Enhancing learning and teaching through technology

A table of resources for academic developers

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

developer view

This is a resource that provides a collection of studies that may be of use to HE developers, both those involved in staff development and those involved in supporting learning and teaching systems and processes. The studies have been examined in relation to an evidence-based approach to the use of technology in learning and teaching. A framework has been used to interpret variations in studies. 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.

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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.
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 & Godsk (2007) DOI: 10.1080/02680510601100143 **2a**	VLE - interactive learning materials, online discussions and other digital resources	Postgraduate course on Human-Computer Interaction	Reducing lecturing time by transforming traditional lectures into problem-based blended learning	20 on-campus students	Denmark	Questionnaire; an achievement test; log of VLE activity; assessment of student assignments	The experiment showed that it was possible to reduce lecturing time, support repetition and support educational differentiation by transforming the modules.
Stephenson, Brown & Griffin	Electronic delivery of	Undergraduate	Comparing the efficacy of 'virtual lecture', 'e-lecture'	58 on-campus	UK	MCQ assessment – with Qs related to Bloom's taxonomy; questionnaire	Overall test scores for three types of delivery were similar, but differences found in depth of

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(2008) DOI: 10.1016/j.compedu.2006.08.007 **2a**	lectures	Bioscience	and traditional presentations	students		on attitudes and preferences.	learning (Bloom).
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.
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 & 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	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.

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
2c							
University of Glasgow http://www.jiscinfonet.ac.uk/case-studies/tangible/glasgow/index_html **1a**	Supporting Scottish History courses via Moodle	History Years 1 and 3	Improving accessibility to course materials Improving communications between staff and students Reducing photocopying costs.	Not specified	UK	Not specified	Improvement in pass rates and in grades.
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	To provide examples/evidence of student engagement that encourage 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.

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2a							
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 r esearch	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.

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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,

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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

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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 Leicester Podcasting in Assessment: New Technology in Higher Education Research	'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.

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(PANTHER) **2a**							

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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 **2a**	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 course.

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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.

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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 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.

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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.

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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 situatiuons?	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.

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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

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							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: 10.1080/17439880903141521 **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 trainee's reflective development and provide support as required – not previously possible with paper-based systems.

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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

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							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 tutor's 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.

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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 benefitted 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.

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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

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: 10.1080/14703290902843778 **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/thorpe.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, team work 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.
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.

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.
University of Wolverhampton http://www.jiscinfonet.ac.uk/case-studies/tangible/wolverhampton/index_html **2a**	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 programmes	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 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.

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 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.

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							
Kay & LeSage (2009) DOI: 10.1016/j.compedu.2009.05.001 **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.

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.

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.

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