On-line Innovation in Higher Education

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Submission to
the Rt Hon John Denham MP

Secretary of State for Innovation,
Universities and Skills

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1. Executive Summary

1.1 Information and Communications Technology (ICT) is international and UK Higher Education (HE) plays a very active part in it. The UK is seen as world class, and often world leading, in networking, content and digital libraries, access management, and many areas of e-learning. Until recently the UK was world class in providing e-infrastructure for research and in e-science. We lag behind in generating and making available high quality modern learning and teaching resources. It is essential that the UK does not lose its lead, and continues to play a full and leading role internationally in the ICT world.

1.2 A successful HE sector at the forefront of research and learning and teaching needs to enjoy and exploit world class ICT infrastructure tailored for the needs of Higher Education Institutions (HEIs) which can be personalised for students, lecturers, researchers and administrative staff. This includes the provision of national services and a significant involvement in defining and developing international co-ordination.

<u>Overview of Recommendations</u>

1.3 UK higher education enjoys a world class ICT infrastructure; this should be maintained. But more effective leadership, at all levels, is required to exploit this infrastructure. In particular the UK should, and can, be world leading in on-line learning; it must manage and curate research data more effectively; and HEIs need to treat information as a resource to be managed strategically.

1.4 HE and the research funding bodies should continue to support and promote a world class ICT infrastructure and do more to encourage the innovative exploitation of this infrastructure through:

> 1) <u>a new approach to virtual education based on a corpus of open learning content:</u> the UK must have a core of open access learning resources organised in a coherent way to support on-line and blended learning by all higher education institutions and to make it more widely available in non-HE environments. This needs to be supported by national centres of excellence to provide quality control, essential updating, skills training, and research and development in educational technology, e-pedagogy and educational psychology. All HEIs should be encouraged and helped to exploit virtual education technologies as appropriate to their student's requirements and their strategies.

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[1] In preparing this paper, whilst it has been written in a personal capacity I have drawn extensively on the very substantial contributions of Dr Malcolm Read and Ms Alice Colban, and advice from a large number of members of the JISC, and evidence from a wide range of individuals and organisations, all of which are gratefully acknowledged. I have broadened the remit to include other areas of HE than learning and teaching, in particular research and my recommendations are applicable to all the UK countries and not restricted to English higher education.

Actions to meet this recommendation are detailed in the table overleaf and include the establishment of a small number of centres of expertise (probably big clusters of institutions addressing similar student populations) in educational technology and e-pedagogy, charged with changing the culture across HE, a comprehensive staff and student skills training programme, and the creation of a national co-ordinated collection of open learning resources.

Building an effective and competitive on-line learning capacity at both undergraduate and postgraduate level will help meet the changing needs of students and stimulate growth in both higher education and the skills sector. A coherent collection of learning resources can also be exploited to save staff time. Failure to do so will reduce the UK's ability to exploit e-learning; an aspect of learning and teaching where the UK should aspire to, and gain, a world leading position.

2)   revitalised investment into e-infrastructures: central investment through the funding councils and research councils needs to be maintained in the core infrastructure of networking and high performance computing. More investment and policy leadership is required for the curation of research data, including international collaboration, to build a layer of academic and scholarly resources readily available to all. This should be a priority for DIUS, RCUK and others where clear policy leadership is urgently required. This is different from and complementary to public online resources such as Google. The Research Councils should be invited to review their approach to e-science in order to re-establish the UK's pre-eminent position in this important research process.

Actions to meet this recommendation are detailed in the table overleaf and include creating a comprehensive mechanism for co-ordinating the curation of research data, a review of e-science, and an extensive digitisation programme.

Research data is a significant national asset that is not uniformly well managed or curated; it is costly to collect and has the potential to improve the research process. Failure to protect and exploit the UK investment in research data will eventually reduce our international standing and the effectiveness of research.

3)   development of institutional information strategies: HEIs should be encouraged and supported to develop integrated information strategies against their individual missions, which should include a more visionary and innovative use of ICT in management and administration. This should include the consideration of shared administrative services, more innovation through ICT for business and service delivery, and measures to improve the sustainability of institutions particularly by reducing energy consumption.

Actions to meet this recommendation are detailed in the table overleaf and include encouragement and support for HEIs to produce integrated information strategies including the consideration of shared services and green computing.

Information resources are expensive and need to be managed as strategically as financial and human resources to improve the effectiveness of institutions. Failure to do so hampers leadership and innovation and puts at risk the UK's ability to provide world class higher education.

1.5 Few HEIs can achieve this on their own. It will require collaboration, and a coherent infrastructure to maintain and enhance the UK HE's international competitiveness.

1.6 The cost of meeting these recommendations would largely be met within the HEIs and represent good management practice. For example it should not cost more to make course material openly available on professionally managed repository platforms. Preserving research data will get expensive in the longer term but it is assumed that the need for culture change within the research community will mean relatively little data will be preserved in the short term: and by no means all data needs preserving. But it will represent an additional cost to the research process as the cost of describing data and putting it into a format that is usable by others could be significant. On the other hand there has been and continues to be significant efficiency in research through the availability of online resources and improved ICT procedures such as those developed under the e-science programme.

1.7 It is however essential that central expenditure on ICT infrastructure (both at the national level through JISC and within institutions in the form of ICT services and libraries) are maintained. HEFCE has already allocated funding for open educational pilots with monies earmarked until 2011; the programme would need to continue for at least a further two to three years however.

1.8 Establishing a small number of centres of excellence to help establish the UK as world leading in on-line learning would require additional investment by HEFCE of the order of £4 million per year in additional to their existing open educational content resources investment.

1.9 The actions proposed for the other recommendations can be met from existing recurrent and capital investments in JISC and other centrally funded organisations. A complete list of actions is provided in the table below.

ACTIONS PROPOSED	GOVERNMENT	RESEARCH COUNCILS/FUNDING COUNCILS/JISC AND OTHER NATIONAL BODIES	HIGHER EDUCATION INSTITUTIONS
LEARNING AND TEACHING			
i) Centres of expertise in educational technology and e-pedagogy (probably big clusters of institutions addressing similar student populations), including comprehensive staff and student skills training programme.		Funding Councils in conjunction with relevant national bodies	HEIs to embrace centres and training
ii) Review to identify key players in HE e-learning, current practice and strategies, benefits, benchmarking; and advise on ToRs for centre(s) of excellence.		HEFCE and other Funding Councils	

iii) National co-ordinated collection of freely available open learning resources.		HEFCE and other Funding Councils	HEIs to embrace open learning resources
iv) Negotiation to ensure the Gowers Review of IPR facilitates the use and sharing of all types of open learning content across multiple platforms of delivery to enable the UK to excel as a world leader in e-learning provision.	DIUS		
v) Bring together key parties to discuss how best to embed digital literacy good practice across the HE, FE and skills sectors.		JISC in conjunction with other relevant national bodies	
RESEARCH AND INNOVATION			
i) Independent assessment of where the UK is at in relation to the original strategy (OSI e-Infrastructure Report: Developing the UK's e-Infrastructure for Science & Innovation) and how it compares with key countries.	DIUS/RCUK		
ii) Policy leadership and a comprehensive mechanism for co-ordinating the curation and preservation of research data.	DIUS	Research and Funding Councils and JISC	
iii) Review approach to e-science, in light of current review, in order to re-establish the UK's pre-eminent position across research disciplines.		Research Councils	
iv) Look across research and learning to ensure techniques developed in one environment are applied to the best effect in the other.	DIUS/DCSF	JISC	HEIs to support this approach
v) Extensive digitisation programme.	DIUS		
MANAGEMENT AND ADMINISTRATION			
i) Encouragement and support for HEIs to include the integration of their library, information and IT services in the development of their strategies for research and learning and teaching. Such strategies to include a coherent approach to the management and exploitation of infrastructure resources, sustainability and the consideration of shared services with other HEIs where appropriate.		Funding Councils and JISC	HEIs to prioritise this approach
ii) Continuation of work on security, privacy, interoperability, the transfer of data workflow, resilience and data recovery.		JISC	HEIs to continue and prioritise such work

2.   Introduction

2.1   Information and Communications Technology (ICT) supports all aspects of higher education and is now recognised by the Government as a critical driver of the economy, wider learning and global competitiveness. While largely well provided and managed at present, there are key areas where the Government should set priorities for further action:

- ICT is not always considered strategically by senior management against the business needs of the institution;
- internet "literacy" and skills are not adequate;
- the UK is falling behind in its ability to meet the ICT needs of research;
- online resources, and associated information and data management, are insufficiently exploited.

Dealing with these areas is essential to ensure that UK higher education and research remains world class and the country remains at the cutting edge of the global ICT economy. Otherwise, UK higher education and research will fall behind other countries and by 2020 will be following the same downward path as the UK's computer industries during the 1970s and 1980s.

2.2   The long-term UK vision should be clear - to remain at the international forefront of the development and adoption of ICT in learning and research, and to do so through:

- appropriate national and institutional investment in networks, content, services and research and development;
- appropriate "frontier" initiatives (e.g. in repositories and e-science) to keep the UK seat at the international table;
- appropriate mechanisms to secure efficient infrastructure (both inter-institutional and international) and commercial collaboration;
- development of competencies and skills in teaching and support staff.

ICT needs to be more effectively exploited to enable UK HE to remain at the forefront in research and learning and teaching. This applies as much to campus-based HE that needs to combine e-learning[2] with more traditional approaches (blended learning) as well as institutions that are concentrating on distance delivery.

