AQUA-TNET

Education and Culture
Lifelong Learning Programme
ERASMUS

Workpackage 5 Report

Innovation in aquaculture teaching and learning

AQUA-TNET is the European thematic network in the field of aquaculture, fisheries and aquatic resources management. The network is funded under the European Commission Socrates Erasmus programme, from 2005-2008

www.aquatnet.com

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Latest version at:
https://docs.google.com/document/d/13FHnQXTmdfRtm1UAugxPW50gtkjAd7xmwbGi7ZsPvBs/pub

For additional links see https://groups.diigo.com/group/aqua-tnet

Workpackage 5 group members and report contributors

John Bostock (Workpackage leader), *University of Stirling, UK*
Stefan Oli Steingrimsson, *Hólar University College, Iceland*
Juhani Pirhonen, *University of Jyväskylä, Finland*
Jaime Fernández-Borrás, *Univ. Barcelona, Spain*
Bent Rønsholdt, *Aalborg University, Denmark*
Jean Dhont, *Ghent University, Belgium*
Jose de Lara Rey, *Technical University of Madrid, Spain*
Michael Kirby Moulton, *Norwegian University of Life Sciences, Norway*
Anders Kiessling, *Norwegian University of Life Sciences, Norway*
Bernd Ueberschaer, *Leibniz-Institut für Meereswissenschaften, Germany*

Contents

GLOSSARY

ADL - Advanced Distributed Learning
CAM - Content Aggregation Model
EML - Educational Modelling Language
GPS - Global Positioning System
IEEE - Institute of Electrical and Electronic Engineers
IMS - Instructional Management System
LD - Learning Design (IMS Specification)
LMS - Learning Management System
LOM - Learning Object Metadata
LOR - Learning Object Repository
OECD - Organisation for Economic Co-operation and Development
OER - Open Educational Resources
RIO - Reusable Information Object
RLO - Reusable Learning Object
RTE - Run-Time Environment
SCO - Sharable Content Object
SCORM - Sharable Content Object Reference Model
TEL - Technology Enhanced Learning
UoL - Unit of Learning
UoS - Unit of Study
XML - eXtensible Markup Language

1. Introduction and background

This report has been prepared by the Workpackage 5 working group on innovation in learning. It aims to summarise the main findings of the group, and serve as an introduction to the topic for teachers and learners in aquaculture and aquatic resources management.

The main focus of the group is the use of Information and Communications Technologies (ICT) in teaching and learning. The increasing power of computers and particularly their interconnections through the Internet, is changing the social and economic landscape and presenting new opportunities and challenges for learners, educators and academic institutions. This document has been developed from presentations and discussions between the group members. It aims to identify the key technologies and trends affecting higher education in Europe and potential responses by the aquaculture and aquatic resource community.

The aim is to briefly introduce key themes, technologies and state of the art. Most of the topics can be explored in much greater detail through the Internet links that are provided at the end of each section.

2. Changing landscape of European higher education

2.1 European policies

Globalisation is one of the dominant economic trends, impacting massively on the European manufacturing industry, and transforming many types of primary production. It is also changing markets and the relative value of many goods and services. The European Union response is encapsulated in the Lisbon Strategy, formulated in 2000 with the aim of turning Europe into the most competitive and dynamic knowledge economy by 2010. Reform and development of the education and training sector forms a central part of this strategy. Indeed, the higher education sector itself is globalising with greater mobility of students and many universities establishing overseas campuses. Some of the key elements of EU policy are dealt with in detail by other Aqua-TNET workpackages, including the Bologna Process (for developing the European Higher Education Area) and the Tuning Project (which addresses several specific Bologna Process action lines). These integrate with other initiatives, including the Copenhagen Process (dealing with vocational education and training), and the European Research Area. This policy push accompanies and enables an already evident trend for students to be more mobile, for instance through the Europass Scheme and European Credit Transfer System. Competition between universities is also evident in the increasing consolidation of research expertise, narrowing the range of subjects taught by many of the smaller European universities.

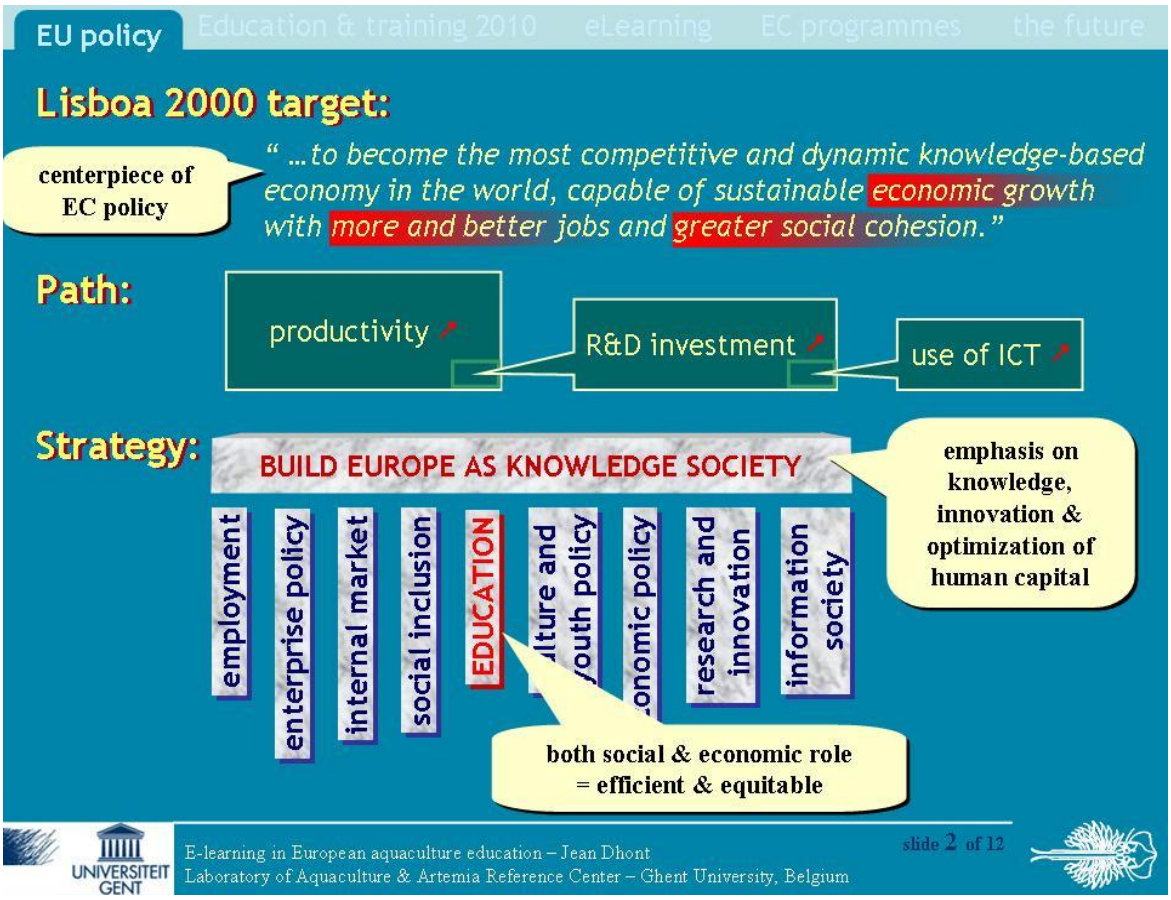


Figure 1: The role of education in the Lisbon Agenda (Slide from Jean Dhont presentation)

Of particular relevance to Aqua-TNET Workpackage 5, is the way in which education is now framed within a wider policy of support for lifelong learning. This encourages wider access to education and places new emphasis on the value and role of informal and non-formal learning, especially in the context of continuing adult education. Informal learning is generally understood as the day to day accumulation of knowledge from diffuse sources, whilst non-formal learning is through structured learning activities that are not certificated in any way. There is a growing impetus for formal recognition of informal and non-formal learning, e.g. through OECD and EU programmes. Of particular relevance here is the WAVE Project for validating experience in aquaculture.

2.2 Development of the Internet

The development of the Internet is fueling these developments, making access to information much easier and cheaper, and providing new channels for delivering formal and non-formal learning. The opportunities for higher education institutions to use the Internet to reach out to both on-campus and a wider constituency of off-campus students are explored in the next section. However, the Internet cannot simply be seen as a new platform for delivering distance learning, or reducing the need for libraries full of books and journals; it is also a disruptive technology, with new tools (broadly labelled as Web 2.0) for "social networking". Almost anyone now can publish their thoughts, opinions, photographs, videos and knowledge to a global audience without having to go through the traditional editorial gatekeepers (from academic peer-reviewed journals through newspapers and publishers to broadcasting companies). The potential dangers in this are well argued by Andrew Keen in his book "The cult of the amateur", where it is argued that quality is at best diluted, and perhaps eroded altogether. This is countered by arguments that the technology is delivering real democracy and freedom of speech, and that community knowledge can be more accurate and valid than that of a single "expert". The success of Wikipedia, a global encyclopedia to which anyone can contribute, is cited as evidence of the power of this approach. Closely related to this is the view that everyone has a right to learn and that anything that widens access should be promoted. Of particular relevance to European universities is the growing movement for Open Educational Resources (OER). An increasing number of educational institutions, individuals and other organisations are making teaching and learning materials freely available on the Internet. The extent and rationale for this has recently been reviewed by the OECD ("Giving knowledge for free"). The Wikimedia Foundation (parent of Wikipedia) for instance has launched Wikiversity. In the same way that open source software has challenged the business model of commercial software companies, the OER movement challenges the approach of many traditional educational institutions. However, the benefits of open sharing are significant, and explored further in Sections 4 (technical considerations) and 5 (trends and drivers).

2.3 Challenges for higher education

In different ways therefore, the traditional roles of higher education (setting aside the key issue of research for the moment) are being challenged. For instance the role of teaching/tutoring may be substituted by more peer-to-peer interactions through social networking (see the following section which includes discussion of learning as a social process). The role of academic institutions as guardians and delivers of knowledge (through lectures and library collections) is challenged not only by the open-access movement discussed above, but also the increasing volume of user-generated materials available.

Finally, the role of intuitions as setters and validators of standards in education, is challenged through increasing internationalisation of standards and the development of validation systems that do not equate qualifications with having undertaken formal courses. It may be that current institutional models will become increasingly unsustainable, and both institutions and individual lecturers will have to re-evaluate their role, the value they can add, and how their activities can be financially rewarded. Nevertheless, EC policy stresses the importance of higher educational institutions, seeing them as a critical partners in bringing about the knowledge driven society envisaged by the Lisbon Declaration. The identified challenges can therefore be seen as opportunities for change and development, and the Aqua-TNET project an important first step along the road for the aquaculture and aquatic resources sector.

At the technology level, it is the continuing development of information and communications technologies that underpin the changes and challenges identified. The group has therefore focused attention both on how the technologies work, and how they can be best employed to further the aims of aquaculture teaching and learning.

Further information

Presentation on EC policies and initiatives to promote innovations in teaching and learning (Jean Dhont) http://www.aquatnet.com/client/files/WP5DhontEUPolicyE-learningGent06.pdf
Presentation on lifelong learning (Juhani Pirhonen) http://www.aquatnet.com/client/files/WP5PirhonenLifelongLearningBarcelona07.pdf
Bologna in a Global Context (Prof. Brenda Gourley, UK Open University Address) - http://www.open.ac.uk/vice-chancellor/Speeches_3a00_Publications/Speech/Bologna_in_a_Global_Context.html
European Commission glossary page on the Lisbon Strategy - http://europa.eu/scadplus/glossary/lisbon_strategy_en.htm
European Commission Home Page on Higher Education Policy - http://ec.europa.eu/education/policies/educ/higher/higher_en.html
European Commission Lifelong Learning Programme - http://ec.europa.eu/education/programmes/llp/index_en.html
EC JRC IPTS - School's over: Learning spaces in Europe 2020: An imagining exercise on the future of learning - http://ftp.jrc.es/EURdoc/JRC47412.pdf
OECD Report: Giving Knowledge for Free - http://www.oecd.org/document/41/0,3343,en_2649_37455_38659497_1_1_1_37455,00.html
David Wiley arguing for open access to learning materials - http://opencontent.org//docs/teachers_claim.html
New Media Consortium - http://www.nmc.org/

3. Application of ICT to teaching and learning

3.1 Pedagogical context

All teachers will be familiar with the study and practice of Pedagogy (science of teaching, or correct use of teaching strategies), although for university-based research lecturers, considerations of method are often secondary to the question of subject content. Teaching approaches are often well established and changing these can be difficult, with resistance from other lecturers, course administrators and students alike. However, discussions within the Aqua-TNET workpackage 5 workgroup have repeatedly concluded that any application of ICT in teaching and learning must be based on good pedagogical principles for them to be successful. A common approach is to start with a clear definition of expected "learning outcomes", and then determine an appropriate mix of activities that will enable the learners to reach these outcomes. The framing of these learning outcomes is therefore critical and "Bloom's Taxonomy" is often used; For instance is there an expectation that students will be able to:

- remember ....
- demonstrate knowledge of .....
- explain....
- critically assess....
- do ....
- apply

etc.

