A virtual Biology laboratory for Year 1 students (supplementary)	Biology	To motivate students and enhance learning in a large Year 1 cohort	783 on-campus learners	USA	Comparison of the grades/scores of users and non-users; questionnaires; observations.	Use of the virtual laboratories was advantageous in relation to better course performance, especially in the laboratory practical exam. Students believed that it enhanced their experience in real laboratory activities. The system enabled learners to check their understanding and provided immediate feedback.
University of Edinburgh http://www.jiscinfonet.ac.uk/case-studies/tangible/edinburgh/index_html **1a**	e-Assessment: specifically to replace clinical practice previously executed face to face.	Year 3 Medicine and Veterinary Medicine	To reduce possible student collusion To reduce the costs of face-to-face clinical practice To provide a system-based standard for marking To reduce complex assessment administration To provide	Not specified	UK	Comparison of exam results with face-to-face clinical assessment, questionnaires, anecdotal feedback.	Effective high quality assessment. Efficiency savings: examinations, assessment marking, and in developing assessment questions. There was also and impact on College assessment policy.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
			assessment that accurately reflects student ability				
University of Edinburgh http://www.jiscinfonet.ac.uk/case-studies/tangible/edinburgh/index_html1 **1a**	Virtual patient cases developed by students using Labyrinth	Year 5 Veterinary	Enabled student groups to collaborate in generating their own e-learning resources in the form of virtual patient scenarios.	Not specified	UK		The process of creating Labyrinth virtual patient cases allowed students to contextualise their own learning in a way not previously available to them. Extended the range of student-centred learning activities staff had previously been able to use. An added benefit was that the completed cases could be used as future learning objects.
University of Edinburgh http://www.jiscinfonet.ac.uk/case-studies/tangible/edinburgh/index_html2 **1a**	The Virtual Farm An online resource delivered via a bespoke VLE	Veterinary Year 5	To address the limited access that students had to the farms by providing ready access to the real-life educational farm resources (animals, agricultural practice and records).	Not specified	UK	Anecdotal feedback At assessment events external examiners asked students about their views of the exam. The examiners also effectively 'sat' the exam.	The informally gathered feedback from these sessions was positive.
Thames Valley University A comprehensive systematic review of the use of simulation in the continuing education and training of medical, nursing and midwifery staff	This seminar presented the findings of a systematic review of the use of simulation	Health Care	To establish the benefit of simulations in the continuing education in a range of health care staff	Various	UK	Various	There is some evidence that improvement in risk assessment is brought about by simulation although this is weakened by the fact that none of the studies specifically controlled for the effects of simulation.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
3c							
University of Manchester A virtual laboratory for Bioscience e-learning projects **2b**	Case study describing a framework for a course to train and support final-year students who opt for e-learning	Bioscience Final year	To support students who wish to work away from the laboratory, as well as to alleviate pressure on staff to supervise relatively large numbers of students with limited resources.	Not specified	UK	Not specified	Annual evaluation over three years demonstrated consistently high student attendance at face-to-face sessions and participation in the online course, as well as high level of satisfaction with the programme overall. Over 80% of students liked being a member of a project group, and found that working in project groups was helpful or very helpful.
De Montfort University Development of a Virtual Analytical Laboratory (VAL) multimedia resource to support student transition to laboratory science at university **2c**	Development and pilot testing of an online laboratory skills resource containing multimedia content to support student transition to laboratory science	Bioscience Year 1	To enable students to have a foundation knowledge of laboratory skills before entering the biosciences lab.	Three cohorts (~ 75 each year)	UK	Survey	Most students found the virtual laboratory experience useful as a foundation to entering the lab.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Technology-enhanced case-based learning							
Demetriadis, Papadopoulos, Stamelos & Fischer (2008) DOI: 10.1016/j.compedu.2007.09.012 **2a**	Scaffolding questions to activate cognitive processes in technology-enhanced case-based learning	Computer Science (Software Project Management) – Year 3	Does the systematic use of online question prompts affect (a) the acquisition of conceptual domain knowledge and (b) knowledge transfer in novel problem situations?	32 on-campus learners	Greece	Pre- and post-tests; questionnaires	Computer-based question prompts can effectively scaffold learners in the process of problem representation in ill-structured domains, activating their context-generating cognitive processes and guiding them to reflect on the effect of contextual constraints on problem solving.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Blogging/promoting reflection							
Sim & Hew (2010) DOI: 10.1016/j.edurev.2010.01.001 **General literature review**	Weblogs in educational settings	Various	Various	Various	International	Literature review of empirical studies	Results usually obtained from self-report studies. Initial familiarisation or guidance to improve user confidence and ice-breaking activities to help to reduce possible discomfort. Privacy a cause for concern.
Xie, Ke & Sharma (2008) DOI: 10.1016/j.iheduc.2007.11.001 **2a**	Weblog journals to promote reflective learning	Year 1 Political Science students	Does peer feedback on online journals result in enhanced stages of reflection?	27 Year 1 on-campus students	USA	Weekly weblog journals; survey on learning approach; students' course grades	Students improved in their reflective thinking skills over time. The higher a student's reflective thinking level, the higher the course grade achieved. Students involved in solitary blogging showed a significantly higher level of reflection over time than did those who provided and received peer feedback.
Cooner (2010) DOI: 10.1111/j.1467-8535.2009.00933.x **2a**	Blended learning approach; activity-led preparation for enquiry-based learning	Year 1 Social Work degree students	Facilitating individual critical reflection within large groups (80+) of students	81 on-campus students	UK	Questionnaire, focus groups and semi-structured interviews	The flexibility to access recorded lectures 'on demand' and to control the pace of learning allowed time to consider the material in more depth – important in reframing and reinterpreting existing knowledge, values and beliefs. Email contacts between tutor and individual students enabled a more personal response – important for reflection and personal development. Watching video case studies not a passive activity – gave them opportunities to 'think on their feet'. Compared with previous