2.3   ICT is a complex and broad area. It covers computer networks (e.g. JANET[3]), computers from personal mobile devices to supercomputers, security applications to find and access online resources, content, and related services and innovation. The rate of change in ICT over the past 15 years has been dramatic and this will continue relentlessly into the foreseeable future. Higher education in the UK is also complex and largely successful but facing significant challenges; it has also changed considerably over the past 15 years and is set to change further. Coping with two complex, but vitally important, environments continuing to undergo rapid change deserves more strategic attention, investment, innovation and imagination than is currently the case. This paper considers the issues in exploiting ICT in the future against the principal functional activities of HE, but with a particular emphasis on e-learning. It also makes the point that the leadership role in JISC

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[2] The term e-learning is used in this document to mean the effective use of ICT to support learning and teaching, which includes blended learning, where some ICT and more traditional approaches are used.
[3] JANET: www.janet.ac.uk

within HE is now increasingly relevant to learning and content holding institutions across the public sector, reaching citizens throughout their lives.

2.4   There are many existing national ICT-related strategies within the UK[4] which stress the importance of innovation. These provide a strategic context for work in this area, e.g.

- OSI e-Infrastructure Report: Developing the UK's e-Infrastructure for Science & Innovation[5];
- Harnessing Technology: Next Generation Learning 2008-14[6];
- HEFCE's e-Learning Strategy[7];
- The Scottish Government's Life through Learning: Learning through Life[8] and the Scottish Funding Council's e-Learning Strategy[9];
- Enhancing Learning & Teaching Through Technology: a Strategy for HE in Wales, 2008[10].

2.5   The education and research sectors are not short of strategies but a visionary thrust across the UK is lacking. The JISC is working with a number of organisations to create a UK Framework[11] for e-content and this offers a very practical demonstration of how in future content can be integrated for the benefit of learners of all ages. Elsewhere, all institutions have IT or Information Strategies but there appears to be a lack of vision in exploiting the IT infrastructure provided, the library as an institutional strategic player is often overlooked because the changes and new capabilities in library services over the past 15 years are not sufficiently recognised, and there are not always effective links between the strategies for research or learning and teaching with those for ICT.

2.6   The remainder of this paper concentrates on the recommendations and actions required in the key areas of learning and teaching, research and innovation and the management of institutions, and comments on issues of scale. The paper is followed by an annex **(Annex A)** that provides more background information and facts to support the recommendations.

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[4] No less than 23 strategies are identified in the UK Higher and Further Education Funding Councils' Funding Advice Letter to JISC for 2008/09 AY which can be found at http://www.jisc.ac.uk/aboutus/whoweare.aspx
[5] OSI e-Infrastructure Report: http://www.nesc.ac.uk/documents/OSI/index.html
[6] Harnessing Technology Report: http://publications.becta.org.uk/display.cfm?resID=37348
[7] HEFCE e-Learning Strategy: http://www.hefce.ac.uk/learning/elearning/strategy/
[8] Life Through Learning, Learning Through Life:
http://www.scotland.gov.uk/Publications/2003/02/16308/17750
[9] SFC's e-Learning Strategy: http://www.sfc.ac.uk/publications/pubs_other_sfcarchive/elearning_report.pdf
[10] HEFCW Enhancing L&T Through Technology: http://194.81.48.132/Publications/4954_4804.htm
[11] The UK Framework is known as the Strategic Content Alliance. The partners in the Alliance are BBC, Becta, British Library, JISC, National Electronic Library for Health, National e-Science Centre (http://www.jisc.ac.uk/whatwedo/themes/eresources/contentalliance.aspx).

3.   Learning and Teaching

<u>ICT and e-Learning: a 15 Year Vision</u>

3.1   It is not possible to predict ICT innovation and its impact beyond a few years, History is littered with inadequate predictions that are now held as risible. Few predicted the Internet in the 1960s, few if any predicted the world wide web in the 1970s and early 1980s and even fewer foresaw its high impact on society and education. But what is clear is that today's children use the Internet as an integral part of their lives as previous generations embraced radio, television and the telephone. Web 2.0 technologies are inherently interactive: the user both responds to and contributes to their on-line experience. It is also clear that their elders will often lag behind, no matter how trendy they consider themselves to be.

3.2   So we can conclude the ICT world will be much more interactive and much more powerful than it is at present. We cannot, in the light of experience, however be confident of the full potential of any one technology: will automatic language translation be accurate? Will useful automatons and robots exist? Will ICT have led to a Big Brother society or one where individuals can assert and protect their individuality more effectively than at present? Will video conferencing finally be reliable and pervasive?

3.3   It is perhaps easier to predict the longer term future of UK HE. It will continue to expand by offering more "layered" and tailored courses ranging from the research-led universities to a variety of skills-based courses delivered from, and accredited by, a range of non- traditional providers: FE colleges, large businesses, other private providers. It will be less dependent on public funding and will become more private sector in its thinking, behaviour and composition. The UK traditional student base may not increase significantly because of demographic and financial factors (although the school system is striving to increase the quality of students); but there is a huge, and still largely unmet demand, for higher education from South East Asia and the developing world. Growth in UK HE can come from professional development, adult learning etc. but might be critically dependent on providing attractive educational offerings to this international market. But to do this it must retain its reputation for excellence to UK students. Success overseas would be poor consolation for a reduction in the quality of education to UK students.

3.4   A step change is required. To exploit ICT it follows that UK HEIs must be flexible, innovative and imaginative. A good ICT infrastructure is essential but not sufficient and similarly funding for innovation is essential but not sufficient. The UK enjoys the former but the latter is only just adequate and is under threat: just at the time when HE must provide leadership and exploit its expertise.

3.5   **The first requirement** for e-learning to evolve to meet the needs of the next 15 years is to maintain a world class e-infrastructure, and a body of research and expertise adequately funded to create innovative approaches. This responsibility primarily rests with the funding councils and is currently being met and delivered through JISC but is under threat from declining funding in real terms especially special funding to promote innovation.

3.6   **The second requirement** is for teaching staff and their students to be adequately skilled in making effective, imaginative, widespread and critical use of this

infrastructure, which crucially includes a critical mass of very high quality open learning content. This responsibility primarily rests with the HEIs (particularly the teaching staff, and information experts in the libraries and computer services departments) and supporting bodies such as the HE Academy and the Leadership Foundation. A number of CETLs (Centres for Excellence in Teaching and Learning)[12] also provide expertise in the use of the Internet and on-line resources to improve the effectiveness and quality of virtual education. Some of these offer national services. The role of these CETLs should be reviewed with a particular aim of addressing, at a national level, the skills gaps in HEIs by making their expertise more widely available. This requirement is not currently being adequately and systematically met.

3.7   **The third requirement** is for leadership from management to develop the e-learning offerings of their institutions appropriately for the student body. This will range from integrating research outputs at the research-led universities, offering on-line resources and services to part-time and distance, including overseas, students, to providing a mostly on-line service to non-traditional students who seldom, if ever, visit the campus. This responsibility primarily rests with institutional management and is only partially being met, by only some HEIs.

3.8   In particular the UK is not doing enough to provide a more or less complete on-line educational experience to students who, for a variety of reasons (economic, lack of time, geography) cannot enjoy a conventional campus based learning experience. This is especially true of students where demand for higher education outstrips supply such as the emerging economies of South East Asia and South America and those developing countries that are likely to become increasingly more important over the next 15 years. Here the UK is currently doing very little under the excuse of having tried it once (the UK e-University) and failed.

3.9   A different model would be to encourage some HEIs to make virtual education offerings aimed at the largely untapped market of national and overseas students who cannot find (or do not feel comfortable finding) places in traditional universities. This approach can exploit open educational resources but it would be naïve to expect all HEIs to contribute open education resources if only a few exploit the potential offered. All HEIs should be enabled to provide virtual education but a few exemplar universities should be encouraged (the OU is an obvious candidate).

3.10   There would be a number of problems to overcome (e.g. identity management, developing appropriately social networking tools, cultural difference of students) but these are not unique to virtual education and can, and have been, solved by others, for example the University of Phoenix.[13]

3.11   Meeting these requirements in HEIs is not sufficient. Much HE is delivered in FE colleges, illustrating the learning continuum that supports HE. In any case the benefits of e-learning can be reaped across education and beyond and should not be tackled in HE alone. The FE sector takes advantage of the JANET academic network and a menu of national ICT HE-led services of relevance to FE to disseminate good practice and initiatives such as the recently established e-books pilot[14]. Cross community co-operation is evidenced by the JISC Regional Support

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[12] The full list of CETLs can be found at http://www.hefce.ac.uk/learning/tinits/cetl/final/
[13] University of Phoenix: http://aptm.phoenix.edu/
[14] http://www.jiscebooksproject.org/

Centres[15] and JISC and Becta continue to collaborate for the benefit of all sectors; and recently Becta has been commissioned to offer a future vision for FE and Skills. JISC is also actively engaged with major content providers such as the BBC, British Library, National Library for Health, museums, archives and public libraries to integrate learning content for citizens at all stages of their lives.

3.12   Two important specific issues to establishing a UK lead in HE e-learning are now considered further: the changing expectations of HE students; and the need for an "infrastructure" of freely available high quality HE learning resources.

Student Experience

3.13   ICT has greatly increased and simplified access by students to learning materials on the Internet[16]. Where, as is nearly universal in HE, this is coupled with a Virtual Learning Environment[17] to manage the learning process and to provide access to quality materials there has been significant advances in distance and flexible learning. Thus students can learn and interact with their peers and teachers independently of place or time – within reason. Work at University College London is one of many examples of interactive on-line tutorials which not only provide students with a more effective way of learning the tutorial material but also provide a more effective use of scarce staff time[18].