For e-Learning aimed at adults, many tutors are adopting a pedagogy based on the constructivist theory of learning. This asserts that people learn actively, building knowledge by assimilating new information and ideas and then reconstructing their understanding and mental models. Emphasis moves away from remembering facts to developing skills for analysis, away from delivering teaching, to coaching learning. This approach values what the learner already knows and takes into account that the adult learner will have clearer learning objectives - a reason for learning so as to be able to reach specific goals. They are more likely to be self-motivated and follow specific interests. The importance of reformulating, presenting and debating is emphasised to help with the process of analysis and the deepening of understanding. However, this is not to suggest that other modes of learning should not be considered and used. The following figure summarises three modes that are commonly used in training and education.

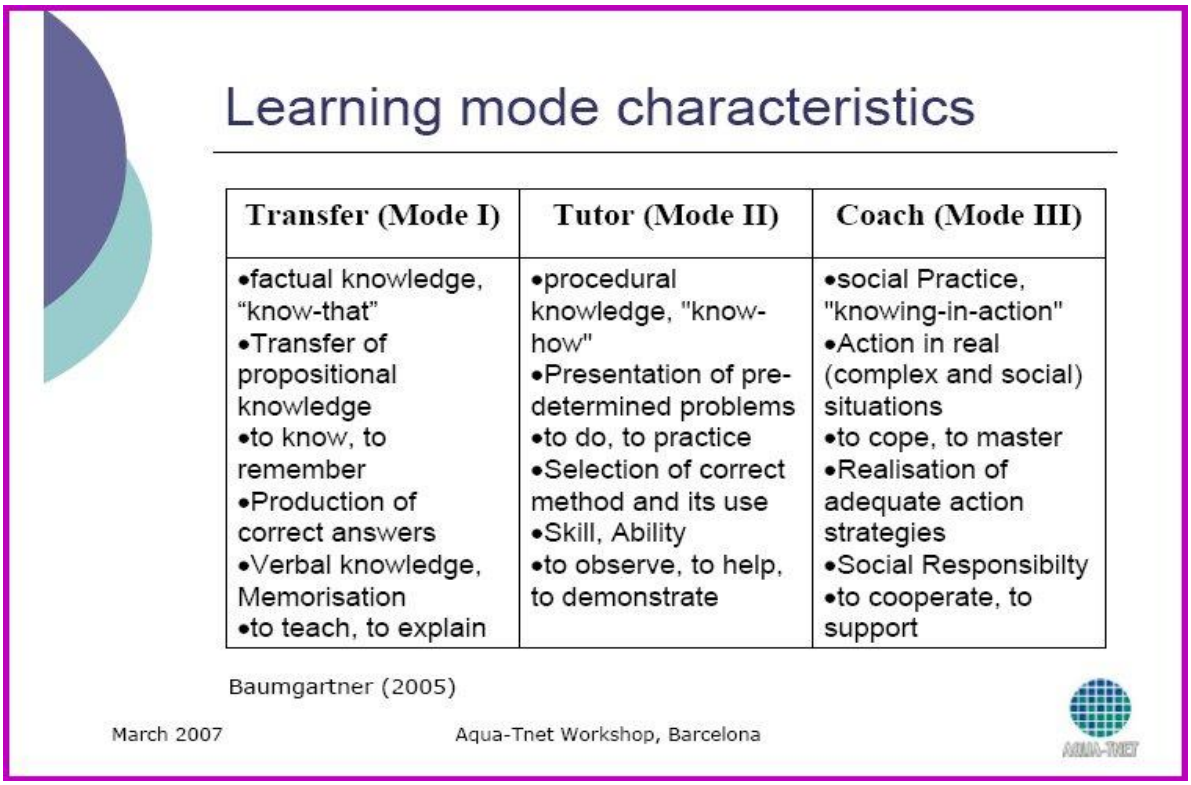


Figure 2: Three approaches to teaching and learning commonly used in training and education

Mode 1 teaching is characteristic of traditional "learn by rote" approaches where the teacher delivers knowledge for the student to absorb. Mode 2 teaching emphasises the development of skills and abilities and characterises the approach used in many vocational training courses. Mode 3 is more characteristic of modern education, moving away from students having programmed responses to having the skills to solve new problems and take responsibility for their own learning.

Account also needs to be taken of different learning styles. In part, this is determined by cultural traditions and conventions. the key works has been that of Hofstede (1991 & 97; cited in Tylee) who defined five cultural aspects of eLearning:

Table 1: Cultural dimensions of learning styles

Dimension	***Characterisation***	***UK Index***	***Germany Index***	***USA Index***	***Japan index***
Power-distance (PDI)	The differences in hierarchy between cultures – e.g. the accessibility of tutors to students, the degree to which students are expected to question the material presented to them by tutors	35	35	40	54
Individualism versus collectivism	Cultural differences with respect to collaborative work – e.g. the degree to which students prioritise their own academic progress or the collective good	89	67	91	46

Dimension	*Characterisation*	*UK Index*	*Germany Index*	*USA Index*	*Japan index*
(IDV)	of the class. In the eLearning environment it could influence student expectations with respect to learning through one-to-one relationship with the tutor, or through collaboration in a group				
Masculinity versus femininity (MAS)	The importance of gender roles in different cultures – the way that may influence student expectations and interactions	66	66	62	95
Uncertainty avoidance (UAI)	The importance of structure and certainty – some cultures will be used to a highly regulated learning environment, whilst others encourage a looser, multi-tasking approach.	35	65	46	92
Long-term versus short-term time orientation (LTO)	The degree to which different cultures focus on long or short-term benefits – e.g. whether students focus more on the most recent assessment, or longer-term objectives.	25	31	29	80

This in part explains why a teaching approach may work well in Europe, but prove unsuccessful in Asia, or vice versa. Differences are also found between European Countries. An interactive tool for comparing between a home and host culture is available at http://www.geert-hofstede.com/hofstede_dimensions.php. For instance, comparing Sweden and Greece there are substantial differences in most scores:

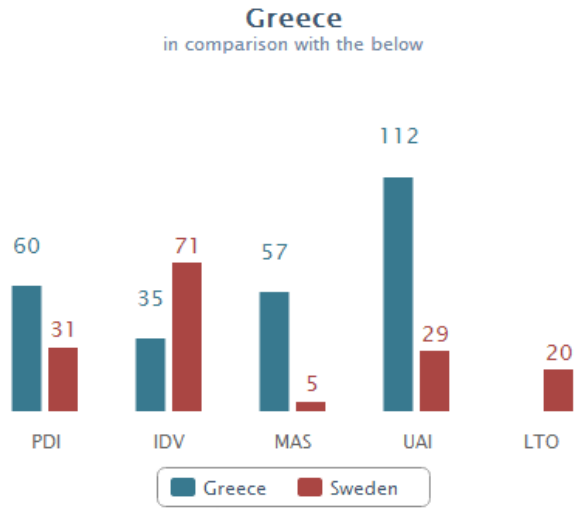


Figure 3: Example cultural comparison between Sweden and Greece (see table above for key to abbreviations)

Another classical analysis of learning modes is that of Kolb (1976, cited in Cornelius, 2001):

Table 2: Different learner types

Learning mode	**Characteristics**
Active learners	Learn by trial and error, tend to be impatient and want to do things by themselves rather than wait to be told how to do things. Tend to give spontaneous answers and to quickly move onto something new.
Reflective learners	Tend to adopt a "wait and see" approach; try to think things through and do not answer quickly, but require more information; Can be uncertain about what to do, so tend to confer with others
Experimental learners	Seek to find new ways of doing things; want to quickly put new learning into practice; can be impatient and take short cuts in solving problems; new challenges are seen as possibilities for learning
Theorising learners	Try to build an all-encompassing logical system and make coherent pictures of complex situations; Will adopt a critical approach and try to detach themselves from emotions and personal opinions in reaching the truth

Most student groups will include people who tend towards each of these modes, so designing teaching programmes to involve each approach is one of the keys to success. Salmon (2000, cited in Cornelius, 2001) applied this analysis to the context of online tutoring, suggesting that asynchronous text-based communication can be used for all these styles as the active learners will tend to keep group momentum whilst reflective and theorising learners will have the opportunity to reflect on and structure their responses. However, additional opportunities may need to be provided for experimental learners to apply and test their new knowledge. Managing different learner approaches within a single course has always demanded considerable skill and effort on the part of tutors!

Gardner (1983, cited in Cornelius, 2001) goes on to identify seven types of intelligence affecting learning styles:

Table 3: Types of intelligence

Type	**Characteristics**
Verbal intelligence	Learners have the ability to use words (orally or written) effectively
Spatial intelligence	Learners have the ability to perceive the world accurately
Musical intelligence	Learners have the ability to work with musical forms
Logical (mathematical) intelligence	Learners can use numbers effectively and reason well

Bodily-Kinaesthetic intelligence	Learners use their body to express ideas and feelings they are likely to be “good with their hands”
Interpersonal intelligence	Learners can perceive and make distinctions in the moods, motivation and feelings of others
Intrapersonal intelligence	Learners have a good level of self-knowledge and can act on the basis of that knowledge

These categories have been simplified and varied by subsequent authors, most simply by Lockitt (1977, cited in Cornelius, 2001) who considered three main categories relating to the senses:

- auditory – using words and sounds for learning
- visual – visualising images during learning
- kinaesthetic – feeling and doing things in order to learn

Each learner will combine these in different degrees. Cultural influences will be only one factor, but for instance many cultures with traditionally low literacy rates have excellent auditory/verbal intelligence. Arguably, visual and kinaesthetic intelligence is likely to be increasingly important as younger people are raised with computer games and learning through video (e.g. documentary) materials. This is undoubtedly a challenge for higher education where budgetary/resource constraints and tutor competences are likely to lead to a continued emphasis on text-mediated learning for the next few years. For the long-term however, much greater use of interactive audio and video media must be anticipated to access a wider range of sensory and perceptory channels.

Building courses that provide a range of learning tracks using alternative resources and approaches to suit different learning styles has become the target of some e-Tutors. The ultimate goal here is "personalised learning" courses that are effectively constructed based on the needs of each student, rather than the "one size fits all" approach of traditional classroom teaching. The closely related term "individualized learning" tends to be used for computer-based learning that is customized to each student, but delivered individually. Personalised learning can and should still involve a good deal of student to student and student-tutor contact.

Whilst personalised learning places greater emphasis on the needs of students, tutors still more or less retain control of the learning process. Some educators argue that to fully embrace the principles of constructivism, especially for mature learners, it is necessary to adopt "student centred learning", where control of the learning, and even assessment process, is handed over to the students, and the tutors become "collaborators in learning". Wikipedia describes the characteristics of student centred learning as follows:

- Students are active participants in their learning
- Students make decisions about what they will learn and how
- Students construct new knowledge and skills by building on their current knowledge and skills
- Students understand expectations and are encouraged to use self-assessment measures
- Students work in collaboration with other learners
- Students work demonstrates authentic learning

- Teachers recognize different learning styles
- Teachers help students work through difficulties by asking open-ended questions to guide the student so that they arrive at a conclusion or solution that is satisfactory to them
- Learning is an active search for meaning by the learner;-constructing knowledge rather than passively receiving it, shaping as well as being shaped by experiences
- Students monitor their own learning, to understand how knowledge is acquired, and to develop strategies for learning
- Students are intrinsically motivated to reach goals they have set for themselves
- Students make decisions about group membership; who they will work with and how

Whilst student centred learning theory has much support, it is less common to find it fully implemented. An intermediate approach that is more widely adopted is that of "problem based learning" (PBL) these are often discrete exercises or units where students can be challenged with an open-ended problem which they have to try to solve. Group work is common, and the tutor acts as a resource person and facilitator rather than direct provider of knowledge. PBL shares many of the same principles as student based learning, but can be more easily integrated into traditional teaching structures and approaches, and can also be effectively used in e-Learning. Whilst many tutors use PBL to some extent, Republic Polytechnic in Singapore has adopted the more radical approach of using the methodology as the basis for all their courses.

A further variation of self-directed learning is the concept of "learning swarms/clusters" or the related, but usually more persistent "Communities of Practice". These concepts move away from that of fixed courses, and build education, particularly adult (lifelong) learning, around groups of people coming together with a shared interest for a specific topic or issue.