71

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
							years, the presentations demonstrated evidence of better reflective analysis and deeper theoretical understanding of the issues. If we use technology-enhanced processes, then the assessment methods must also be adapted to reflect the changes.
Kerawalla, Minocha, Kirkup & Conole (2009) DOI: 10.1111/j.1365-2729.2008.00286.x **2b**	To promote reflection, knowledge sharing and collaboration	Masters-level Education modules (online)	Motivations for and issues associated with students' blogging; impact of pedagogy	25 distance learners	UK and international	Semi-structured interviews; content analysis of blog postings	Blogging can be appropriated by students to meet a range of personal learning needs, not always as a collaborative/ communication tool. Presents a framework for developing blogging behaviour and skills within the technological and pedagogical context of any course.
Hramiak, Boulton & Irwin (2009) DOI: 10.1080/17439880 903141521 **2c**	Blogs as personal diaries to support reflective professional development	Education (Postgraduate ICT teacher training)	Use of an online medium to help trainee teachers develop their professional identity as reflective practitioners	18 and 20 (at two universities)	UK	Qualitative case study approach. Interview data, thematic analysis of blog archives.	There is positive evidence that the blogs were a useful tool for recording reflections and developments throughout the year for a majority of each of the cohorts. Tutors were able to access trainees' reflective development and provide support as required – not previously possible with paper-based systems.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Collaborative tools/wikis							
Neumann & Hood (2009) http://www.ascilite.org.au/ajet/ajet25/neumann.html **2a**	Report writing using a wiki	Year 1 Statistics	Course evaluations by students and the assessment of learning outcomes identified 'report writing' as an area in need of improvement for both student learning and engagement.	180 on-campus Psychology students	Australia	Questionnaires to measure: demographic characteristics; self-efficacy for statistics; statistics anxiety; report writing knowledge; student engagement experiences and qualitative feedback on tutorials. Instruments used twice – pre-test and post-test.	Those who used the wiki to write the practice report gave higher ratings on engagement with other students and cognitive engagement than the students who wrote the practice report individually. Student engagement, but not performance on assessment, may be enhanced.
Zorko, V. (2009) http://www.ascilite.org.au/ajet/ajet25/zorko.html **2a**	Wiki for English language learning	Year 2 Sociology students	To explore collaborative wiki interactions – does this facilitate effective collaborative language learning?	10 x 40 full-time Year 2 Sociology students	Slovenia	Case study method; questionnaire about students' collaboration; wiki editing history; interview.	The wiki did promote peer and student-teacher interaction, the students' interactions with the hyper-linked resources and the software was beneficial and supportive of collaboration. However, students could meet face-to-face, so much of the peer-to-peer communication and co-construction of knowledge could take place 'live' or via phone or Messenger.
Elgort, Smith & Toland (2008) http://www.ascilite.org.au/ajet/ajet24/elgort.html **2a**	Using a wiki for conducting assessed group projects	Postgraduate modules in Information Management	Whether wikis could facilitate collaborative learning and positively affect student attitudes to assessed group work	44 on-campus and distance learners	New Zealand	Questionnaires; examination of wikis as they progressed; online journal entries	Wikis found useful for arranging information and sharing knowledge. Use of a wiki does not communicate expectations of high-level intellectual engagement. Scaffolding likely to be required to help student prepare for assessed collaborative work. Attitudes to group work are mixed and use of a wiki is not sufficient to