3.14   But there is reason to believe this ready access to content is not matched by training in the traditional skills of finding and using information and in "learning how to learn" in a technology, information and network-rich world. This is reducing the level of scholarship (e.g. the increase in plagiarism, and lack of critical judgement in assessing the quality of online material). The Google and Facebook generation are at ease with the Internet and the world wide web, but they do not use it well: they search shallowly and are easily content with their "finds".[19] It is also the case that many staff are not well skilled in using the Internet, are pushed beyond their comfort zones and do not fully exploit the potential of Virtual Learning Environments; and they are often not able to impart new skills to students[20].

3.15   All institutional learning and teaching strategies should consider how learning may be enhanced by the application of technology. The diagram below identifies the challenges for HEIs when introducing ICT to improve pedagogic excellence, showing areas where students are currently pushed beyond their comfort zones. This can help institutions to develop the inclusion of ICT in teaching and course design, to appreciate which elements of technology are likely to be new for students, and hence to provide the support structures which need to be in place to encourage students to adopt new technologies.

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[15] Regional Support Centres: http://www.jisc.ac.uk/whatwedo/services/as_rsc/rsc_home.aspx
[16] A report on the tangible benefits of e-learning can be found at:
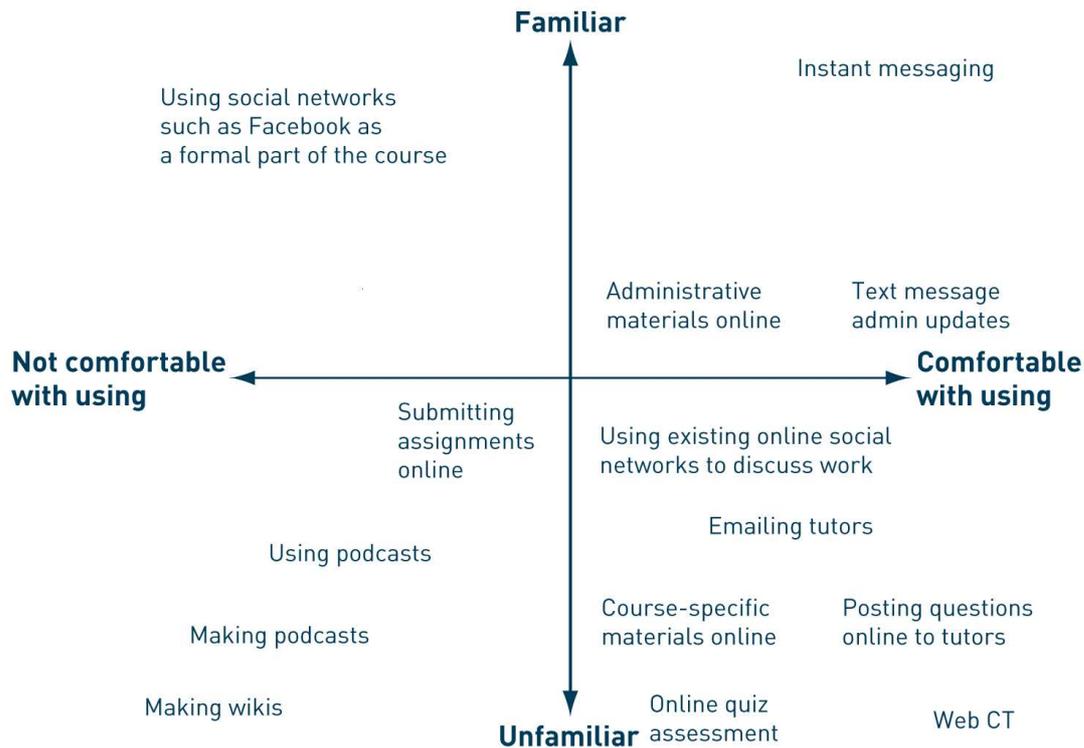http://www.jiscinfonet.ac.uk/publications/publications/info/tangible-benefits-publication
[17] It is noteworthy that UK HE is dependent on one major US package (Blackboard): there are now no widely adopted UK offerings, although opportunities exist to tailor open source Virtual Learning Environments (such as Moodle which is widely used in FE) for specific needs.
[18] An introduction to these interactive exercises and demonstrations of some of them can be found at http://www.brightida.com
[19] A study on the information behaviour of the researcher of the future can be found at:
http://www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen.aspx
[20] The work of learning technologists and similar staff is particularly important in supporting the teaching profession to make best use of ICT. Professional accreditation such as the CMALT scheme run by the Association for Learning Technology (ALT), has a significant role to play here.

Familiar

Instant messaging

Using social networks
such as Facebook as
a formal part of the course

Administrative
materials online

Text message
admin updates

**Not comfortable
with using**

**Comfortable
with using**

Submitting
assignments
online

Using existing online social
networks to discuss work

Emailing tutors

Using podcasts

Making podcasts

Course-specific
materials online

Posting questions
online to tutors

Making wikis

Online quiz
assessment

Web CT

Unfamiliar

3.16   The use of Web 2.0 technologies is greatly improving the student learning experience and many HEIs are enhancing their teaching practices as a result. A large majority of young people use online tools and environments to support social interaction and their own learning represents an important context for thinking about new models of delivery.

3.17   As Professor Brenda Gourley, the Vice Chancellor of the Open University has said[21] "Web 2.0… is an interactive, participatory experience….[which]…gives a whole new meaning to 'community of scholars' and a whole new dimension to 'internationalisation'."

3.18   There are likely to be opportunities and demand that has not been witnessed before. More should be done to understand and benefit from these technologies to improve learning effectiveness, engage with pedagogic practice and institutional learning and teaching strategies, and to meet changing student expectations[22]. A comprehensive review on the changing learner experience is underway, chaired by Professor Sir David Melville, and due to report in the New Year[23].

3.19   The effective use of e-learning and pedagogic approaches differ for different sectors of higher education, for example:

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[21] Scholarship in the Digital Age. Festschrift Conference for Professor Sir Colin Campbell on 'The Internationalisation of Higher Education' September 2008
[22] A study on the student experience and expectation of ICT can be found at: http://www.jisc.ac.uk/publications/publications/greatexpectations See also Becta (2008) Research Report: Emerging Technologies for Learning Volume 3
[23] Committee of Inquiry into the Changing Learning Experience: http://www.clex.org.uk/

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in research-led universities there is a need to link effectively research resources with learning and teaching;
in HEIs that attract a lot of part-time and distance learning, e-learning tools are essential and often well-deployed;
where HE is taught in FE Colleges, there is a need to ensure access to the same on-line materials as students taught in HE;
where students tend to learn almost entirely at a distance (e.g. The Open University and the student base the UK e-university aimed for) high quality, purpose written, online materials and high quality online support services are essential;
post graduate education such as taught Masters courses which can be international and intranational;
career professional development where HE could usefully seek a greater share of a potentially lucrative market.

3.20 These require different approaches; there is not a "one size fits all" solution or optimal approach to e-learning and e-pedagogy. The sector is moving towards the view of enhancing learning and teaching through the use of technology in order to create a more student-focused and flexible system, which in turn will help institutions to service an increasingly international and competitive market. This movement should be encouraged but there is a need for real cultural change on the part of teachers, institutions and learners, in particular in relation to sharing and re-use of learning materials. Initiatives and approaches that develop general "capacity for excellence" which get institutions working together to their own agendas have proved a helpful mechanism, such as those described in Annex A.

3.21 Students will have a very different expectation of the use of technology in their learning in future. There is a need to consider what must be delivered in HE to meet this rising expectation and experience in a consistent manner for every student across all HEIs and courses within HEIs. Consideration should also be given to what needs to be delivered in schools (prompted by HE) to ensure that future university students are well prepared: not just to be competent in using the devices but also to be intelligent users of information, knowledge and data. School students need to be ready equipped to get the best out of their time at university and to keep them effective after they leave university and contribute to society.

3.22 Students value, and expect, contact time with teachers and professors. They will use online resources, and are at home doing so, but most do not consider this an adequate higher education experience[24]. We need to continue to support a blended learning approach. It is necessary to make available a critical mass of high quality learning materials in order to free up staff time so that contact time and other on-line teaching functions can be enhanced. One lesson from the past is that ICT innovation is hampered by lack of time, cost and curriculum constraints; problems that are made worse by decreasing staff/student ratios (SSRs). Decreasing SSRs can easily lead to a reduced quality of the learning experience. ICT can, properly adopted, help to offset this reduction in quality[25].

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[24] A study on the information behaviour of the researcher of the future funded by the British Library and JISC can be found at: http://www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen.aspx
[25] Direct comparisons are difficult because the data is not always consistent but SSR has increased from 8.6:1 in the mid 1970s to 16.9 in the mid 1990s and was 18.8 in 2003/04 (UCU Report: http://www.ucu.org.uk/csrdocs/csrsection26.pdf). Of course these are average data and there will be considerable variation between institutions and subjects. It is worth noting that in schools the pupil teacher ratio has fallen slightly from 19.4:1 in 1975/6 to 17.6:1 in 2003/04.