Further information

Presentation on the pedagogy of eLearning (Bent Rønsholdt) http://www.aquatnet.com/client/files/WP5RonsholdtE-learningPedagogyGent06.pdf
Using Learning outcomes (European review) - http://www.scotland.gov.uk/Publications/2004/09/19908/42704
Revised Bloom's Taxonomy - http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy
Article by Brenda Mergel on Instructional Design and Learning Theory - http://www.usask.ca/education/coursework/802papers/mergel/brenda.htm
EC JRC IPTS - ICT for Learning, Innovation and Creativity - http://ftp.jrc.es/EURdoc/JRC48707.TN.pdf + review of the impact of ICT in learning - http://ftp.jrc.es/EURdoc/JRC47246.TN.pdf
EC JRC IPTS - Digital competence for lifelong learning - http://ftp.jrc.es/EURdoc/JRC48708.TN.pdf
Cornelius, S (2001). Learning Online: Model and Styles. Chapter 1 in Higgison, C (Ed) Online Tutoring e-Book. Online Tutoring Skills Project (OTiS) - http://otis.scotcit.ac.uk/onlinebook/
Kathy Sierra blog on learning theory - http://headrush.typepad.com/creating_passionate_users/2006/01/crash_course_in.html
Quick check list of learning theories - http://www.bbk.ac.uk/ccs/elearn/teach_and_learn_models.htm
Primer on Learning Theories from Brookes University -

http://www.brookes.ac.uk/services/ocsd/2_learntch/theories.html
Tylee, J - Cultural issues and the online environment - www.csu.edu.au/division/landt/resources/documents/cultural_issues.pdf
Wikipedia entry on student centred learning - http://en.wikipedia.org/wiki/Student-centered_learning
Wikipedia entry on problem based learning - http://en.wikipedia.org/wiki/Problem-based_learning
Wilhelm - Cultural factors in the design of online learning - http://kn.open.ac.uk/public/getfile.cfm?documentfileid=2673
Wenger, E. 1998 - Communities of Practice; Learning as a social system - http://www.co-i-l.com/coil/knowledge-garden/cop/lss.shtml
Communities of Practice literature review - http://www.tcd.ie/CAPSL/academic_practice/pdfdocs/Couros_2003.pdf
EC Information Society Technologies Project "Palette" on Technology Enhanced Communities of Practice - http://palette.ercim.org/

3.2 e-learning

e-Learning is now widely understood as any type of education carried out over the Internet, although it can also include other types of computer-based learning or computer-based instruction. The use of computing and information technology is a central element, although most e-Tutors and e-Learners would probably agree that the focus must be learning processes and content rather than the means through which it is delivered. e-Learning can be used alongside more conventional face-to-face learning (as discussed below in "blended learning"). It can also be used to deliver courses at a distance, which tends to be of particular interest to adult learners who do not have the time and opportunity to study full time at a college.

There were great expectations for e-Learning in the late 1990s and early 2000s, but several high-profile failures, such as the UK e-University initiative which collapsed after an investment of £62 million (approximately €90 million). An e-Learning venture between the UK University of Oxford and US Stanford and Yale Universities also collapsed in 2006 due to lack of students (see http://education.guardian.co.uk/elearning/story/0,,1735137,00.html). The hope of some institutions that e-Learning would be a cheaper means of delivering learning proved to be very misguided as it was realised that tutor time per student needs to be higher, and in many cases, substantial investment in adapting materials for online delivery is also required. e-Learning students also quickly realised that the flexibility to learn anytime was of little benefit if in reality they had little time to spend on it. More importantly however, the e-Learning experience was too often isolated and dispiriting, lacking the important social elements of community endeavour, mutual support, encouragement, debate and competition. The phrase "learning is a social process" became popular, highlighting the importance of the personal interactions between students on a course and with their tutor(s).

To date, most e-Learning has relied on the use of bulletin-board style discussion forums (text-based) for student/tutor interactions. This has suited some students who feel confident expressing themselves in this way, but not for many others, who need greater immediacy and the feedback of body language and eye contact. The gradual introduction of

more video-conferencing may help, but perhaps students and tutors will also have to learn new communication skills and adapt to this new learning style. The pedagogy of the lecture theatre does not translate well to e-Learning, so new learning models are required. The increased use of computer conferencing systems by teenagers suggests that future generations of students may be more comfortable with e-Learning technologies. In the mean time, any e-Learning course should include ample time and activities for building the course social network and developing core e-Learning skills.

So far, there are relatively few E-learning courses available in aquaculture. In the Aqua-TNET survey of 26 European Higher Education establishments, 5 (19%) indicated they are offering credit bearing e-Learning courses and 4 (15%) are offering e-Learning short courses.

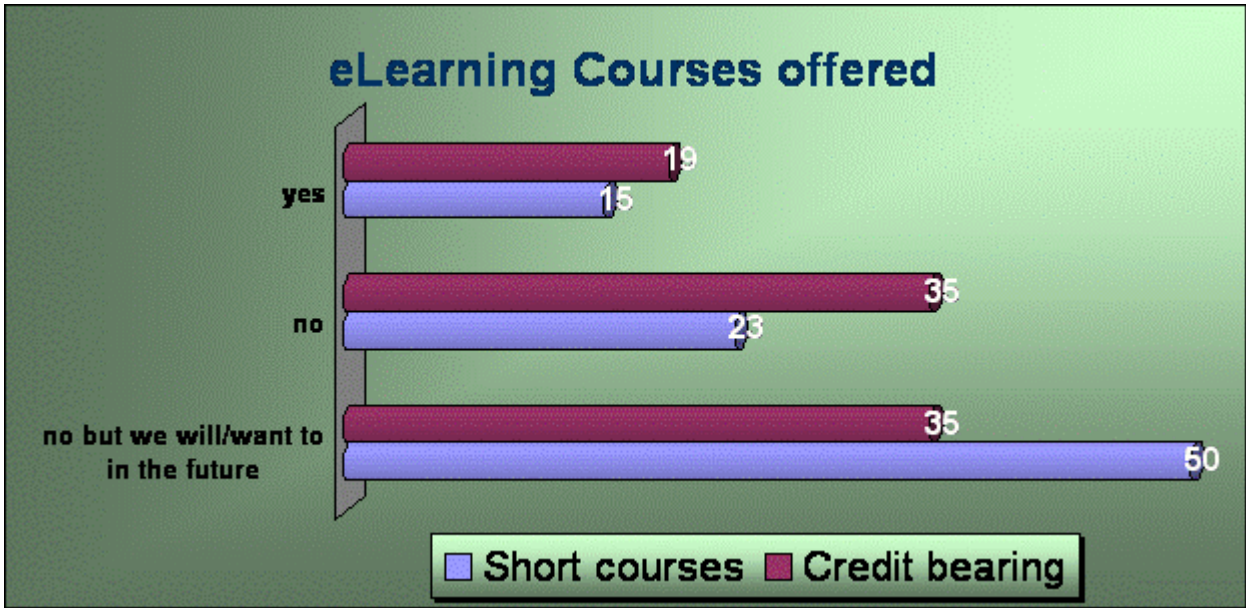


Figure 4: Results of the Aqua-TNET survey on provision of e-Learning by European Higher Education institutions involved in aquaculture teaching (Slide from John Bostock presentation, Barcelona 2007)

Steingrimsson (see link below) carried out a global survey by Internet in early 2007, and found 3 whole degrees offered through online learning, 10 credit-bearing courses, 3 short courses and 3 sets of supporting materials. However, from the information provided online, it was often difficult to obtain a clear understanding of the approaches that are used, the types of assessment or the degree of tutor contact. Much of the eLearning currently offered is actually blended learning (see below) combining some elements of traditional face-to-face teaching. Relevant examples include the NOVA project that links Nordic Universities teaching agriculture, veterinary studies and forestry. eLearning approaches are used to provide course units to students based at the different campuses. A part-time Masters Course in Aquatic Resources Development is run over the Internet as a continuing professional development course by the University of Stirling in collaboration with Bangladesh Agricultural University.

Further information

Experience of eLearning in Nordic Countries (Anders Kiessling) - http://www.aquatnet.com/client/files/WP5KiesslingCaseStudyE-learningGent06.pdf
Update on e-Learning (Stefan Oli Steingrimsson) - http://www.aquatnet.com/client/files/WP5SteingrímssonUpdateELearningAquacultureBarcelona07.pdf
Wikipedia entry on eLearning - http://en.wikipedia.org/wiki/Elearning
UK JISC Article on e-Learning Pedagogy - http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy.aspx
Learning Light E-Learning Centre (UK) - http://www.e-learningcentre.co.uk/
Scottish Online Tutoring e-Book- http://otis.scotcit.ac.uk/onlinebook/
UK Higher Education Funding Council Strategy for e-Learning - http://www.hefce.ac.uk/pubs/hefce/2005/05_12/
The Higher Education Academy - e-Learning - http://www.heacademy.ac.uk/ourwork/learning/elearning

3.3 M-learning

m-Learning, short for mobile-learning, is an emerging concept as people start to find ways of using the increasing range of electronic devices that we carry in pockets, handbags, on belts and round the neck. These are effectively microcomputers, often with wireless connections between each other or to the Internet. These include:

- mobile phones/smart phones
- personal digital assistants (PDAs)
- iPods, mp3 and video players
- blackberry devices
- hand-held computer games consoles

Increasingly these devices are merging, with smart phones capable of voice, text and video communications, playing audio and video files, displaying electronic books and running other software such as basic word processing, spreadsheets and games. An increasing number of devices are also including GPS functionality. They are generally significantly cheaper than laptop computers and are carried almost everywhere. Within an educational context, possible uses include:

- Access to learning materials any time any place - audio and even video "podcasts" can be downloaded and played at any convenient time; e-books can be downloaded and read, the Internet can be accessed and searched, quiz style programs can be used for self-assessment
- Facilitation of synchronous (real time) or asynchronous communications between students or with tutors; potential use in simulation exercises and for student support
- Delivery of administration and course management information to students
- Use by students to organise and journal their learning
- Use as a data capture device (photos, video, text, numeric etc.) for student research.

In Japan, a popular way of linking printed material with mobile technologies is the use of QR codes. These are 2-dimensional bar codes that can be included in any printed material, or displayed on a computer screen, that essentially provide either an Internet web link, an address book entry or an SMS message. Special software (e.g. Kaywa Reader) can be installed on most modern mobile camera phones so that when a user photographs the code, the instructions in the QR code, e.g. to connect to a mobile web site, are carried out. RFID (Radio Frequency Identification) chips is another technology that could be used for linking objects with online information without the need for cameras or optical scanners.

Figure 5: A QR Code for loading the Aqua-TNET web page

There are however several major challenges facing tutors interested in implementing m-learning technologies. Firstly, the considerable variation in capabilities between different devices, particularly with respect to size and resolution of display screens, means of text or data input and type of wireless connectivity (if any). Standard formats such as JPG pictures, PDF documents and MP3 sound files are quite widely supported, but more interactive programmes are likely to be restricted to particular software platforms. Some institutions have issued students with standard devices as a way round this problem. Many PDAs and smart phones now include wireless networking (WIFI), which can be reasonably cheap to implement in a University campus setting, but suffers limited availability of connections elsewhere (often requiring subscriptions to a variety of different service operators). 3G or GPRS phone technology is more widespread, and available through a single operator. However, at the present time it may be too expensive for substantive use. Bluetooth is another wireless technology available on many devices, but is limited to quite short-range communications and (at present) is too slow for video or other high-bandwith applications. Further considerations include security (possibility of viruses and other malware), increased risk to students if they are encouraged to use devices in public spaces, unauthorised distribution of materials by students or other misuse.

Further information

Presentation on m-Learning (John Bostock)
http://www.aquatnet.com/client/files/WP5BostockM-learningGent06.pdf
Wikipedia entry on m-Learning - http://en.wikipedia.org/wiki/M-learning
Alexander, B. 2004 - Going Nomadic: Mobile Learning in Higher Education - http://www.educause.edu/pub/er/erm04/erm0451.asp?bhcp=1
Wikipedia entry on QR codes - http://en.wikipedia.org/wiki/QR_Code
Semapedia (QR) tags - http://www.semapedia.org
Wireless Education and Training Centre - http://wetec.csumb.edu/site/x17154.xml

Ericsson Leonardo da Vinci project on m-Learning - http://learning.ericsson.net/mlearning2/index.shtml
Tribal CTAD m-Learning products - http://www.m-learning.org/
Mobilearn project - http://www.mobilearn.org/
RM Education Podcasts - http://www.rm.com/Generic.asp?cref=GP955644&srcurl=g_edulec
California Aquaculture Podcast - http://aqua.ucdavis.edu/Podcast/index.htm
The Podcast Directory - http://www.podcast.net/
Live video streaming from mobile to Internet - http://qik.com/

3.4 Blended learning

Blended learning is the combining of e-Learning, sometimes m-learning, and traditional face-to-face educational approaches. This is increasingly popular for a number of reasons:

- Perceived difficulties in e-Learning can be overcome whilst retaining some of the advantages of that approach
- Traditional taught courses can be broadened or made more flexible to suit students with different interests or abilities
- Teaching and learning resources are brought together in a more transparent way and provide institutions with greater control over their intellectual assets
- Economies may be found in material production and distribution
- Course management may be improved

One of the main drivers and facilitators of blended learning is the emergence of virtual learning environments (VLEs) or Learning Management Systems (LMS) - web-based systems for managing courses, delivering course materials and interacting with students. These are discussed in more detail in section 4.2, but are providing tutors and institutions with the technology for varying degrees of blended, through to full e-Learning courses.