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
							improve those attitudes.
Cubric (2007) http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.96.3492&rep=rep1&type=pdf **2b**	Blended learning using wikis for communication and collaborative activities	Postgraduate level Business course modules	Engaging students in wiki-based activities	17 and 27 on-campus students	UK	Attitude questionnaires; activity log; assessment grades	Students' engagement with wiki-based learning activities is directly proportional to the quality and frequency of tutors' feedback and the clarity of the underlying learning and teaching process. A 'Blended learning process framework' developed and presented.
Wheeler & Wheeler (2009) DOI: 10.1080/17439880902759851 **2a**	Wikis to support students' writing skills	Education – Initial teacher training. Years 1, 2 and 3, and postgraduate	Would the social collaborative context of a wiki encourage high-quality writing	35 on-campus students	UK	Analysis of discussion boards; email questionnaire	The wiki aided the development of critical awareness, particularly in relation to the citing of sources and the nature of intellectual property. Most students considered that they had raised their skill level in academic writing.
Hemmi, Bayne & Land (2009) DOI: 10.1111/j.1365-2729.2008.00306.x **2c**	Use of social media (wikis and blogs) for collaborative activities	Masters-level Education; Undergraduate Engineering Design and Religious Studies	Appropriation of social media as participatory learning spaces	24 on-campus and distance learners (at two universities)	UK	Virtual ethnographic approach. Analysis of blogs, wikis, discussion boards; interviews.	Blogs: It was the wider context of course design and the embedding of programmes of study within particular institutional contexts that determined how students negotiated these new writing and learning spaces. Wikis: For a wiki to work well as a learning space characterised by genuinely collaborative writing and collective meaning-making, it is necessary to nurture among students a sense that it is acceptable to be ruthless – to edit amend and challenge each other via direct manipulation of each other's text.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Wyatt, Krauskopf, Gaylord, Ward, Huffstutler-Hawkins & Goodwin (2010) http://www.nlnjournal.org/doi/abs/10.1043/1536-5026-31.2.109 **2a**	Mobile tools (PDAs) to support mobile and co-operative learning	Nurse practitioner students	Do co-operative and interactive m-learning techniques enhance classroom and clinical Nursing education at multiple locations? Is there a relationship between m-learning and students' learning styles?	22 students at two universities	USA	Survey; focus groups	PDAs are useful reference tools in the clinical setting and all students benefited from using them. Connecting students with classmates and other nurse practitioner students at distant universities created a co-operative learning community providing additional support and knowledge acquisition.

Accessing the studies

75

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Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Online discussion boards/conferences /forums							
Downing, Lam, Kwong, Downing & Chan (2007) DOI: 10.1080/09687760701673592 **2a**	Promoting interaction in online discussion environments	Year 1 Applied Psychology students	What encourages early engagement with asynchronous discussions? How can a learning community be encouraged? How can online discussion be sustained?	32 blended learning students	Hong Kong, China	Case study method. Analysis of discussion activity (student-tutor and student-student); interviews.	Early engagement can be facilitated by the design of a simple yet appropriate socially formative assignment. The timing and handling of the group summative assessment task clearly interfered with the continued establishment of a supportive and nurturing online community. Students gradually disengaged, taking a pragmatic approach based upon the requirements for summative assessment. Discussion sustained for as long as there is value to be derived.
Kanuka, Rourke & Laflamme (2007) DOI: 10.1111/j.1467-8535.2006.00620.x **2a**	Comparison of instructional activities intended to facilitate asynchronous online discussion	Education – Year 4	Does the type of instructional activity influence the quality of students' contributions to online discussion?	19 distance learners	Canada	Case study – qualitative content analysis of messages	Discussions do not automatically become interactive and collaborative simply by virtue of being conducted in an asynchronous medium. Highly structured, planned, confrontational and demanding activities that include directed roles and responsibilities for students are key elements to moving them to higher levels of understanding and critical discourse.
Chen, Chen & Tsai (2009) DOI: 10.1016/j.compedu.2009.05.026	Synchronous online text-based discussion for teacher professional development	Education (pre- and post-qualification)	Can online discussion deepen teachers' content knowledge and change pedagogical practices (to improve their students'	61 pre-service and in-service teachers (distance learners)	Taiwan	Content analysis of messages; interviews with teachers.	Over half of messages were not related to set discussion topics. One quarter of messages demonstrated learners' cognitive or metacognitive skills. Social sharing & knowledge