<u>Open Learning Content</u>

3.23   In the UK most online material should be openly available to all, free of charge at the point of use. This will encourage re-use of materials by other teachers, make available high quality resources to students that they can have confidence in, and provide a valuable marketing tool to potential overseas students (whether they learn in the UK or in an overseas campus). Other countries (notably USA[26] and Australia[27]) are already building a critical mass of open learning content; the UK is in danger of lagging behind. Open learning content could also, if well managed as a national corpus of resource, stimulate virtual learning by a variety of educational institutions, including the private sector, and encourage and facilitate life long learning in schools, colleges, work based learning, and adult learning (whether formal or informal). It would support both education and skills. It should be recognised that an e-learning culture starts before higher education so becoming a world leader in higher education e-learning will require good articulation between how learners learn when in HE and how they learn in preparation for entry to HE, with the need for mentoring and support, in particular for FE and Skills learners.

3.24   Whilst a national centre for open access course materials, for example through the Open University, is a potential model worth considering, there are real costs related to establishing an appropriate legal framework to address IP/rights management issues, sustainability and ensuring high quality and compliance with agreed technical standards. It is important to understand that most online material is not in itself adequate for a student. Crucially, free online material is only, at best, the beginning for education. Effective e-learning requires using ICT imaginatively, to inspire, enthuse and engage students as well as for creating knowledge and understanding, for wisdom, and for creating the competitive advantage that is so important to the UK in an increasingly competitive academic world.

3.25   Open learning content has already proved popular[28], both in terms of positive press coverage for the institutions involved and in terms of usage by learners and educators. The MIT OpenCourseWare initiative materials have seen one million unique users each month[29], and the Open University's OpenLearn materials have been accessed 1.7 million times in the last 18 months[30]. Both initiatives are experiencing interest worldwide from both learners and educators, with an obvious reputational and visibility benefit to the institutions involved. Evidence from MIT suggests that overall students use the site most frequently to find materials that complement a course they are taking, to enhance personal knowledge and to plan their course of study. [31] 96% of educators said the site has/will help improve courses. An analogy can be drawn with textbooks, as the precursor of free online course materials. Some weaker courses only need a textbook as their basic

[26] MIT OpenCourseWare (OCW) is a web-based publication of virtually all MIT course content (1,800 courses). It is open and available to the world and is a permanent MIT activity (ocw.mit.edu). It was launched in 2002 and was the first significant, managed, collection of online open educational resources.
[27] Australia and New Zealand's The Learning Federation is funded by the national governments. This focuses on school content and has 4581 items of online content, including learning objects in six curriculum priority areas (http://www.thelearningfederation.edu.au)
[28] See CETIS Briefing Paper on Open Educational Content (http://wiki.cetis.ac.uk/images/0/0b/OER_Briefing_Paper.pdf) which provides a detailed analysis of the current deployment of managed open educational content provision across the world
[29] http://ocw.mit.edu/OcwWeb/web/about/stats/
[30] http://kn.open.ac.uk/public/document.cfm?docid=11281
[31] MIT OpenCourseware: 2005 Evaluation Program Findings Report, June 2006

material. Good courses build on them or, often better, only use material that is online and assumes the textbook has been read.

3.26   A greater focus is needed on understanding how such content can be effectively used. Necessary academic skills and the associated online tutoring and support skills need to be fostered in exploiting open learning content to add value to the higher education experience. It is taken for granted in the research process that one builds on the work of others; the same culture can usefully be encouraged in creating learning materials.

3.27   A further requirement for the UK to prosper internationally in the use of e-learning is further research and development in educational technology, educational psychology and pedagogy; specifically new pedagogies for online learning are required. Current funding for teaching does not directly target innovation. Research such as that funded by EPSRC/ESRC's Technology Enhanced Learning Programme into "Learning Design Support Environments" has the potential to help our understanding of ways in which teachers might come to make best use of emerging technologies. Further research and development needs to be promoted and requires an explicit commitment both at the national and institutional level, which requires focus and integration to build on existing centres of excellence, such as the Open University, the HE Academy, and the Centres for Excellence in Teaching and Learning (CETLs) such as the Blended Learning Unit CETL at the University of Hertfordshire[32]. High quality contributions to e-learning need to be better recognised and rewarded, e.g. as a criterion for teaching professorships.

3.28   It is not necessary to repeat all the reasons for the failure of the UK e-university: it fundamentally failed due to a poor business case and the inability to engage the HE community. Any new approach needs a better thought through business case where contributors such as authors can benefit as well as students, and where HE institutions can develop opportunities they wish to exploit. The e-university was ahead of its time but the UK can learn from its mistakes and it is not too late to try again to address the demand for virtual, largely on-line education in the UK and elsewhere. Indeed it is essential we do so through a national policy framework for lifelong learning if the UK is to provide the full breadth of HE in an increasingly competitive international market. However, a single new university to gain the high ground in e-learning is not the answer and what is proposed is not in any way linked to the concept of the UK e-university. The diversity of need internationally, needs to be met by a diversity of provision in the UK. HEIs already committed to e-learning should be encouraged, where appropriate to their context, missions and communities, to address further the needs of virtual and blended education and be provided with support and leadership to develop their international reputations given the significant organisational commitment and change required. The experience of Ufi/learndirect[33] in providing high quality e-learning should also be built upon.

3.29   Clusters of institutions, focused on the online education needs of different student groups should be created to pull expertise and stimulate innovation. These centres of expertise will build on a coherent body of open educational content using new pedagogies informed by evidence-based research.

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[32] Blended Learning Unit CETL: http://www.herts.ac.uk/about-us/learning-and-teaching/blended-learning-institute/home.cfm
[33] Ufi/learndirect: http://www.ufi.com/home/default.asp

3.30   The ultimate aims of the Gowers Review of Intellectual Property[34] are to create a flexible and balanced legislative framework fit for the digital age. However, there is a danger that copyright law is being undermined in the digital age. The World Intellectual Property Organisation (WIPO) Copyright Treaty[35] says copyright must "maintain a balance between the rights of authors and the larger public interest, particularly education, research and access to information." A legislative framework which supports the needs of users in education and research whilst protecting rights holders, will be essential in increasing the use of ICT within HE and FE, obtaining the optimum benefit of investment in this and related areas, and supporting the realisation of the UK as an international e-learning provider. In the UK, government needs to address these fundamental issues as well as ensuring that contract law cannot overrides the copyright exceptions following the lead set by Ireland, and in accordance with the provisions outlined in the UK's implementation of the database right.

RECOMMENDATION 1

The UK must have a core of open access learning resources organised in a coherent way to support on-line and blended learning by all higher education institutions and to make it more widely available in non-HE environments. This needs to be supported by national centres of excellence with a core mission to engage with other institutions, to provide quality control, essential updating, skills training, and research and development in educational technology, e-pedagogy and educational psychology. All HEIs should be encouraged and helped to exploit virtual education technologies as appropriate to their student's requirements and their strategies.

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[34] Gowers Review: http://www.hm-treasury.gov.uk/independent_reviews/gowers_review_intellectual_property/gowersreview_index.cfm
[35] WIPO Copyright Treaty: http://www.wipo.int/treaties/en/ip/wct/trtdocs_wo033.html

ACTIONS TO ACHIEVE RECOMMENDATION 1

i) Centres of excellence for promoting technology enhanced learning should be established with the remit of researching good practice, encouraging the wider use of e-learning, providing skills training, identifying benefits and advising the sector. The focus would be to engender a long term cultural change on the part of teachers, institutions and students. A small number of centres (preferably made up of clusters of institutions) are required to focus on the diverse needs of HE students.

ii) In the shorter term a review should be carried out to identify key players in HE e-learning, investigate current practice and strategies, highlight strategic best practice and benefits, benchmark UK activity internationally and advise on the terms of reference for centres of excellence.

iii) A comprehensive national resource of freely available open learning content should be established to provide an "infrastructure" for broadly based virtual education provision across the community. This needs to be curated and organised, based on common standards, to ensure coherence, comprehensive coverage and high quality[36].

iv) Negotiation by DIUS ensure the Gowers Review of Intellectual Property facilitates the use and sharing of all types of open learning content across multiple platforms of delivery to enable the UK to excel as a world leader in e-learning provision

v) Bring together key parties to discuss digital literacy and how best to embed digital literacy good practice across the FE and skills sectors, as well as the HE sector, including the educators themselves and trainee teachers. A significant programme of staff training is required, coupled with good student induction training, to improve competence in the use of ICT.

These activities should be developed in a broader context of UK education provision and involve schools, FE and the skills sector, as well as support adult and work based learning, industry and the commercial sector. They must be fully informed and work in collaboration with other countries: ranging from countries that are currently strong in providing e-learning, to the developing world where significant benefits can be expected. The level of investment must be sufficient to create high quality resources that attract re-use.[37]

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[36] The Strategic Content Alliance (SCA – see footnote 11) will help achieve this and a further analogy is the concept of Repositories UK, designed to provide joined-up research repositories across UK higher education; such repositories could also form the basis for open educational content.
[37] As demonstrated, for example, by the ChemLabs CETL for the teaching and learning of experimental sciences based at the University of Bristol

4.   Research and Innovation

4.1   It is important to recognise that the major driver for investment in leading edge ICT in many research-led universities is to meet the needs of research, which ranges from blue sky to applied research, is often linked with industry and other organisations, is often international in scope and is a critical driver for innovation.

4.2   The UK currently enjoys a good ICT infrastructure for research in the JANET network and computer resources. There is also an appropriate international provision and the UK has in place good structures to address future needs. However, the impact of the lack of institutional planning is that weaknesses exist in some institutions, where plans and strategies for the ICT infrastructure have not been consistently applied throughout the institution.