As with e-learning, the combination of approaches used in blended learning should be driven by clear educational objectives and selection of best tools for achieving that. Students are quick to recognise when online tools are only being used to save on printing costs for instance. However, if they are used for more interactive content and making life easier for students living away from campus, they can be much appreciated.

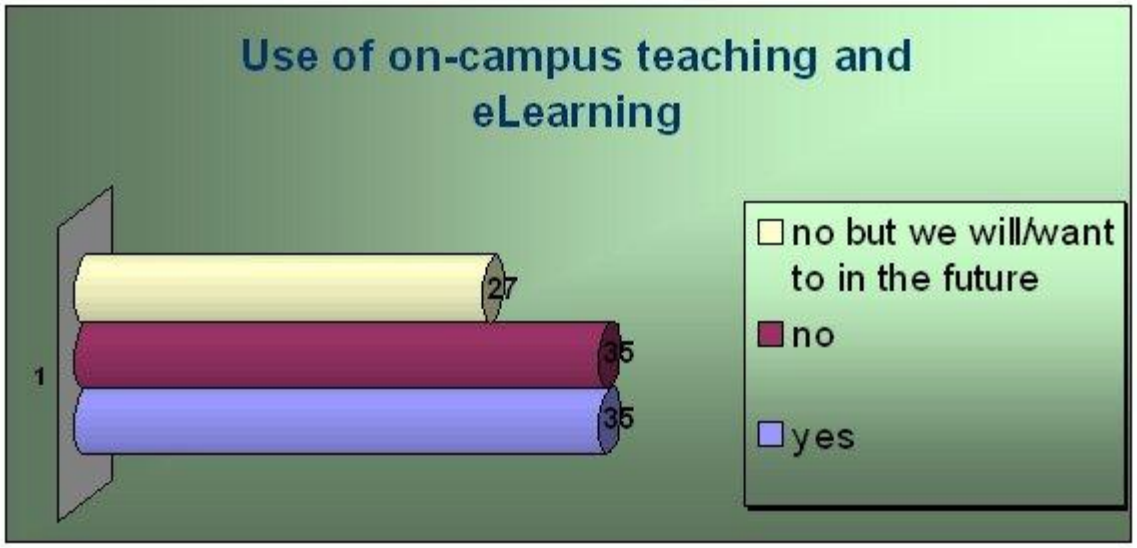


Figure 6: Blended learning is currently used by 35% of the respondents to our questionnaire

Another aspect of both eLearning and blended learning is that of accessibility for students with disabilities and learning difficulties. Legislation already exists in some countries to ensure that web site are accessible to people with disabilities, such as blindness. Higher Education Institutions are increasingly adopting policies and taking actions to ensure that they both comply with disability discrimination laws and have internal policies on teaching methods and materials that allow access for disabled students. Such policies may lead to stricter requirements in the future, including for instance a requirement for audio transcripts of lectures as well as text or other versions.

Further information

Wikipedia entry on blended learning - http://en.wikipedia.org/wiki/Blended_learning
Article on pedagogy for blended learning - http://www.ppecorino.com/Articles/PEDAGOGY-blended-instruction-primer.html
Europa eLearning Papers on blended learning - http://www.elearningpapers.eu/?page=home&vol=3
Blended Learning in training - http://www.trainingreference.co.uk/blended_learning/blended_learning.htm
Experiences of the NOVA project in Nordic Countries (Anders Kiessling) http://www.aquatnet.com/client/files/WP5KiesslingCaseStudyE-learningGent06.pdf

Web accessibility initiative - http://www.w3.org/WAI/
Open University: Inclusive Teaching - http://www.open.ac.uk/inclusiveteaching/pages/inclusive-teaching/index.php
University of Strathclyde Teachability web site - http://www.teachability.strath.ac.uk/

4. Technology tools

4.1 Introduction

In this section, we look in more detail at some of the technologies that are opening up new opportunities for teaching and learning. Our focus is very much on computers, mobile computing devices and the linking of these through computer networks. Essentially, these tools are providing new channels for communication, and access to unprecedented amounts of information. A commonly used term for this view on educational innovation is "Technology Enhanced Learning (TEL)". We have become used to computers becoming ever more powerful and at the same time cheaper, especially when measured by any unit of performance, or storage capacity. A modern mobile phone costing perhaps Euro 200 - 300 has considerably more computing power and data storage capacity than a a desktop computer costing Euro 2000 ten years ago, and there is little sign of a slowdown anytime soon. Many people will be downloading information from the Internet to home computers using broadband connections at rates that are between 400 and 5000 that which they experienced using dial-up modems ten years ago. Related devices such as video cameras are also evolving rapidly, from very bulky devices costing many hundreds of Euro to something that can be included in even quite slim and modestly priced mobile telephones. Meanwhile the quality that can be obtained from the larger more expensive models continues to rise.

As the technology evolves, it is becoming both financially more accessible, and in most cases, more user-friendly. Much of the increase in processing power is being used to improve the usability of computers and computing devices, e.g. through more intuitive graphical interfaces. Also important from the educational perspective is that the tools needed to create digital (computer-based) materials are also becoming more powerful and easier to use. Programs such as Microsoft PowerPoint are now almost ubiquitous, allowing tutors to quickly assemble material for class-based presentations to a standard that would have been considered astonishing 20 years ago. The use of digital video and audio is somewhat less common, but will almost certainly will increase as the tools for producing and editing good quality video become increasingly available and accessible.

We are still in the very early days of the digitisation of teaching materials and delivery, with a good deal of fragmentation between many different type of medium, systems and software standards. However, efforts are in place to facilitate increasing integration of learning materials and learning processes that should improve access to learning whilst reducing cost of delivery.

For the present there are a number of well established technologies and approaches for enhancing learning on or off-campus. These are examined in greater detail in the following sub-sections.

Further information

Principles and problems of collaboration between students, teachers and administrators (John Bostock)
[Part1] [Part 2]
EC Information Society Home Page on Technology-enhanced Learning - http://cordis.europa.eu/ist/telearn/index.html
European Association of Technology Enhanced Learning - http://www.ea-tel.eu/
Kaleidoscope network on technology enhanced learning - http://www.noe-kaleidoscope.org/pub/about/

4.2 Virtual learning environments

Virtual learning environments (VLEs) are essentially tools for creating and managing a web site for educational courses. They provide a content management system (CMS) that makes it easy for academic staff to upload and organise teaching materials, and tools such as e-mail and bulletin board forums for interaction with and between students. Other facilities vary, but most have tools for tutors to set and students to upload assignments, and they usually have course management tools for tracking student progress. Other terms in common usage include Learning Management System (LMS), Learning Content Management System (LCMS), Course Management System (CMS), or Managed Learning Environment (MLE). These all have slightly different focus, and overlap to varying degrees. The term MLE is promoted as including all information systems involved in the delivery and administration of learning.

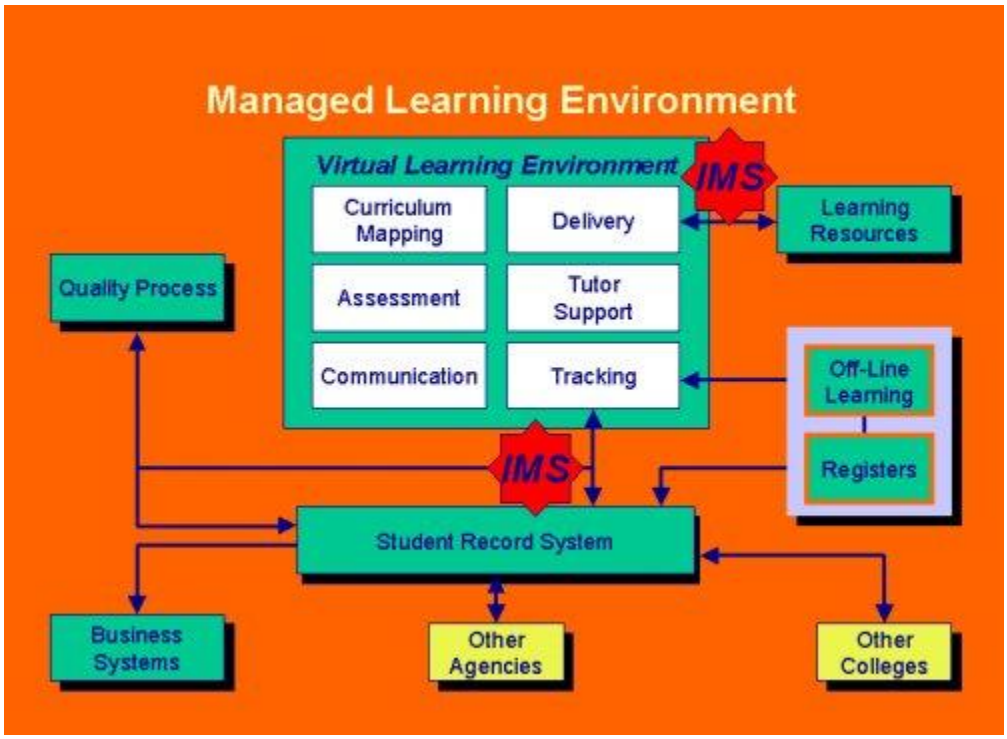


Figure 7: VLE and LMS as components of a MLE (Source http://www.jisc.ac.uk/uploaded_images/ACF18.jpg)

A VLE will normally have the following facilities (Adapted from Wikipedia):

- The syllabus for the course
- Administrative information including the location of sessions, details of pre-requisites and co-requisites, credit information, and how to get help
- A notice board for up-to-date course information
- Student registration and tracking facilities, if necessary with payment options
- Basic teaching materials. These may be the complete content of the course, if the VLE is being used in a distance learning context, or copies of visual aids used in lectures or other classes where it is being used to support a campus-based course.
- Tools for setting, submitting and marking assignments, and perhaps other web-based assessment facilities including quizzes and tests
- Additional resources, including reading materials, and links to outside resources in libraries and on the Internet.
- Electronic communication support including e-mail, threaded discussions and a chat room, with or without a moderator
- Other collaborative tools such as student and group pages for presenting work or sharing personal interests
- Differential access rights for instructors and students
- Production of documentation and statistics on the course in the format required for institutional administration and quality control
- Easy authoring tools for creating the necessary documents including the insertion of hyperlinks - though it is acceptable (arguably, preferable) for the VLE to be designed so that standard word processors or other office software can be used for authoring.
- Capable of supporting numerous courses, so that students and instructors in a given institution (and, indeed, across institutions) experience a consistent interface when moving from one course to another.

The more sophisticated VLEs link with institutions other management information systems, such as student record systems and computer services user management. Direct linkages between VLEs and library systems are also under development.

There are a number of commonly used terms to describe the structure of educational provision. These include Courses, Programmes, Electives, Modules, Units, Classes, Lectures, Practicals, Tutorials etc. They can be arranged in a hierarchy according to length of time or academic credit accumulated. For instance, an MSc course might for instance have 3 units, each consisting of 6 modules, which are made up from a selection of lectures, practicals and tutorials etc. Standardisation, not only of terminology, but also of the basic types of course component and the academic credits associated with them is underway, and is one of the issues being considered by Aqua-TNET workpackages 1 and 3. The issue is relevant in the case of VLEs, as they need to reflect the underlying course structure if they are to provide a truly useful one-stop solution to course delivery and management.

There are over 100 different VLE software packages available. Some are commercial, others are open-source, while others are custom-built by Higher Education IT departments. There is a gradual process of consolidation, particularly in the commercial sector, with some open-source packages also developing faster and gaining market share. In the UK, the use of VLEs has increased steadily during this decade, whilst the number of VLEs used by any one institution has decreased. This may partly be due to the general trend for consolidation, but also reflects the fact that IT and academic administrative departments are implementing institutional policies for VLE use and support.