Accessing the studies

76

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Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
2a			performance)?				construction did not happen online naturally – they resulted from careful planning of learning activities and facilitation during the learning process.
McLoughlin & Mynard (2009) DOI: 10.1080/14703290 902843778 **2a**	Using online discussions to facilitate higher-order thinking processes	Education – BEd degree courses	Encouraging learners to reflect upon their studies, to interact with each other and discuss course-related issues to a greater extent than in face-to-face sessions.	Five female on-campus students	United Arab Emirates	Content analysis of online discussion threads	The majority of postings were categorised as 'exploration' or 'integration'; the percentage of 'integration' postings suggests that students went beyond sharing and comparing. Topics related to courses and teaching practices – also participation was assessed. "The nature of the course, the type of task and the wording of the initial prompt can all affect the type of higher-order thinking processes that will emerge in an online discussion."
Melrose & Bergeron (2007) http://www.ascilite. org.au/ajet/ajet23/ melrose.html **2a**	Strategies to facilitate group work in online graduate study	Postgraduate Health Care students	What issues do online graduate learners face during the beginning, middle and end stages of their small group work? What instructional behaviours help address these issues?	Distance learners on two graduate programmes	International	Qualitative: 20 individual interviews and four focus groups over a three-year period.	Various instructor immediacy strategies were helpful at different stages of online group work. Linking and feeling close to their teachers helped the graduate learners feel safe, encouraged them to risk participating in group projects and allowed them to achieve closure.
Thorpe (2008) http://www.ascilite. org.au/ajet/ajet24/t horpe.html	Structured tasks to promote effective online interaction – interpersonal and with resources, etc.	Environmental Studies	Positive engagement with co-operative and collaborative online tasks	Undergraduate distance learners	UK and international	Course retention data; semi-structured interviews with tutors and students	Computer-mediated interaction (of various kinds) provided a highly structured context which successfully engaged students and supported their achievement of key skills and assessment goals, notably problem solving, teamwork and

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
2a							tackling unfamiliar problems.
Ng'ambi & Brown (2009) DOI: 10.1111/j.1467-8535.2008.00899.x **3a**	An anonymous consultation tool – Dynamic FAQ Environment (online and SMS)	Year 1 Information Systems (programming)	To provide students with anywhere, anytime engagement with learning materials and allow the outcome of consultation to become a class resource.	35 and 63 and 610 (over three years) on-campus students	South Africa	Narrative analysis of postings in DFAQ	Questions were responded to by students as well as lecturers. Students asked questions not only about course activities, but also about how those activities were conducted and administered. The tool became a means for formative evaluation and consequently the pedagogy was continuously revisited.
de Leng, Dolmans, Jöbsis, Muijtjens & van der Vleuten (2009) DOI: 10.1016/j.compedu.2008.12.012 **2a**	Asynchronous communication to promote critical thinking about basic science topics while on work placement	Medicine – Years 5 and 6	Can students on practical work placement be enabled to reflect upon and discuss science concepts from the perspective of a professional practitioner?	Eight students (from four universities) on hospital placement	Netherlands	Quasi-experimental – quantitative (logs of online postings) and qualitative (interviews)	The model was successful in establishing a dialogue among a group of students and an expert during work placements at different locations. The 'practical inquiry' model was useful in facilitating a sustained on-topic discourse involving critical thinking.