4.3   The UK has two High Performance Computing (HPC) facilities managed by the Engineering and Physical Sciences Research Council [38]. These systems have somewhat different architectures, enabling access to an exceptional range of resources and providing a high level of flexibility in the way the services operate. The UK is also fully involved in ambitious European plans for HPC. These also provide key technologies as teaching environments for next generation scientists. Institutions have also invested in HPC to support their research activity and to provide a teaching environment, for example a shared service is currently being pursued to improve capacity.

4.4   However, modern research is generating massive amounts of data and there is little indication that the UK is gearing up to deal with this. It was a major issue identified in the OSI e-infrastructure report[39] which is still not being adequately considered[40]. This is partly due to the loss of focus on e-science, an area where the UK was recognised as the world leader but is now falling behind other countries just when it could have exploited its advantage.

4.5   Recent developments in Australia in building their Australian National Data Service[41] and in Germany in producing an impressive Priority Initiative on Digital Information by the Alliance of German Science Organisations[42] clearly demonstrate the extent to which the UK has already lost the initiative in this area. The UK research policy makers urgently need to understand and respond to the requirement to properly manage research assets such as data and intellectual outputs. DIUS needs to provide strong national leadership in this area.

4.6   The elements of a national e-infrastructure as depicted in the OSI e-infrastructure report can be found in the following diagram. This can also be applied to the learning and teaching environment and there is also a need to look across research and learning to ensure techniques developed in one environment are applied to the best effect in the other.

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[38] HPCx is provided by a consortium led by the University of Edinburgh, with the Science and Technology Facilities Council and IBM. HECToR, the new UK national High Performance Computing Service, which came into operation on 16 October 2007, is operated by the Edinburgh Parallel Computing Centre
[39] OSI e-Infrastructure Report: Developing the UK's e-Infrastructure for Science & Innovation: http://www.nesc.ac.uk/documents/OSI/index.html
[40] The latest annual report for the Science and Innovation Framework 2004-2014 can be found at: http://www.berr.gov.uk/files/file40538.pdf
[41] http://ands.org.au/
[42] www.mpdl.mpg.de/news/Allianz_prioInitiative_en.pdf

4.7   Provision of the basic infrastructure in the bottom triangle is largely adequate but more focus and development activity is needed in the management and effective use of research data. In particular, major issues are related to the needs for data curation and preservation of data and the mechanisms for search and navigation online.

Supporting research and innovation
The elements of a national e-infrastructure
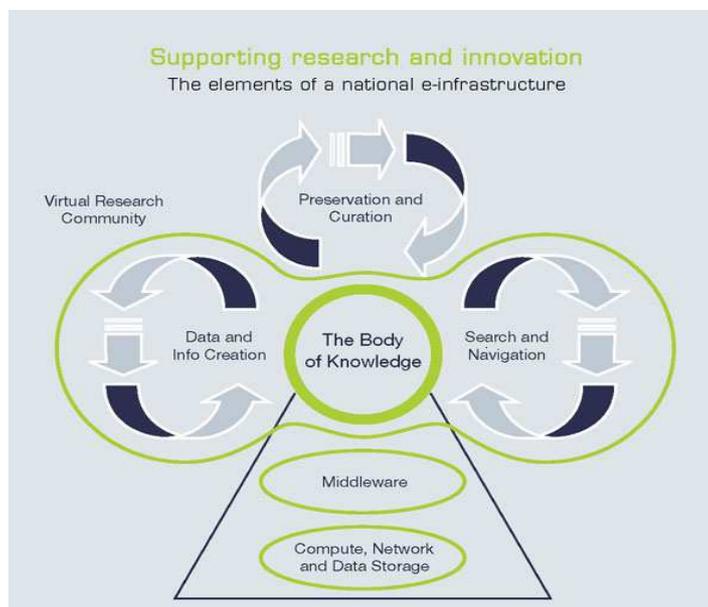
4.8   The UK e-science programme of a few years ago was world leading in developing advanced techniques for developing innovative research, with particular emphasis on inter-disciplinary research[43]. The Research Councils are currently reviewing this programme and it is to be hoped this will stimulate further work across all disciplines with the deliberate objective of regaining the UK's pre-eminence in this area.

4.9   Researchers increasingly demand and expect resources to be available on-line yet digitisation of scholarly and academic resources in the UK has been piecemeal. It is time for a significant national strategy to plan a coherent approach to large scale digitisation.

4.10   It is also necessary that the UK retains a strong core of expertise in research into ICT: not just computer science and network technologies, but the development of uses of online resources and tools to manage these resources including technical standards and interoperability.[44]

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[43] E-science activities are now managed by the individual Research Councils with EPSRC, NERC and STFC making significant investments.
[44] For example, SCONUL has undertaken helpful work on 'information literacy' to improve the management of the research process.

RECOMMENDATION 2

Central investment through the funding councils and research councils needs to be maintained in the core infrastructure of networking and high performance computing. More investment and policy leadership is required for the curation of research data, including international collaboration, to build a layer of academic and scholarly resources readily available to all. This should be a priority for DIUS, RCUK and others where clear policy leadership is urgently required. This is different from and complementary to public online resources such as Google. The Research Councils should be invited to review their approach to e-science in order to re-establish the UK's pre-eminent position in this important research process.

ACTIONS TO ACHIEVE RECOMMENDATION 2

i) Independent assessment of where the UK is at in relation to the original strategy (OSI e-Infrastructure Report: Developing the UK's e-Infrastructure for Science & Innovation) and how it compares with key countries.

ii) Establish, from existing centres of expertise, a comprehensive mechanism for co-ordinating the curation and preservation of research data.

iii) Review and consider a revised approach to e-science techniques in light of the current review to re-establish the UK world class position across research disciplines.

iv) Look across research and learning to ensure techniques developed in one environment are applied to the best effect in the other.

v) Continued government investment in content digitisation at a much more serious level of co-ordinated activity, establishing a national framework strategy;

5. Management and Administration of Institutions

5.1   There are a number of applications designed and used to provide administrative computing to HEIs. These range from large, but expensive, enterprise solutions to heterogeneous (often open source) applications for different functions (e.g. student records, personnel, finance) usually loosely coupled. Provision across the sector is diverse and often piecemeal.

5.2   This is not necessarily a bad thing but the spectre of a 1980s initiative to create a few generic administrative computing solutions hangs over HE and inhibits progress. There are now some signs, particularly driven by sustainability (in the "green" sense) that HEIs are prepared to rationalise and develop common approaches to administrative computing. This should be encouraged; shared services and the more efficient use of computers (usually by sharing resources) can save the sector money, improve data management and security, and encourage innovation[45]. There is also growing pressure for student data transfer between institutions[46] across the whole educational system, requiring compliance with data specifications and the need for interoperable business systems.

5.3   Solutions can vary. Approaches based on commercial suppliers and "Application Services Providers" will be favoured by some; whereas tailored open source solutions may be preferred where they can improve flexibility and cost.

5.4   A better understanding of the use to which management information can be put should be encouraged to enable the full potential of current management systems to be realised.

5.5   Work also needs to continue to address issues such as security, privacy, interoperability between systems, the transfer of data workflow, resilience and data recovery.

5.6   ICT is also an important component in an institution's outreach and business and community engagement activities. This is not appreciated by many HEIs. Small and medium enterprise (SME) managers need good ICT resources to help them deliver their learning needs. Online resources and e-learning are massively beneficial to work based learning. Too little is being done to exploit ICT in HE in this area although progress is being made[47]. There is also an opportunity to consider a pan-institution strategic approach to enable HE students joining UK industry to continue to build on the tools and techniques they learned in HE in their new roles.

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[45] Shared Network Security Service http://www.hefce.ac.uk/finance/shared/feasibility/show.asp?id=11&cat=1 and Shared Data Centre Initiative http://www.hefce.ac.uk/finance/shared/feasibility/show.asp?id=12&cat=1 A JISC Study of Shared Services in UK FE/HE undertaken by Duke and Jordan will also be published shortly.
[46] The Burgess Report: Measuring and Recording Student Achievement (http://bookshop.universitiesuk.ac.uk/downloads/measuringachievement.pdf) recommends introducing a single document, to be known as a 'Higher Education Achievement Report' (HEAR). JISC is exploring the potential for using structured, electronic achievement data and has also funded the XCRI project to produce a technical specification to support the exchange of course-related information (http://www.xcri.org/Welcome.html). See also the MIAP (Managing Information Across Partners) programme (http://www.miap.gov.uk).
[47] Within FE, the Learning and Skills Council (LSC) has set up the mulit-agency work-based learning e-strategy group to address this issue which has resulted in national advisors, £10m Learning Innovation grant scheme and staff development and management ILT programmes

5.7   Environmental sustainability is one of the most urgent and high-profile issues to challenge the global community at present, occupying both international governments and commercial organizations in equal measure. In the education sector ICT is seen as both a positive, enabling influence but also as a significant consumer of environmental resources in an unsustainable way. Colleges and universities are faced with the practical issues of increasing electricity bills and issues of update and disposal of outdated technologies, and the need to identify more energy-efficient work spaces, as well as being asked by their funding bodies to consider issues of environmental responsibility[48].

RECOMMENDATION 3

HEIs should be encouraged and supported to develop integrated information strategies against their individual missions, which should include a more visionary and innovative use of ICT in management and administration. This should include the consideration of shared administrative services,[49] more innovation through ICT for business and service delivery, and measures to improve the sustainability of institutions particularly by reducing energy consumption.