Table 4: Use of VLEs by UK Higher Education Institutions 2001-2005

	UK Higher Education Institutions		
	2005	**2003**	**2001**
N =	85	102	75
Percent using VLEs	95%	86%	81%
No VLE	5%	14%	19%
Using One VLE	52%	36%	29%
Using Two VLEs	21%	32%	24%
Using Three VLEs	14%	10%	25%
Using Four VLEs	4%	5%	3%
Using Five VLEs	5%	1%	-
Using Six VLEs	-	2%	-

Source: http://www.ucisa.ac.uk/groups/tlig/vle

Whilst the survey of VLE use in UK Higher Education Institutions in 2005 found 95% of respondents were using at least one VLE, a survey of Aqua-TNET partners in 2006 found only 38% of respondents using VLEs, although 35% indicated that they expect to in the future.

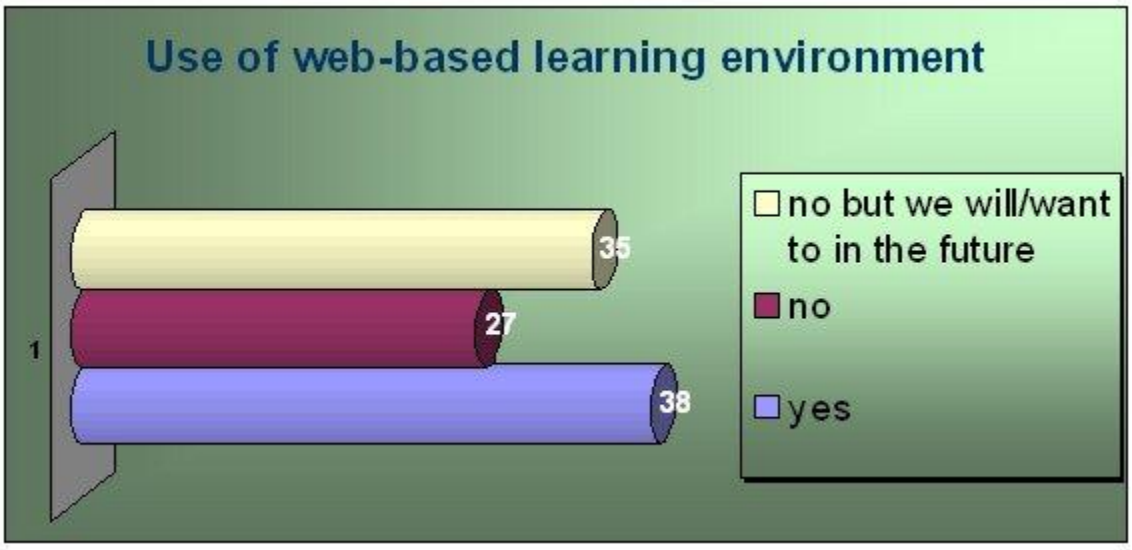


Figure 8: 38% of respondents to the Aqua-Tnet questionnaire are using a VLE, whilst a further 35% expect to do so in the future

In the UK Higher Education survey (2005) the commercial packages, WebCT and Blackboard were clear market leaders. These companies have now merged and the product lines are being rationalised under the Blackboard brand. The second most significant group are the custom-built VLEs. Open-source VLEs appear to be more popular in other European countries and are gaining ground in the UK. Leading examples include Moodle and Bodington. Some institutions are using more generic Intranet tools such as Lotus Domino or Microsoft Sharepoint.

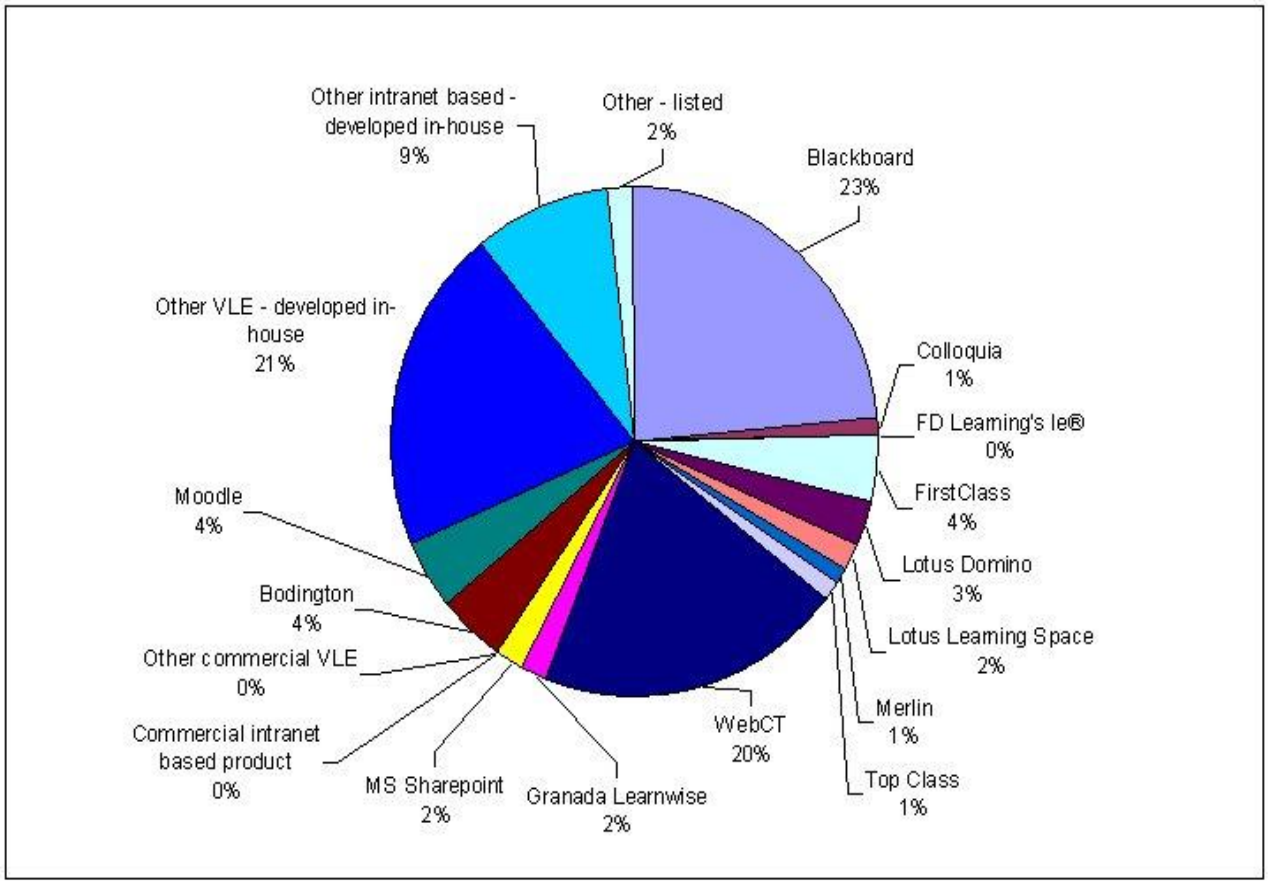


Figure 9: Use of VLEs in survey of UK Higher Education Institutions, 2005 (Source http://www.ucisa.ac.uk/groups/tlig/vle - note total percentage exceeds 100 as some institutions were using more than one VLE)

Respondents to the Aqua-TNET survey showed considerable diversity in products used. The most common (4 out of 10) being Moodle.

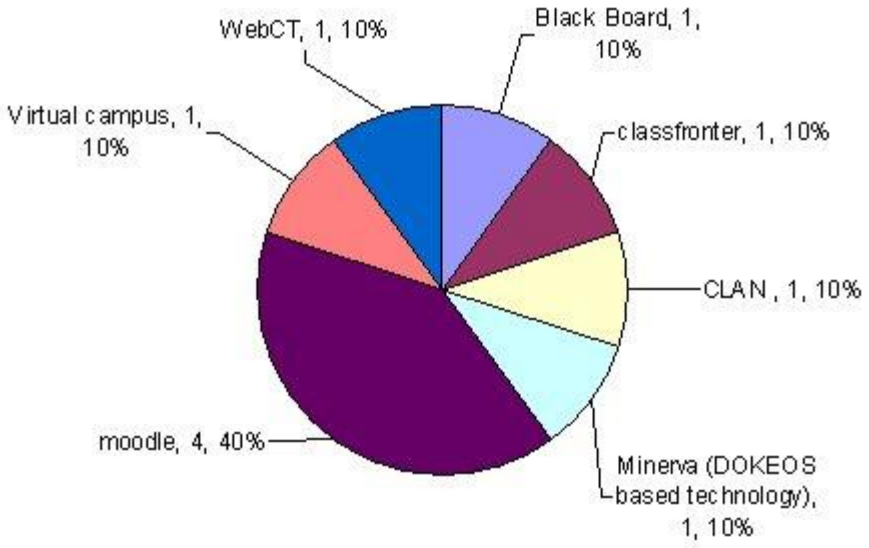


Figure 10: VLEs used by respondents to the Aqua-TNET questionnaire

VLEs offer web-based tools for delivering e-learning (distance learning), blended learning, or simply providing administrative tools and material support for conventional courses. The introduction of VLEs is perceived as bringing advantages with respect to improving transparency and enhancing efficiency of course delivery. However, current products are often criticized by both staff and students as not so user-friendly and in some respects imposing limitations on tutor initiative and creativity. Some students are also concerned that VLEs are being used to reduce face-to-face contact time with tutors and are passing on the cost of printing lecture notes onto the students.

Table 5: Benefits of VLEs

Potential benefits of VLEs - students	Potential benefits of VLEs - teachers/institutions
flexibility - anytime, anywhere access	flexible online creation and delivery of materials
gains in ICT, writing skills, and presentation skills	anytime anywhere support for student-teacher communication
development of strategic learning styles for students through collaborative working	new communication dimension - e-mail, chat, bulletin board - in addition to lecture theatre/lab
improved motivation and engagement for students	variety of ICT tools in one consistent interface
widened access to learning materials for diverse learners	sharing and re-use of resources
potential for self-testing	reduction in administration through integrated management information systems
	new testing and assessment methods
	enhanced consistency and uniformity of teaching across departments

Source: http://www.saradunn.net/VLEreport/section05.html

As VLEs become more complex and more widely used, a major consideration is the ease of moving materials and other course elements between packages. This is particularly an issue where departments from different institutions wish to collaborate on course delivery (such as European Masters Courses). Most leading packages are now compliant with one or more standards, particularly SCORM. The issue of standards is discussed in more detail in Section 4.9 below.

Further information

Wikipedia entry on Virtual Learning Environments - http://en.wikipedia.org/wiki/Virtual_learning_environment
Wikipedia entry on Learning Management Systems - http://en.wikipedia.org/wiki/Learning_management_system
UCISA/JISC survey (UK) of Virtual Learning Environments - http://www.ucisa.ac.uk/groups/tlig/vle
Moodle (Example of leading open source VLE) - http://moodle.org/
Bodington (Another open source VLE) - http://bodington.org/
Blackboard (Example of leading commercial VLE) - http://www.blackboard.com/europe/
JISC - MLEs and VLEs explained - (http://www.jisc.ac.uk/whatwedo/programmes/programme_buildmle_hefe/mle_lifelonglearning_info/mle_briefingpack/mle_briefings_1.aspx)
JISC - Article on effective use of VLEs http://www.jiscinfonet.ac.uk/InfoKits/effective-use-of-VLEs

4.3 Learning object repositories

All teachers build collections of teaching resources which they modify and re-use for different courses, or between teaching years. Teachers will also commonly share materials with their colleagues, either informally, or formally as required by institutional policies and practices. However, for most teachers, especially in universities, that sharing has limits. Teaching materials are considered to be the intellectual property of the teacher, or of his or her employers, and therefore not for sharing without adequate financial compensation or other reciprocal benefit.

From an institutional viewpoint, and even more so from a national viewpoint, a huge amount of financial and time resource is spent by teachers developing and modifying teaching materials, often with a great deal of duplication, especially in basic subject areas taught at degree level. Surely the advent of computers and the Internet should create opportunities for improving the efficiency and productivity of teachers?

Learning object repositories (LORs) are an important part of the emerging solution. Learning objects are defined in various ways, but of primary interest here are those that are in digital format (i.e. computer files including documents, spreadsheets, graphics, video, audio and programs etc.). Learning objects are any building block of teaching materials, ranging from a single graphic image, to a full set of materials to teach a specific topic. The "granularity" of learning objects is shown in the following illustration.