Accessing the studies

78

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Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
e-Portfolio							
Herman & Kirkup (2008) DOI: 10.1080/14703290701757468 **2a**	Use of an e-portfolio for personal/ professional development planning	Science, Engineering & Technology (SET) – a university course for graduates returning to employment.	Enabling mature students to develop an electronic portfolio to aid their re-entry to employment in SET.	47 female distance learners	UK	Questionnaire; email accounts of critical incidents; analysis of online discussion messages; telephone interviews	Integrating the development of an e-portfolio within the curriculum and assessment proved highly successful. For mature students a supported environment in which to reflect and then build an e-portfolio can be a life-changing experience that can enhance employability.
Newcastle University http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html 2b	Use of e-portfolios to develop a reflective approach in Medicine	Medicine Years 1, 2, 3 and 5	e-Portfolios were developed as a method to help foster a reflective approach to evidencing the achievement of both module-specific and programme learning outcomes.	~1700	UK	Online questionnaires and focus groups	80% of students found it to be a useful learning experience and 72% said it influenced their approach to learning. 93% said it led them to reflect following the end of the placement. 70% of students found it useful and 58% said it would influence their learning in the subsequent year. e-Portfolios reduced printing, copying and other administrative costs. e-Learning supports new pedagogy.
Sheffield Hallam University http://www.jiscinfonet.ac.uk/case-studies/tangible/hallam/index_html 1a	Use of e-portfolios in Social Sciences	Social Science Years 1, 2 and 3	Used to integrate, group work, peer/tutor support, regular feedback as the focus for personal development planning.	Not specified	UK	Not specified	Ease of use of the package appears to have motivated many students to engage with it.
University of Wolverhampton http://www.jiscinfonet.ac.uk/case-	Use of e-portfolios to support Nursing and Midwifery	Nursing and Midwifery Postgraduate	Examines the use of a personal learning space offered by an e-portfolio system in two undergraduate	45	UK	Staff and students were asked to evaluate the experience of using the e-portfolio subjectively.	The students are highly positive about the use of the e-portfolio to share experiences and gain feedback. Staff comment that they know their students better

Accessing the studies

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79

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
studies/tangible/wolverhampton/index_html 2a			programmes				as a result. This model has been adopted by staff at another centre who report greater awareness of student difficulties and hence are more responsive.
University of Wolverhampton http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html1 2c	Use of e-portfolios and blogging in Teacher Education	Education PGCE	The impact of e-portfolios on learning: the affective, social and conative aspects of the student experience, in contrast to the conventional focus on the cognitive.	15 per year for three years	UK	Naturalistic using *'Interview plus'*, where some artefact or activity is chosen to guide, recall or aid thinking aloud.	e-Portfolios benefit learning most effectively when considered as part of a joined-up teaching and learning approach, rather than as a discrete entity.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Online course resources							
Kirkwood (2006) DOI: 10.1016/j.compedu.2004.11.002 **2b**	Required or recommended use of online resources to support courses	Undergraduates in all faculties	How much do UKOU students use online resources? What course characteristics account for the variability found between courses?	16,389 distance education students	UK	Quantitative analysis of survey data	Students' use of online resources is closely related to the pedagogic design and to assessment requirements, not merely to the availability of such resources on the web.
University of Exeter http://www.jiscinfonet.ac.uk/case-studies/tangible/exeter/index_html 1a	Online Economics texts Using online formative exercises for several modules	Business and Economics	To address changes in the structure of the course from one 30-point course to two 15-point courses. Also to address issues related to students' desire to 'get the right answers' from lectures.	Not specified	UK	Statistics recorded students logging in and completing assessments. Student feedback: formal and informal. Log-ins records were compared with exam results.	The pass rates/average marks with prior modules compare favourably. Retention rates were very high. Improved student access to resources. Savings in staff time were identified.
Newcastle University http://www.jiscinfonet.ac.uk/case-studies/tangible/newcastle/index_html1 1b	Use of a VLE to deliver a 'regional' medical school	Medicine	To collate learning resources and organise them around the Medical programme structure, allowing both students and staff to identify what learning outcomes were being met.	~1700	UK	Online questionnaires and focus groups	Significant improvements in student learning (e.g., assessment performance, pass rates, retention and student access).
Sheffield Hallam	Use of a VLE to introduce	Social Science and	To provide a flexible format for the student	Not specified	UK	Not specified	The use of e-learning has produced improvements in