ACTIONS TO ACHIEVE RECOMMENDATION 3

i) Encourage and support institutions to include the integration of their library, information and IT services in the development of their strategies for research and learning and teaching. Such strategies to include a coherent approach to the management and exploitation of infrastructure resources, sustainability and the consideration of shared services with other HEIs where appropriate;

ii) Continue work on security, privacy, interoperability, the transfer of data workflow, resilience and data recovery

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[48] Sustainable development in higher education (HEFCE, 2005) (http://www.hefce.ac.uk/lgm/sustain/) and Managing environmentally sustainable ICT in HE and FE (http://www.jisc.ac.uk/fundingopportunities/funding_calls/2007/09/environmentallysustainableICT.aspx) (http://www.jisc.ac.uk/whatwedo/programmes/programme_jos/susteit.aspx)
[49] HEFCE's shared services initiative: http://www.hefce.ac.uk/finance/shared/ and JISC's e-Framework Programme (http://www.jisc.ac.uk/whatwedo/programmes/eframework)

6.   Issues of Scale

6.1   ICT provision needs to be considered separately at a number of different levels: the individual, institutional, national, and international.

6.2   It is increasingly taken for granted that students have mobile phones[50] and for many courses at many universities it is expected that students will own laptop computers. It is also taken for granted that most students are ardent users of social networking through Web 2.0 technologies. HEIs are tailoring their offerings against this expectation. There is some cause for concern that institutions are not catering sufficiently for changing student expectations based on their experience and expectations of ICT. A review due to report in the New Year will look to make recommendations to address this in more detail[51].

6.3   The majority of staff in UK higher education are familiar with and competent in the use of ICT. Innovative practice in exploiting the opportunities of ICT is patchy however, although there have been great improvements in recent years. The challenge is how to move beyond pockets championed by enthusiasts to achieve wider institutional impact. Leadership and support is needed by institutions and nationally to create incentives and enable e-learning to benefit from economies of scale and to develop staff skills further to move best practice into the mainstream of research, and especially learning and teaching within HEIs. Reward and recognition is a key issue to address along with a need for a better understanding of the costs and workload requirements of e-learning and blended learning modes.

6.4   At the institution level more should be done to provide students with services based on their ICT expectations and to place them in the role of active, skilled and collaborative creators of knowledge, rather than just consumers of information. Is enough information provided directly to students through mobile phones and mobile technologies? Do all institutions have adequate wireless network provision for laptop users? Are modern learning spaces provided for students - especially given the changing nature of their use of libraries?[52] Is adequate broadband access provided in residences? This can be particularly important for overseas students who will wish to download radio, television and other culturally relevant material from their home country. These questions are even more important in meeting the needs of non-residential students, an increasingly important group to many universities. The extent to which HEIs address these issues is variable.

6.5   More work is needed to address the problems of intellectual property and licensing. As described earlier in this paper, the Gowers Review of Intellectual Property will hopefully ensure that legislation is fit for the digital age.

6.6   The UK has a good national ICT infrastructure for HE and research. However, there is a danger this can reduce innovation in the expectation that the JISC or similar bodies will provide significant investment. However, the scale of the requirements needs significant investment from both national bodies and institutions. Higher education as an "industry" does not invest in ICT-based

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[50] LSC has funded a £6m scheme called Molenet (http://www.molenet.org.uk) to provide mobile learning devices to learners and to facilitate the use of learner-owned mobile devices.
[51] The Committee of Inquiry into the Changing Learner Experience: http://www.clex.org.uk/
[52] A report on designing spaces for effective learning can be found at:
http://www.jiscinfonet.ac.uk/infokits/learning-space-design

innovation on a comparable scale to industry, Examples of huge commercial investment can be seen in Google and its siblings in the creation of tools and systems to "organise the world's knowledge" and by publishers, such as Pearson, into the production of e-learning content. This sits alongside textbooks and is capable of being imported into a VLE or accesses independently in a VLE run by the publisher.

6.7 HEIs should consider how to exploit strategically the world class ICT infrastructure they enjoy, particularly by taking an holistic approach to information management and considering how to use ICT more effectively in the management of their institution and in outreach and employer engagement activities. There should also be greater recognition and encouragement of the role of other organisations in providing ICT:

    i.   the JISC in ICT infrastructure and innovation;[53]

    ii.   the British Library[54] and the Strategic Content Alliance[55] in online content provision;

    iii.   the Higher Education Academy in e-learning especially through their subject centres;[56]

    iv.   the Research Councils in the provision of high performance computing[57] and in some cases (especially ESRC and NERC) research data provision, and the joint EPSRC/ESRC Technology Enhanced Learning Programme;[58]

    v.   through Becta many areas of ICT infrastructure (JANET, access management, content) are cost effectively made available to other areas of education;

    vi.   links with Becta and UCAS[59] to facilitate student progression and the changing nature of ICT in learning and teaching in schools;[60]

    vii.   Ufi/learndirect[61] in providing high quality e-learning;

    viii.   the UK higher education funding bodies who have separately and jointly funded much ICT based innovation;

    ix.   the Quality Improvement Agency (QIA)[62] and recent work by the Leadership Foundation to improve the skills base of staff;[63]

    x.   the professional bodies such as UCISA, SCONUL and the Association for Learning Technology in promoting professionalism in the use of ICT;[64]

    xi.   this work has to be international in nature and involve major players from other countries such as the European Commission[65] and the National Science Foundation (NSF);[66]

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[53] Information about the value that JISC provides can be found at: http://www.jisc.ac.uk/aboutus/whoweare/value_report.aspx and: http://www.jisc.ac.uk/publications/publications/pub_valueofjisc2007.aspx

[54] The British Library: http://www.bl.uk/

[55] http://www.jisc.ac.uk/whatwedo/themes/eresources/contentalliance.aspx

[56] Higher Education Academy: http://www.heacademy.ac.uk/

[57] The UK Strategy for High End Computing can be found at: http://www.epsrc.ac.uk/CMSWeb/Downloads/Other/2006HECStrategicFramework.pdf

[58] EPSRC/ESRC Technology Enhanced Learning Programme : http://www.tlrp.org/tel/

[59] UCAS: http://www.ucas.com/

[60] Harnessing Technology Report: http://publications.becta.org.uk/display.cfm?resID=37348

[61] Ufi/learndirect: http://www.ufi.com/home/default.asp

[62] Quality Improvement Agency http://www.qia.org.uk/ Now called Learning and Skills Improvement Service.

[63] The Leadership Foundation: http://www.lfhe.ac.uk/

[64] UCISA:http://www.ucisa.ac.uk/ SCONUL: http://www.sconul.ac.uk/ ALT: http://www.alt.ac.uk/

[65] European Commission's European Research Area (ERA): http://ec.europa.eu/research/era/progress-on-debate/expert-groups-analyses_en.html

[66] NSF's Cyberinfrastructure Vision for 21st Century Discovery: http://www.nsf.gov/od/oci/ci_v5.pdf

xii.   commercial providers ranging from networking, publishers, learning content suppliers, MIS applications, consultants etc.

6.8   Collectively all these organisations, and others, have worked together with the HEIs in an impressive collegiate manner to ensure the UK can, and does, provide world class, and often world leading ICT provision for research and higher education. More recently this is being put at risk by a noticeably less innovative and risk taking approach: a desire to reduce centrally funded innovation and a drive to force competition over collaboration is detrimental to the provision of ICT infrastructure. It is vitally important that UK HEIs continue to enjoy a world class ICT infrastructure at the highest level that is maintained and developed through infrastructure services, widely available advice and guidance and funding for innovation. It is the responsibility of the HEIs to exploit this common advanced infrastructure to meet their strategic business, educational and research needs in an increasingly international competitive environment. They have the tools, can they provide the leadership?

6.9   Finally ICT innovation must be carried out within an international environment. It is essential that the UK remains fully involved in international ICT activities and co-ordinates international efforts effectively.

i.   UK Performance within the Higher Education World

UK Higher Education and Research: Strategic Context
Despite increasing global competition, the UK maintains its position as a world leader in research outputs, contributing 9% of papers produced annually and a 12% share of citations, second only to the United States (UK) in world rankings[67]. The UK has benefited from a 24% real term increase of investment from 1997–98 to 2008–09[68], though the UK currently only invests 0.8% of gross domestic product on Higher Education; Canada spends 1.3% and the United States 1.2%[69].

Universities in the US continue to dominate the world's top 500 in the latest rankings by Shanghai Jiao Tong University. US universities hold 17 of the first 20 positions and 55 of the top 100. Two UK universities are represented within the top 20 and 10 in the first 100. Germany has six institutions in top 100[70]. Nevertheless, the UK remains one of the most popular destinations for study, attracting 12% of the international student market, US leads with 23%, Germany follows with 11%), France (10%), Australia (7%) and Japan (5%).[71]

Harnessing Technology 2008 - 2014[72] is the UK's strategy for technology enhanced education and skills. The strategy emphasizes infrastructure supporting cross-system information sharing and connected services for consistent and personalised services. The strategy describes the exploitation of digital resources as a priority, supported by national approaches for the collaborative development of content and services.

A number of other countries promote strategies to support technology enhanced education, and wider public sector provision[73]. These strategies extend considerably beyond Harnessing Technology's education focus, articulating legislative reform and approaches to establish common technology infrastructure and access to digital resources across public services.

Supporting UK Academic Technology Infrastructure
Acknowledging that the UK occupies a unique international position, a recent study drew upon the views of senior representatives from leading national and international organisations, concluding that the UK's Joint Information Systems Committee (JISC) is seen as one of a small cadre of world class organisations that provide leadership in the innovative use of ICT, encouraging and often initiating international collaboration and providing a means of influencing worldwide developments in ICT provision[74]. As an indicator of international interest in JISC activities, typically 35% of internet traffic to the JISC website is international, 10% visiting from the US, closely followed by India, Australia and Canada.