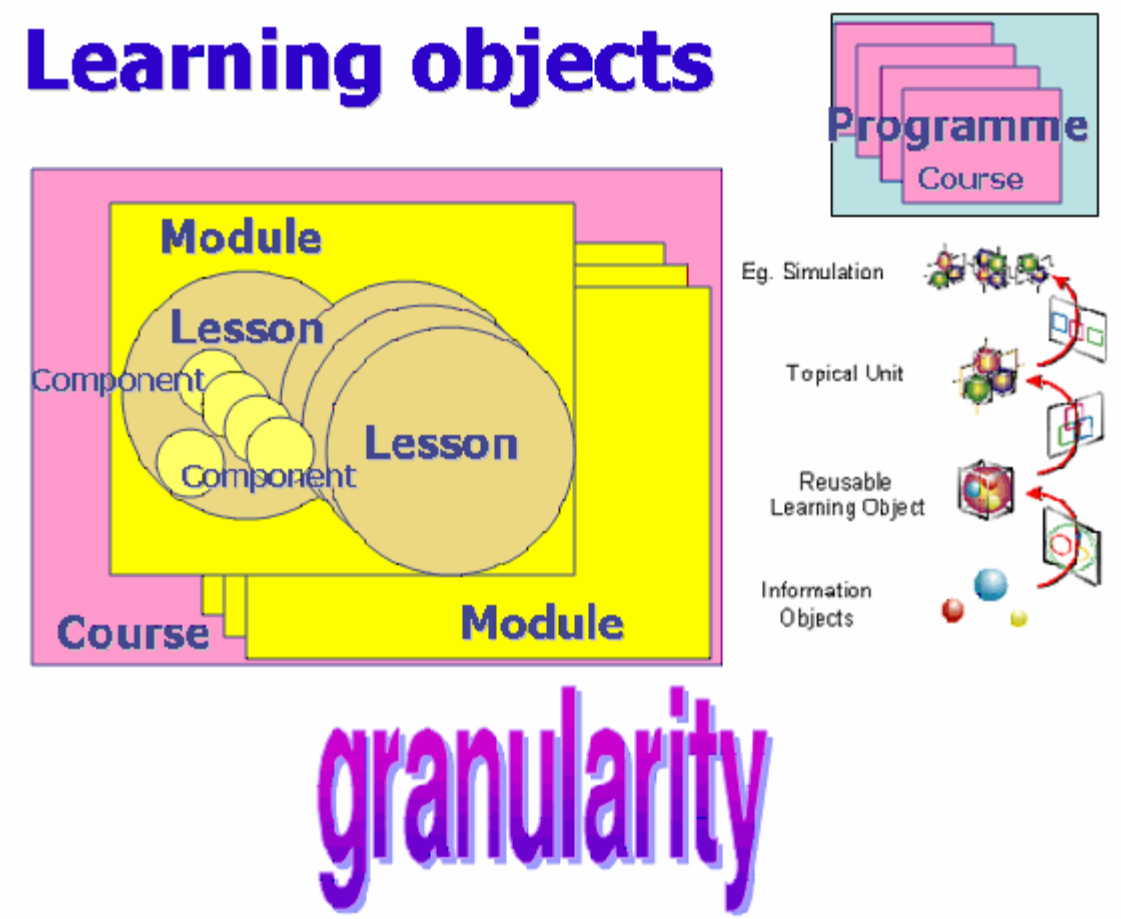


Figure 11: Learning object granularity. Source: http://itdl.org/Journal/Sep_04/article02.htm

The idea of a LOR is to provide an easily accessible (and usually searcheable) online store of learning objects. Teachers should then be able to quickly find relevant resources to assemble into a full set of course materials. For a repository to be useful, teachers should readily find the resources they need. That requires the repository to have an appropriate breadth and depth, which is easiest to achieve if it is large and comprehensive. Repository projects are underway at institutional, national and international levels, some are subject focused, whilst others meet the needs of specific educational levels. Some are based on voluntary collaborative efforts whilst others are a result of institutional policy. In practice, specific funding is almost certainly required for the initiative to have real impact. In the Aqua-TNET initial survey, respondents were asked if they would consider using materials and tools provided by others, and if they would be willing to share their resources. 77% of respondents were interested in using resources provided by others, but only 42% would be willing to contribute.

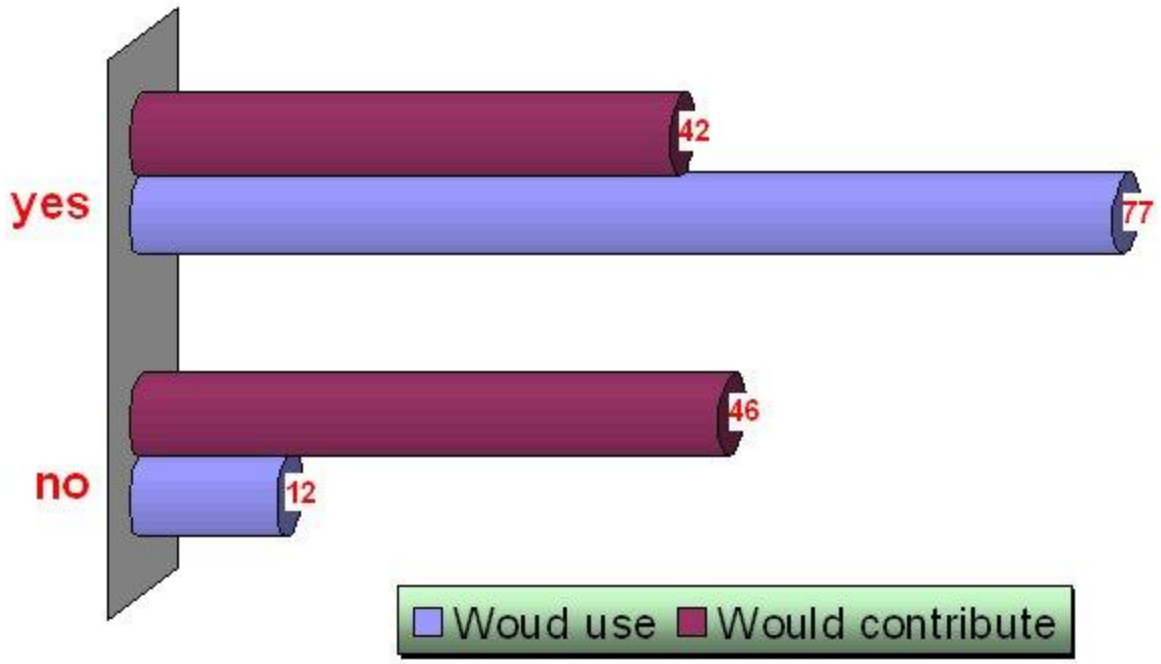


Figure 12: Aqua-TNET Questionnaire response on using and sharing teaching resources

LORs may directly store the learning objects directly (assuming they are digital files), or may store pointers to the resources that could be distributed in many locations across the Internet. Some may combine both approaches. More significant is that the LOR stores information about each learning object in a structured way that allows appropriate resources to be quickly identified using search tools. Information about each learning object is termed "metadata" and several standards exist for this. Perhaps the most widely accepted is the IEEE LTSC LOM, with others including the Dublin Core Metadata Initiative and CanCore.

Example metadata set:

- Title
- Creator
- Subject
- Description
- Publisher
- Contributor
- Date
- Type
- Format
- Identifier
- Source
- Language
- Relation
- Coverage
- Rights

Each element of the metadata must be expressed in a consistent way (the metadata schema) for it to be accessible using different computer systems. The common standards for this are XML (eXtensible Markup Language) and RDF (Resource Description Framework).

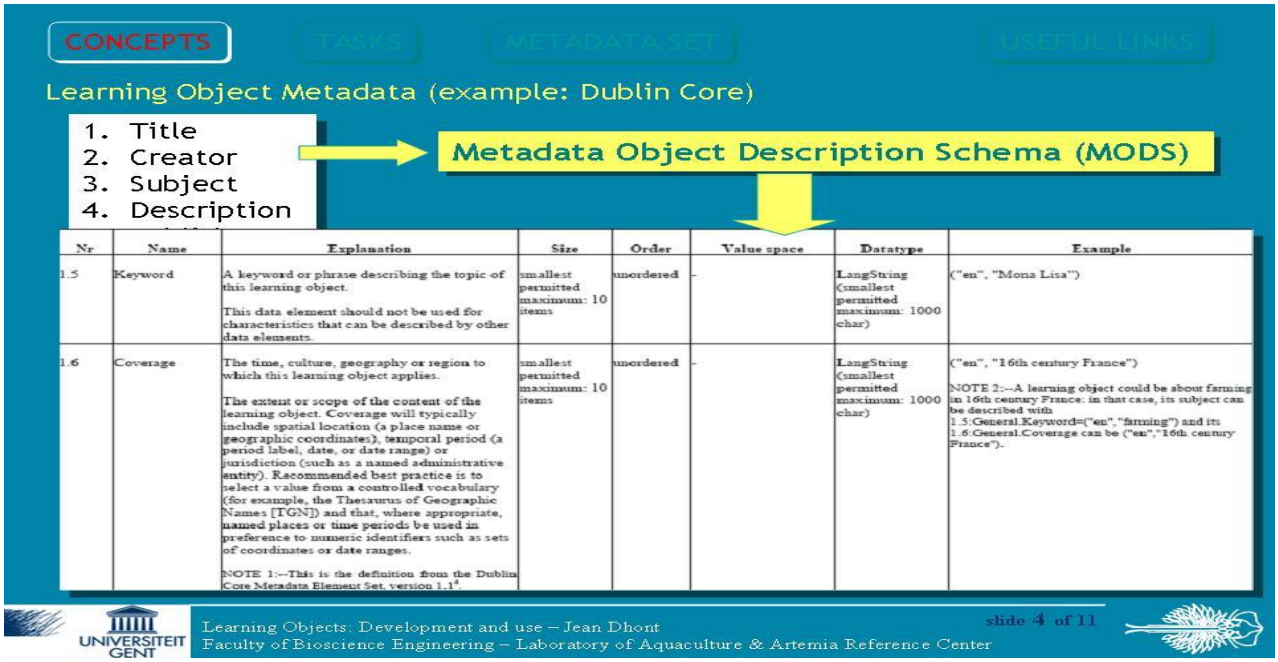


Figure 12: Learning Object Metadata Schema. Source: http://www.aquatnet.com/client/files/WP5DhontLearningObjectsBarcelona07.pdf

The use of standards is important, as it opens up the possibility for repositories to be linked and accessed in different ways depending on the needs of particular user groups (using different client software for instance). Perhaps more significantly, as discussed in more detail below, it allows learning object repositories to be integrated into learning management systems, or even for elements of automation to be introduced into the assembly of learning objects to construct coursework.

Further information

Learning object repositories and importance of metadata (Jean-Dhont)http://www.aquatnet.com/client/files/WP5DhontLearningObjectsBarcelona07.pdf
Primer on learning objects by Rory McGreal - http://itdl.org/Journal/Sep_04/article02.htm
IEEE Learning Technology Standards Committee Workgroup on Learning Object Metadata - http://ltsc.ieee.org/wg12/
Dublin Core Metadata Initiative - http://dublincore.org/
CanCore Learning Resource Metadata Initiative - http://www.cancore.ca/

Example repositories
ARIADNE http://www.ariadne-eu.org/
JORUM http://www.jorum.ac.uk/
INTUTE http://www.intute.ac.uk/
MERLOT http://www.merlot.org/merlot/index.htm
ASK http://ask.oucs.ox.ac.uk/

The Gateway http://www.thegateway.org/
Long list of learning object collections at
http://www.uwm.edu/Dept/CIE/AOP/LO_collections.html
Whole courses at: http://ocw.mit.edu/index.html and
http://www.open.ac.uk/openlearn/home.php

4.4 Tools for real-time teaching and communications

Communication between individuals (students or tutors) is an essential part of learning, allowing students to formulate and express ideas and think critically when responding to others. It also plays an important role in helping to maintain motivation, especially for distance learning courses. Communication may be real-time, as in a conversation, or asynchronous, as in e-mail, where there may be significant delays in the communication process. Real-time communications occur in the classroom and and in face-to-face tutorials etc. For off-campus students opportunities for real-time communication are much more limited. Telephone calls are an option, but unless special arrangements are in place, only two or perhaps three people can be involved at any one time. Video conferencing has been available for several years, but until recently has required expensive equipment at both ends, and often used ISDN data services which were not common in domestic installations. The development of the Internet, and growth in lower cost and higher speed (broadband) connections to many homes is opening up new possibilities:

- Chat or instant messaging tools (text messages are typed by the user, but appear immediately on the screens of other participants in the conversation (commonly called "chat rooms")
- Audio conferencing (similar to telephone, sometimes with several participants)
- Video conferencing (similar to telephone with live video, sometimes several participants)
- Virtual classrooms (where tutor presentations - video and slides - are streamed over the Internet to many participants who may ask questions as in a lecture)
- Shared whiteboard (usually in conjunction with audio or video)
- Shared applications (participants in the conference can see and sometimes interact through a shared application such as a spreadsheet, word processor document, or Powepoint presentation)

Real-time tools are particularly valued by students with an active (rather than reflective) learning style. Whilst availability of suitable hardware and network connections can be an issue, the greater problem for e-Learning/distance learning courses is finding a time suitable for all participants. The number of participants is also relatively limited, and considerable management of the conference is required if multiple participants are involved.