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
University http://www.jiscinfonet.ac.uk/case-studies/tangible/hallam/index_html1 1a	contemporary resources on 'Drug use in context'	Law	and a rewarding and continuously updatable module for the tutor.				student learning with increased numbers of first and upper second class awards.
Dublin City University Access to lecture notes 1a	Providing lecture notes to students	Various	Examining whether providing lecture notes encourages more discussion and interactive learning	Not specified	Ireland	Not specified	Student notes generated using partial notes supplied by the lecturer were more effective to aid learning than self-generated notes alone or full lecture transcripts.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Electronic voting/personal response systems							
Lorimer & Hilliard (2008) https://uhra.herts.ac.uk/dspace/bitstream/2299/2625/3/ECEL%2b2008%2bPaper%2bFinal%2bv1%2bB%26W.pdf **3a**	Use of a personal response system (PRS) for formative assessment and feedback during taught sessions	Level 2 students of Radiography/Health Care	Fostering active engagement in a large group by providing formative assessment and feedback	119 on-campus students	UK	Comparison of individual students' performance on formative and summative multiple-choice questions (MCQs)	The PRS increased classroom interactivity. Students who performed well in the formative MCQs were generally among the high achievers in the summative assessment.
Kay & LeSage (2009) DOI: 10.1016/j.compedu.2009.05.001 **General literature review**	Use of audience response systems with on-campus students	Various – mostly undergraduate students of science- or maths-based subjects in large classes	Examining the benefits and challenges of audience response systems	Literature review of 67 studies	International	Literature review	*Classroom benefits:* attendance; attention; anonymity; participation; engagement. *Learning benefits:* interaction; discussion; contingent teaching; learning performance; quality of learning. *Assessment benefits:* feedback; formative; comparison with class. *Technology challenges:* remotes missing/not working. *Teacher challenges:* responding to student feedback; coverage; developing questions. *Student challenges:* new method; discussion; effort; summative assessment; attendance for grades; identifying individuals; negative feedback.

University of Glasgow Shared Thinking **1a**	Using voting technologies and interactive whiteboards for collaborative reflection and co-operative inquiry	Various	Shared thinking as a form of group-oriented generative learning (GOGL).	Not specified	UK	Not specified	The use of voting technology changes pedagogical orientation towards: - co-operative inquiry; - the class working as a group; - participation and dialogue as the content.

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Assistive technologies							
Abingdon and Witney College http://www.jiscinfonet.ac.uk/Resources/external-resources/jisc-elearning-case-study-abingdon-pdf **2a**	Embedding assistive software as a common learning aid for students	FE college 16 + academic and vocational courses	To support students with a range of (often undiagnosed) learning difficulties such as poor language skills, note-taking or comprehension skills, and dyslexia.	Not specified	UK	Not specified	Rapid identification of learning difficulties enables learners to be more effectively supported.
Liverpool Community College Developing an E-learning Dyslexia Resource to improve the learning environment for students, CPD for lecturers, and to be piloted as part of the college's new Foundation Degree in Teaching in the Lifelong Learning	Using of e-technology to support both staff CPD and teaching of students with specific learning differences/dyslexia	All students and staff	To develop a more inclusive (non text-based) learning environment for dyslexic (SpLD) students through e-learning strategies and targeted staff development.	Staff and student	UK	Action research	Students surveyed felt that the project had developed the right approach to the alleviation of feelings of anxiety and stress.

Accessing the studies

To access journal articles use the DOI as a universal locator by pasting the DOI into the search box in a web browser. To access reports, hold down the control button and click on the link highlighted in blue.

Sector. **3b**							

Study/form of evidence	L & T intervention	Subject/discipline & level	Challenge/aim of L & T intervention	No. of participants	Country	Research/evaluation method(s)	Key findings
Work-based learning/employability							
Institute of Education, University of London Harnessing technology to enhance teaching and learning 2b	Collection of studies examining the student experience of technology use in supporting mixed-mode professional courses.	Various	Facilitating innovations in: learning at work and through professional practice; teaching and assessment modes for work-related and work-located learning; uses of e-learning and digital technologies.	Various	UK	Small-scale research projects based on qualitative data collection and some included literature reviews.	Careful exploration of what constituted valid evidence of impact of technology on learning is required. Examination results alone need not necessarily be the best indicators. The session raised the important question of 'old wine in new bottle' approach often inherent in the introduction of new technologies.
The Open University Employer Engagement and Development of Skills for Employability 3c	The 'Employer Engagement and Development of Skills for Employability'	Business and Health and Social Care	To explore the challenges and opportunities for effective learning in the workplace.	Various	UK	Action research, telephone interviews, questionnaires.	Learners gained increased confidence in ICT, even when already proficient. ICT had a positive in their lives and their practice. However, motivation was affected by lack of reward.

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