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[67] International Comparative Performance of the UK Research Base, Department for Innovation, Universities and Skills (DIUS), July 2008.
[68] Departmental Report, DIUS, 2008.
[69] Organisation for Economic and Co-operation Development (OECD), 2006.
[70] www.arwu.org
[71] United Nations Educational, Scientific and Cultural Organisation (UNESCO) Global Education Digest, 2007.
[72] Harnessing Technology: Next Generation Learning 2008-14
http://publications.becta.org.uk/display.cfm?resID=37348
[73] Such as New Zealand's Digital Strategy and eNorway: The Digital Leap 2009, launched in 2005
[74] International Benchmarking Study, JISC, July 2007.

The JANET network provides high speed access (at 40gb, four times greater than that originally planned) to support more than 18 million users including research institutes, universities, further education, primary and secondary schools. It is estimated that the connectivity offered by JANET would cost UK research more than five times its £50m annual cost if procured by individual organisations[75]. One of the first academic networks, JANET currently maintains one of the fastest academic networks in the world, but competition from other national education and research networks (NRENs) continues to grow.

Access Management permits access to protected online information. Launched by JISC and Becta in November 2006, the UK Access Management Federation enables education institutions from across the entire education and research sectors with a route to single sign-on to resources through devolved authentication. Many of the technical developments prompting this revolution in access management were developed in the US but the US education and research sector has been slow to capitalise, largely due to the lack of federal support for academic infrastructure development. In 2007 a study concluded that the UK is '*at the forefront of federated access management*', largely due to the significant numbers of institutions participating in the federation[76]. However the landscape is changing fast as a number of national federations are being established, notably the fastest developments are in northern Europe.

Repositories are widely understood to be a necessary function within the academic and research infrastructure, 'improving improved efficiency of research processes, promoting greater co-operation, improved learning and teaching, a commitment both to preservation and wider access to digital resources'[77]. The UK, alongside Australia and Netherlands are recognised as world leaders in the development and service provision of repositories. Experts in the UK have lead strategy development, focusing upon interoperable repositories, approaches since replicated in countries such as Germany and Sweden and under consideration in the US by the National Science Foundation (NSF). Such is the success of JISC funded repositories projects,[78] discussions are underway for development into international services.

Over recent years, the UK has made considerable investment in the creation of new digital resources and online access to a range of authoritative resources previously difficult or impossible to access[79]. Recognised internationally as pioneering digitisation projects in technology and administrative development, the UK, through JISC, seeks to create useable resources, reflecting the diversity of rich and vivid perspectives on the history, culture and landscape of the UK and beyond.

In 2006, a study demonstrated how for every £1 funding in national UK content agreements for the provision of licensed digital resources, the further and higher education sector received services with a commercial value of over £26[80]. JISC Collections are one of only a small number of such national services, increasingly called upon to provide advice and services to other countries. In 2006 a study[81] provided a

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[75] Value for Money Study, JISC, 2006

[76] Federated access Management: international aspects, JISC, July 2007.

[77] Professor Drummond Bone, Vice Chancellor of the University of Liverpool and President of Universities UK, June 2007.

[78] Projects such as SHERPA and ROMEO:
www.jisc.ac.uk/whatwedo/programmes/programme_digital_repositories/project_sherpa_romeo.aspx

[79] JISC Digitisation Programme: http://www.jisc.ac.uk/whatwedo/programmes/programme_digitisation

[80] Value for Money Study, JISC, 2006.

[81] Online access to content: international comparisons, JISC, September 2006

comparison of science and technology researchers in the following countries: the UK, Germany, the Netherlands, Canada and the US. The key conclusion was that there are very few differences in the amount of resources available to researchers in such institutions and that licensing models in use do not generally place barriers to researcher productivity differentially across countries.

ii.   The Development of e-Learning Tools

The appropriate use of technology is leading to significant improvements in learning and teaching across the sector and this is translating into improved satisfaction, retention and achievement. For example, the JISC/ ALT/HE Academy project, CAMEL Tangible Benefits of e-Learning[82] shows that student retention has improved as a result of the improved personalisation and mentoring opportunities afforded by e-learning applications such as e-portfolio systems. In addition, e-learning offers opportunities for enhanced recruitment through greater accessibility and opening up of new markets, locally and internationally.

Evidence points to areas for further development of e-learning, now often referred to as technology enhanced learning (TEL)[83]:

1) Findings from the 2008 Survey of Technology Enhanced Learning for HE in the UK[84] show that:
- 59.4 per cent of institutions rated '*attracting new markets*' as 'fairly' or 'very' important. The greatest improvement in rankings is for 'a*ttracting new markets'* for Post-92 universities, which has changed its ranking from seventeenth in 2003, thirteenth in 2005 to sixth in 2008.
- 74.3 per cent of institutions rated '*creating/improving competitive advantage*' as 'fairly' or 'very' important.
- The main driver identified by institutions which encouraged the development of TEL was '*enhancing the quality of learning and teaching*'. The driver of '*meeting student expectations*' has steadily increased its ranking.
- *'Lack of time'* and *'lack of academic staff knowledge'* were identified as the top two barriers to further developments to promote TEL for all types of university.

2) Institutions should effectively promote the quality of institutional course materials to prospective students worldwide, and support the use and reuse of high-quality content across the sector. There are a number of successful international initiatives to release free learning content on the Internet. In the UK, the Open University's (OU) OpenLearn project has been running for 18 months and has attracted over 1.7 million unique visitors[85], substantially raising the OU's profile. HEFCE, working with JISC and the HE Academy, has recently approved a one-year pilot programme to support similar work more widely in the UK HE sector.

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[82] The CAMEL Tangible Benefits of e-Learning project aimed to collate and share the tangible and real benefits to staff, learners and institutions of e-learning, through a discipline and academic department focus by using the CAMEL model devised by JISC infoNet, the Association for Learning Technologists and the Higher Education Academy. See:
http://www.jisc.ac.uk/whatwedo/programmes/programme_elearning_capital/camelbelt.aspx
[83] Title for HEFCE's revised strategy for eLearning (due out Oct 2008) will be 'Enhancing learning and teaching through the use of technology'.
[84] Source: Survey of Technology Enhanced Learning, UCISA, 2008
(http://www.ucisa.ac.uk/publications/tel_survey.aspx Sample size 74 representative UK HEIs.
[85] See http://kn.open.ac.uk/public/document.cfm?docid=11281

3) There is still an opportunity for institutions to engage further with technologies such as Web 2.0 to enhance student learning, but in a way that is driven by students themselves. Evidence from the 2008 survey, Great Expectations of ICT[86] shows that learners are engaging with technology on their courses (and largely using their own equipment). However, staff require support so they can effectively exploit the potential of these new technologies. There is also an opportunity to help students understand best practice for checking the validity of internet sources used for research, something which 69% of students believe they are doing despite evidence elsewhere[87] suggesting they may lack the critical and analytical skills to do so rigorously.

4) Evidence from The Learner Experiences of e-Learning strand (2005-09) of JISC's e-Learning programme[88] shows that attention should be given to the ways in which institutional and personal ownership of ICT resources are balanced and the different models of provision and support which may be needed by different groups of learners.

5) Institutions need to develop their course management systems and processes to ensure that they can effectively market their offerings. Learners need access to an accurate, up-to-date list of learning opportunities, and the use of a standard format for describing learning opportunities can facilitate the collection and aggregation of this data. XCRI (eXchanging Course-Related Information) is a technical specification that enables UK institutions to describe in an open and consistent manner the courses and learning opportunities they offer, making those offerings more visible and easier to compare with like offerings from other institutions. The XCRI project has been working with partners in other EU countries to develop an EU-wide standard, for the first time enabling citizens to compare in detail learning opportunities from providers across Europe.

6) Institutions will increasingly need to respond to the needs of lifelong and work-based learners to facilitate upskilling of the UK workforce (in line with Department's and Funding Councils e-learning and innovation strategies[89], as well as the Leitch Review of Skills[90]). For example, JISC's recent Institutional Approaches to Curriculum Design circular received 55 bids, and its Transforming Curriculum Delivery Through Technology circular, 65 bids. A large number of bids for both calls related to lifelong, work-based or distance learning.

7) The UK HE sector should consider lessons learned from the UK e-University initiative. A useful analysis of lessons learned was provided by Paul Bacsich in July 2005[91]. These lessons were incorporated into both the (then) DfES e-strategy and HEFCE's e-learning strategy.

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[86] Findings of Second Phase of Research, Great Expectations of ICT, Ipsos Mori, June 2008. See http://www.jisc.ac.uk/news/stories/2008/06/greatexpectations.aspx

[87] See 'Information Behaviour of the Researcher of the Future', CIBER research team, University College London (http://www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/googlegen.aspx)

[88] See http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_learneroutcomes.aspx for information on the first phase of work; the second (current) phase of projects are listed at: http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_learnerexperience.aspx

[89] Relevant policies include Beyond the Honours Degree Classification - The Final Burgess Report (UUK, Oct 07); Becta: Harnessing Technology for schools, FE and HE (Apr 2008); HEFCE Strategy for e-Learning (2005 – under review); HEFCW: Technology-enhanced learning strategy (Apr 08); SFC: Review of Council Strategy on e-Learning (Oct 07); DIUS: Innovation Nation White Paper (Mar 08); DIUS: A New 'University Challenge' (March 08)

[90] See http://www.dcsf.gov.uk/skillsstrategy/index.cfm

[91] See http://www.heacademy.ac.uk/resources/detail/resources/publications/web0279_ukeu_reports_1_overview

iii.   How ICT can Support Improved Pedagogies

1a. Improved pedagogies: general

The CAMEL Tangible Benefits of e-Learning Project[92] found that where e-learning projects provided figures for student achievement, they were recording improvements of around 10% in pass rates as a result of e-learning implementation. Tangible benefits for students were also reported in the following areas:
- Improvements in learning style, insight and/or reflection;
- Enhancement of skills, employability and/or confidence;
- Enhanced satisfaction, motivation, attendance and/or retention;
- Enhanced recruitment through greater accessibility or opening up of new markets.