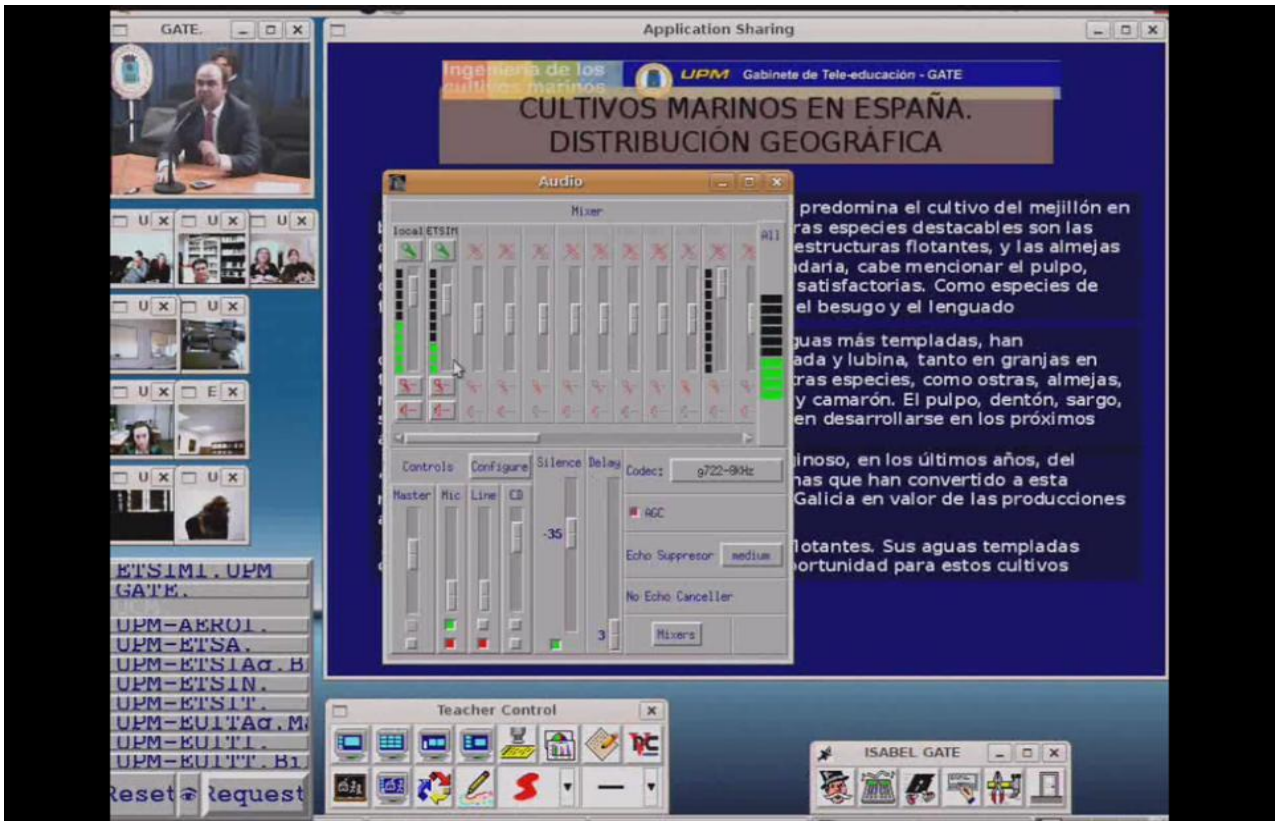


Figure 13: Video conferencing and application sharing using the Isabel system. Source: José de Lara Rey (see links below)

One major application of the technology is the delivery of online lectures in real-time, frequently allowing remote students to see and interact with a lecture being held on campus. Once lectures have been recorded it is fairly common for them to be further edited and made available as an online teaching resource.

Further information

Presentation on video conferencing (José de Lara Rey)
[Part 1] [Part 2] [Part 3] [Part 4] [Part 5] [Part 6]
Synchronous & asynchronous training article - http://www.e-learningguru.com/articles/art1_7.htm
Wikipedia entry on video conferencing - http://en.wikipedia.org/wiki/Video_conferencing
VideoFunet conference, Finland - http://www.video.funet.fi/conference/
Video Conferencing Guide - http://www.wmnet.org.uk/vc/
Institute of Engineering & Technology (live & on demand video of academic presentations and seminars)- http://www.iet.tv/

Common tools/services:

Skype (audio and video calls & instant messaging) - http://www.skype.com/
Windows Live Messenger - http://uk.messenger.imagine-live.com/Messenger/Launch/en-GB/Default2.aspx?thisTour=
Yahoo Messenger - http://messenger.yahoo.com/webmessengerpromo.php
Google Talk - http://www.google.com/talk/

Specialist conferencing services:
Adobe Actobat Connect - http://www.adobe.com/products/acrobatconnectpro/
ePresence - http://epresence.tv/products
Microsoft ConferenceXP - http://research.microsoft.com/conferencexp/
Isabel - http://isabel.dit.upm.es/
WebEx - http://www.webex.com/
Eye Network (network of specialist facilities) - http://www.eyenetwork.com/
Full list 2004 - http://myhome.hanafos.com/~soonjp/vidconf.html

Equipment providers:
http://www.polycom-uk.co.uk/pg.asp?ukhome
Tanberg - http://www.tandberg.com/

4.5 Tools for asynchronous teaching and communication

The most common asynchronous tools are text-based: Written teaching materials, bulletin-board style messaging systems and e-mail. However, the use of graphic media, audio (e.g. podcasts) and video are becoming more common. Tools for creating photo images, video and audio are increasingly available and easy to use, for both tutors and students. At present, most distance e-learning courses rely extensively on asynchronous tools, whereas campus-based learning is delivered with a greater mix of synchronous and asynchronous methods, the asynchronous seen mainly as supporting the primary real-time activities of lectures, practicals and tutorials. For this reason, when starting e-learning courses, both tutors and students can experience considerable difficulties adapting to the mainly asynchronous approach. A good understanding of e-learning pedagogy and careful group management is required to successfully implement this approach. A further major consideration is how student assessment will be carried out. This is dealt with in greater detail in Section 4.8 below.

Basic computer-based learning, particularly web-based is another asynchronous teaching tool. These are usually built around the presentation of some factual material (via text, photographs, diagrams, video, audio etc. followed by some form of quiz to assess student learning and to provide supplementary materials where necessary. A good example is the Australian Flexible Learning Framework project, for instance the Western Australian Seafood Industry Vocational Materials series (http://www.westone.wa.gov.au/toolboxes/aquaculture/).

Further information
Using asynchronous conferencing to promote critical thinking - http://crlt.indiana.edu/publications/crlt99-8.pdf
Asynchronous role play simulations - http://ausweb.scu.edu.au/aw02/papers/refereed/ip/paper.html
Teaching in a web-based distance learning environment - http://crlt.indiana.edu/publications/crlt00-13.pdf
Podcast guides - http://radio.about.com/od/podcastin1/a/aa030805a.htm; http://www.ilounge.com/index.php/articles/comments/beginners-guide-to-podcast-creation/
http://images.apple.com/education/solutions/podcasting/pdf/PodcastCreationGuide.pdf

Example computer-based learning on water quality from Australia - (http://www.westone.wa.gov.au/toolboxes/aquaculture/units/monitorstock/a4_testingwaterquality/00_testingwater.htm)

4.6 ICT in enquiry, problem and game-based learning

4.6.1 Introduction

Many teachers aim to help their students not only acquire knowledge, but also stimulate interest in learning more, and develop the skills to apply it in problem solving and creativity. Basic approaches commonly found in educational literature include:

- Enquiry-based learning
- Problem-based learning
- Game-based learning

These are linked in many ways and involve greater levels of interaction of the student with the subject matter and the construction of personal understanding and confidence in its application. They may involve students interacting individually with a software program, or more commonly, involve group work (which may or may not be computer-mediated). The starting point is a problem, or perhaps set of problems, often presented as a situation from which the student(s) have to move forward. Case studies from real life are often used as the basis for this approach, which for applied courses can provide a useful link with relevant industries and sectoral issues. Students are often required to adopt a role (role-play) when cases are presented in the context of a group activity.

The use of ICT within this approach is influenced to some extent by whether the teacher wishes to constrain enquiry within certain limits and control the information the students should access in order to solve the problem, or whether they wish students to research freely and reach conclusions that may not be foreseen by the teacher. The former approach is better suited to programmed computer-based learning, whereas the latter approach would be more likely to use generic tools such as Internet access and collaborative software for presentations etc.

4.6.2 Computer simulations

Computer simulations are a practical way to support learning. By using simulations the student can manipulate an individual part of the subject and then observe the effects of the action. Computer simulations have several advantages when compared to real life experimentation: safety, cost, independence of time and place, and they enable experimentation which would otherwise be impossible (Kaleidoscope Network of Excellence for Technology Enhanced Learning 2007).

Computer simulations can be used to support e.g. inquiry learning (De Jong 2006) and scientific discovery learning (De Jong & Van Joolingen 1998). However it must be

remembered that simulations are just one possible tool to aid learning and there may sometimes problems for the students to use the simulations correctly or they do not use all experimenting possibilities. Also, the students may face difficulties in dealing with unexpected results (De Jong & Van Joolingen 1998) which imply the need for support and guidance from the teacher. Thus, the use of computer simulations for teaching changes the traditional role of the teacher.

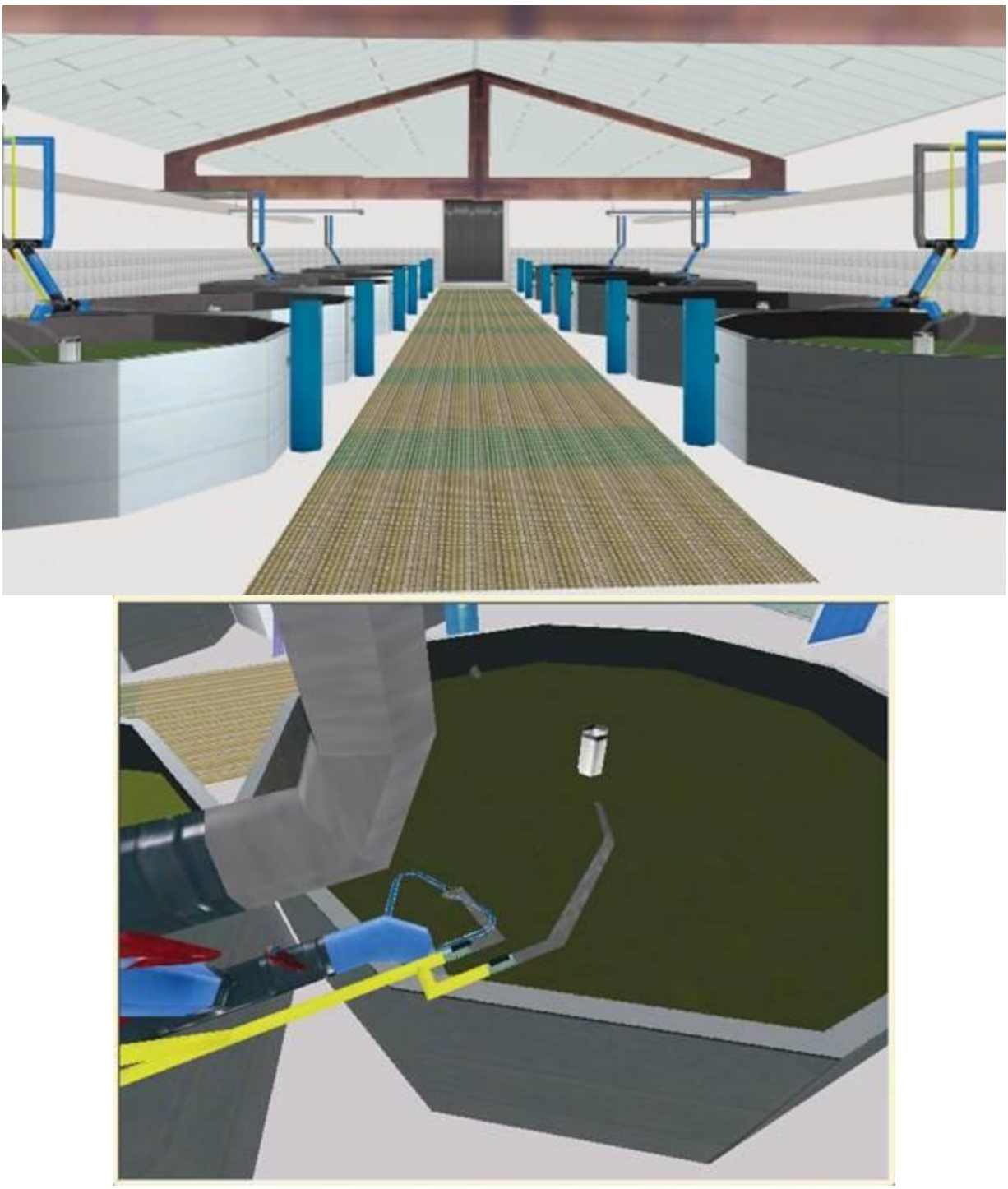
An example of a well developed simulation tool for aquaculture is the program "Pond" from the BioSystems Analysis Group of Oregon State University (USA).