And for staff:
- A stimulus to creative teaching and to educational research;
- Enhancement of staff satisfaction and retention;
- Enhancement of staff skills, employability and/or confidence.

The JISC/SFC e-Learning Transformation Projects[93] were also able to produce good evidence for enhanced achievement and retention through use of technologies on an institution-wide basis.

Projects funded under the JISC e-learning and pedagogy programme[94] identified a number of ways in which the use of technology could transform learning opportunities. These included: connectivity (access to scholarly resources and to learning networks on a global scale), flexibility (enhanced choice for learners about their place, pace, mode and time of study) and interactivity (rapid feedback on tasks and formative assessments, more opportunities for dialogue), among others.

The Design for Learning[95] programme which succeeded this found that learning design tools can improve practitioners' educational planning, particularly their planning for e-learning advantages, whatever their underlying pedagogic approach.

JISC's Institutional Approaches to Curriculum Design Programme[96], is funding 12 large-scale institutional projects on the basis that they will use technologies in a holistic way to enhance the curriculum design and review cycle. An ongoing synthesis of evidence from this programme will be provided by the JISC.

The HE Academy/JISC-implemented 2006-08 UK HE e-learning Benchmarking (77 institutions) and Pathfinder Programme (28 institutions) has provided a rich picture of how institutions are using ICT to support the student learning experience[97]. In particular, many of the Pathfinder institutions have explored specific aspects of using ICT to improve

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[92] Ferrell G. *et al.* (2007): http://www.jiscinfonet.ac.uk/publications/camel-tangible-benefits.pdf
[93] Formative evaluation report by Glenaffric (July 2008):
www.sfc.ac.uk/information/information_learning/presentations_publications/elearning_elt_formative_evaluatio
n_report.pdf
[94] Based on Effective Practice with e-Learning, JISC (2005):
http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_practice.aspx
[95] Design for Learning Review (JISC, forthcoming August 2008): see also
http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_designlearn.aspx
[96] http://www.jisc.ac.uk/fundingopportunities/funding_calls/2008/04/circular508.aspx
[97] http://elearning.heacademy.ac.uk/weblogs/pathfinder/

their pedagogic approach, including areas such as staff development and learner needs/skills.

1b. Improved pedagogies: specific pedagogic approaches

The e-learning and pedagogy programme commissioned a research study[98] which categorised pedagogic models under three broad approaches: associative, constructive and situative. Pedagogic features of these approaches have been explored[99] and mapped to specific technical requirements[100].

The JISC innovative practice in e-learning projects[101] and distributed e-learning projects[102] have demonstrated enhancements to a wide variety of pedagogic approaches. There is evidence, for example, that:
- social learning environments and collaboration tools can support peer learning and teamwork;
- Web 2.0 technologies such as wikis, social tagging, shared bookmarking and reviewing, can support shared knowledge-building and scholarly collaboration;
- Inquiry-based learning is enhanced by a range of e-learning technologies including web searches, bibliographic tools, databases and datasets.

Many advances in e-learning technology have been used to offer learners more choice about how they engage with the curriculum. It may not always be appropriate to think in terms of improved 'pedagogies' for learning, but rather in terms of improved opportunities to engage in learning, with learner needs and preferences in the driving seat. For these opportunities to be fully realised by learners, they require some new as well as many traditional learning skills.

2. Skillsets required by learners

The LearnHigher CETL[103], which supports learning skills across the HE curriculum, reports that *'learners need to acquire an increasingly complex range of skills for effective lifelong learning, including information literacy and e-learning skills'*. Although the 'net generation' of learners have generally high levels of internet usage, the 2007/08 JISC/MORI surveys of student expectations[104] found that there is still '*an urgent need for higher e-literacy skills among a generation for whom access and interaction are taken for granted'*. International studies reflect these findings.[105] [106] [107]

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[98] Mayes T and de Freitas S (2005):
http://www.jisc.ac.uk/uploaded_documents/Stage%202%20Learning%20Models%20(Version%201).pdf
[99] See http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_workshops/elp_session1.aspx
[100] See Wilson S (2005) 'Enter Pedagogy': http://www.elearning.ac.uk/features/pedagandws
[101] See http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_innov_casestudies.aspx
[102] See http://www.jisc.ac.uk/whatwedo/programmes/programme_edistributed/pilotsdetail.aspx and
http://www.jisc.ac.uk/whatwedo/programmes/programme_edistributed/etools2.aspx. All HE Academy Subject Centres (24) were involved in supporting the use of digitised resources with learners, thus providing a much needed discipline perspective.
[103] http://www.learnhigher.ac.uk
[104] http://www.jisc.ac.uk/news/stories/2008/06/greatexpectations.aspx
[105] Caroline Stern (2002) Information literacy unplugged: teaching information literacy without technology. White paper prepared for UNESCO, the US NCLIS and National Forum for Information Literacy. (http://www.nclis.gov/libinter/)
[106] Louise Limberg(2000) Information Literacy Around the World
[107] Rader HB (2002) Information literacy –an emerging global priority. White paper prepared for UNESCO, the US NCLIS and National Forum for Information Literacy (http://www.nclis.gov/libinter/)

UK employers find it difficult to recruit graduates with the attributes they need and expect[108], for example problem solving, high-level communication skills, creative thinking and teamwork and many of these skills are relevant in a new way to online work. The JISC has recently funded an investigative study of 'learning literacies for the digital age' and the impact of different types of provision in UK HE[109].

The JISC Learners Experiences of e-Learning[110] programme has found that 'effective' e-learners:

- use what they have to hand (e.g. mobile phones, ipods) to engage with the curriculum;
- use their personal technologies, know-how and networks to enhance the support available through their institution;
- are adept at multi-tasking.

However, findings from these projects also suggest that most learners look to their institution to help them develop the skills of discovering, evaluating and using information in academic contexts, and of using technologies to support deep learning goals. This programme has evolved a model of development[111] in which learners progress from access through functional skills to personal strategies with technology, and finally to a form of internalisation whereby technologies are used as extensions of the learner's personal intentions and motives to learn. Other accounts of the 'literacies of the digital'[112] confirm that critical, evaluative and reflective skills are coming to prominence after several decades of focus on technical ICT competence. These skills are best acquired if they are integrated into curricula and practiced in ways which are relevant to learners' subject interests and long-term learning goals.

3. Skillsets required by teachers

The JISC does not directly support accredited staff development but evaluations of all the recent JISC-funded development programmes find that high level staff skills are essential if institutions are to maximise the potential of e-learning developments.

Professional development for teaching staff is accredited by, the HE Academy, the Staff and Educational Development Association (SEDA)[113]and the Association for Learning Technology (ALT)[114].

The HE Academy supports and enhances institutional provision of professional development by working with institutions and then accrediting their provision in line with the *UK Professional Standards Framework (PSF) for teaching and supporting learning in HE*[115]. Through the 24 HE Academy Subject Centres[116], individual practitioners and academic departments are supported through a range of events and workshops. All Subject Centres are involved in supporting teachers to use e-learning within the context of their own discipline and within a wider learning, teaching and assessment context.

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[108] Archer, W and Davidson, J (CIHE, 2008)
http://www.eu.nl/education/policies/educ/business/doc/graduate_en.pdf
[109] http://www.jisc.ac.uk/fundingopportunities/funding_calls/2008/05/learningliteracies.aspx
[110] http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_learnerexperience.aspx
[111] Sharpe R and Beetham H (2008)
[112] See for example Martin, A and Madigan, D (2006) Digital Literacies for Learning.
[113] http://www.seda.ac.uk/pdf/31%20Embedding%20Learning%20Technologies2.htm
[114] http://www.alt.ac.uk/docs/cmalt-prospectusv4.pdf
[115] http://www.heacademy.ac.uk/ourwork/institutions/accreditation
[116] http://www.heacademy.ac.uk/ourwork/networks/subjectcentres

Innovation in the education vertical is so very important. We want our students to love learning, we need them to! By being innovativeâ€"whether itâ€™s through incorporating STEAM projects, or building a 3 to PhD(R) community that truly addresses the whole childâ€"we can engage students in ways we never have before, and thatâ€™s pretty incredible. Earlier this year, we ran a giveaway on our public Facebook page for educators (and in a private group with students and alumni) with new school supplies up for grabs. To enter, Concordia students, alumni, and Facebook visitors had to answer one of two quest OTH on-line (online journal from UNC Horizon) Online. Pedagogy Journal Online Submissions. Personnel and Guidance Journal. Research in Higher Education Online Submissions. Review of Educational Research Online Submissions. Review of Higher Education Online Submissions.Â Innovations in Teaching and Learning in Information and Computer Sciences Online Submissions. Journal of Computing in Higher Education Online Submissions. Journal on Educational Resources in Computing Online Submissions. Mathematics and Computer Education Online Submissions.