4.6.3 Virtual reality

Computer simulations can be purely text-based, or developed with different amounts and types of graphic and multi-media content. Perhaps at the leading edge of this in computer terms is the use of virtual reality, 3-dimensional graphical representation that is generated in real time depending on the interactions of the user(s) with the program. This draws heavily on current computer games technologies such as "The Sims" where the user takes control of a on-screen 3-dimensional character (avatar).

Serious attention is being given by many educators on the potential of Second Life - A very large virtual reality environment which allows a wide variety of activities, including the ownership of virtual real estate and the establishment of businesses. This provides scope for role-play and simulation games and exercises, or simply provides a more emersive experience for participants at a virtual seminar or tutorial.

Virtual reality simulations have been used to teach school-age children about fishing and shellfish production in Spain:



Figures 14: Screenshots from virtual reality simulators produced by the Universidad Politecnica de Madrid. Source: José de Lara Rey (see links below)

4.6.4 Case studies

Case Studies are educational stories - real or simulated; open or closed - illustrating important aspects of a field of study. It begins as a pedagogical tool in the law and business

schools, but modified as problem based learning in medical schools it has been largely used and spread all over the world. Terminology about the pedagogical approach of this system may be confusing, due to the high degree of versatility of the system. All variations, however, are active learning focused on take decisions to solve problems. But it could be using:

- a case study (especially a clinical case)
- problem solving, or
- problem-based learning

The Case method, like Problem Based Learning (PBL) is an active form of learning, because it is based on a real problem, or a problem from the real world, that demands a decision and a course of action. The teachers choose a situation, presents it to the students first to read through and then discuss in small groups. Discussion reduces initial number of suggestions, identifying different courses of action, directing the focus and narrowing down the possibilities to solve it. The last part provides the solution although the case can be left open, with two or more possible solutions. The whole case can be dealt with in one session or in two sessions. In the last situation, only stage one is completed at a sitting, generating the learning goals, which should be addressed by the students before the second session. At the second sitting the case is completed.

How to teach with a case?

When we want to teach how to solve a problem that can be of interest for a professional, independently of their discipline, usually we use the case method. Explaining to teachers how to teach their students the main concepts of a theme, or how they can acquire a specific skill, can be done using a case. Regardless of the type of work the teacher/student is engaged, both statements of educative process need problem solving and planning skills. The case method has been found to be extremely useful in acquiring knowledge, developing skills, forming attitudes and influencing behaviour.

Many available web sites are dedicated to the definition of what is a case, or PBL (see the links of the textbox and Wikipedia for a complete up-to-day of the theme), and how to construct a good case. Teaching with cases, or problem based learning or with problem solving, ameliorates with practice but many tools and help-guides are accessible through the Internet to assist the beginners and also the experts. These resources can help finding best materials for a particular problem, students to identify key learning outcomes, designing teaching guides.
Case studies provide a situation and usually a good deal of technical and contextual information from which a variety of problem-solving exercise or role-play games can be developed. Case studies can either be used very explicitly, or as background to a student exercise. Once students have developed their own solution to the problem posed, these and perhaps other possible outcomes can be discussed and compared with the actual outcome where this is available.

Case studies for aquaculture teaching

The case study approach in aquaculture teaching should be similar to that of teaching economical, legal, medical, biological and similar professions, because the aim is to develop practitioners skilled in diagnosing situations, and acting accordingly. A case is not real life, because aquaculture is not made in the classroom, but the discussion of a case study is a useful learning of the future reality. It represents an opportunity for students to practice the application of what they know.

Case studies are often presented as a collection of documents, photographs, maps, diagrams or other resources, either physically in the classroom, or as digital resources through a web page for instance. Where case studies are used in e-Learning, groups can communicate using real-time and asynchronous methods discussed earlier. Case studies can be developed from a wide range of sources; so far there are relatively few fully developed case studies available for aquaculture and aquatic resources, although this is gradually changing. One example is the Icatha case study, developed by IFREMER and Aqua TT for a student workshop in 2004.

Figure 15: Map of Ithaca - from case study developed by IFREMER and Aqua TT

Further information

Presentations on The pedagogy of computer simulation and action-based learning (Juhani Pirhonen) http://www.aquatnet.com/client/files/WP5PirhonenPedagogySimulationsGent06.pdf
Use of case studies in aquaculture learning (Jaume Fernández-Borràs) http://www.aquatnet.com/client/files/WP5FernandezBorrasECaseStudiesGent06.pdf
Case Studies and Problem Based Learning (Jaume Fernández-Borràs) - http://www.aquatnet.com/client/files/wp5fernandezborrascasestudies.doc

Wikipedia entry on Problem Based Learning - http://en.wikipedia.org/wiki/Problem_Based_Learning
Investigating Problem Based Learning - A webquest (San Diego State University) - http://edweb.sdsu.edu/clrit/PBL_WebQuest.html
Dan Tries Problem Based Learning - http://www.udel.edu/pbl/dancase3.html

Wikipedia entry on Serious Games - http://en.wikipedia.org/wiki/Serious_games
JISC report on game-based learning - http://www.jisc.ac.uk/publications/publications/pub_gamebasedlearningBP.aspx
Kaleidoscope Network of Excellence for Technology Enhanced Learning (2007). What do we know about computer simulations ? -http://kaleidoscope.gw.utwente.nl/SIG-IL/D18-09-01-F.pdf (based on a Dutch brochure written by Ton de Jong and Wouter van Joolingen). A brochure to stimulate the implementation of ICT based inquiry learning with computer simulations.
De Jong, T. (2006) Computer Simulations: Technological Advances in Inquiry Learning. Science 312: 532-533 DOI: 10.1126/science.1127750
De Jong, t. & Van Joolingen W.R. (1998) Scientific discovery learning by computer simulations of conceptual domains. Review of Educational Research 68: 179-201
Pond (Aquaculture Decision Support Software) - http://biosys.bre.orst.edu/pond/pond.htm

Presentations on The use of virtual reality style simulations in computer assisted adult education (José de Lara Rey) [Part 1] [Part 2] [Part 3] [Part 4] [Part 5]
Wikipedia entry on Virtual Reality - http://en.wikipedia.org/wiki/Computer_simulation
Second Life - http://secondlife.com/
Wiki for education on Second Life - http://www.simteach.com/wiki/index.php?title=Second_Life_Education_Wiki
Second Life in Education - http://sleducation.wikispaces.com/

Main sites about Case studies and PBL:
National Center for Case Study Teaching in Science at the University of Buffalo - http://ublib.buffalo.edu/libraries/projects/cases/case.html
Problem-Based Learnig at the University of Delaware - http://www.udel.edu/pbl/
FAO Corporate Document Repository: Appendix 2: The case method. http://www.fao.org/docrep/W7500E/w7500e0b.htm#appendix%202:%20the%20case%20method
Método del caso. Educación Superior para el siglo XXI - http://www.itesm.mx/va/dide/red/6/educacion/caso.htm

Case studies on freshwater aquaculture for rural livelihood development - http://www.livelihoods.org/lessons/project_summaries/fisheriesADB_projsum.html
Case study of aquaculture in poverty reduction in the Philippines - http://www.dfid.stir.ac.uk/Afgrp/projects/r8288/WP4R8288.pdf
Seafish environmental assessment case studies - http://www.seafish.org/sea/aquaculture.asp?p=ec499
Problem Based Learning in Biology with 20 case examples - http://www.saltspring.com/capewest/pbl.htm
Example case studies for clinical teaching - http://www.clevelandclinicmeded.com/online/casebased/DecisionMaking/

4.7 Assessment and plagiarism detection

At the core of all academic endeavor lies the fundamental ”art of scholarship”. This art, which we expect our students (and faculty) to master, can be seen as an ethical code of conduct that regulates how we research, understand and build upon the work of others. Essentially, we shall give credit where credit is due when we draw upon others' ideas or materials. Plagiarism is the act of using *borrowed* materials without giving proper credit and is a clear violation of good scholarship.

With the growth of the Internet and the increased use of ICT, we have seen many innovations in teaching and learning. Students all over the world now have access to an enormous and ever growing reservoir of learning materials few could have dreamt of previously. However, the ICT revolution has also ushered in an era of *cut and paste*. The ease and temptation of finding and then presenting others' work as your own is a reality clearly reflected in the growth of plagiarism. This seems to be compounded by the globalization of education where more and more students are being taught in a second or third language. Their mastery of the language of instruction is not always adequate and the temptation to borrow the words of others is strong. The ethical underpinnings of good scholarship are being challenged.

How do we then go about reducing plagiarism? And, perhaps firstly, how do we go about creating a common understanding of plagiarism? From experience, we see a tremendous variation in understanding among faculty and students, and in a global sense, between regional *cultures*, of just what plagiarism is. Carroll and Appleton (2001, p7) advocate ”a balanced institutional approach” to reducing plagiarism, which should include:

- Ways to design out opportunities for plagiarism
- Teaching students what plagiarism is
- Teaching students the skills to avoid plagiarism
- Ways to create a climate that discourages plagiarism
- The judicious use of electronic aids (to detect plagiarism)
- A clear separation between the assessment and disciplinary processes
- A clear fair and consistent disciplinary procedure
- Informing students about the institution's policies and practices to tackle plagiarism
- An overall policy setting out the responsibilities of all staff in relation to each point above

Designing out opportunities for plagiarism is a concept to keep in mind and is in fact an important pedagogical tool. Opportunities for plagiarism can be considerably reduced by giving close attention to learning outcomes and assessment design, by designing in the need to demonstrate the ability to analyse, synthesize, evaluate, compare, reflect and/or gather information. Many students are poor managers of their own time. This results in papers being written at the last minute and increases the tendency to plagiarize. Introducing a structured writing process (f.ex. topic, outline, draft, final product) and requiring students to submit their work for formative assessment will encourage planning and most likely reduce cases of plagiarism.

The following example from the Norwegian University of Life Sciences is one practical approach to plagiarism:

All new students are given a one hour lecture based on the practical memo ”What is plagiarism ?” as part of their introduction to the University. Students are then asked to take

a short quiz to demonstrate their understanding of plagiarism before signing a declaration that they know both the rules and the consequences of breaking those rules. Both the memo and the quiz (with the answers) are always available to students on the University website such that they can check their understanding at anytime. In addition, the Library offers courses and tools to students for handling references.

The University uses a program (Ephorus), which is integrated directly with hand-in folders in the University's learning management system, to check written assignments for plagiarism. Students are informed about the program and how it is used. At the same time, the University emphasizes that they view plagiarism as an ethical problem and their main focus is on creating a climate for good scholarship by teaching students the skills to avoid plagiarism. Faculty are charged with evaluating the results from plagiarism checks. If a faculty member suspects plagiarism, the case is sent to the Department of Academic Affairs, which follows clearly defined procedures with respect to both contact, dialogue and disciplinary actions with the particular student.

Further information

Norwegian University of Life Science Guidelines for managing plagiarism issues (from Mike Moulton)
http://www.aquatnet.com/client/files/WP5NULSPlagiarismGuidelinesBarcelona07.pdf
Wikipedia entry on Plagiarism - http://en.wikipedia.org/wiki/Plagiarism
Wikipedia entry on E-Assessment - http://en.wikipedia.org/wiki/E-assessment
UK JISC Plagiarism Advisory Service - http://www.jiscpas.ac.uk/
Plagiarism.org (Site on plagiarism provided by leading anti-plagiarism software provider) - http://www.plagiarism.org/
UK JISC Page on E-Assessment - http://www.jisc.ac.uk/assessment.html

4.8 Technical standards and interoperability

Section 4.3 above introduced the concept of metadata for learning objects and some relevant international standards. These primarily help humans to search for objects that meet required criteria - such as a quiz to test understanding of the principles of aquaculture aeration suitable for use at undergraduate level. However, structured data can also be used by software to provide additional functionality. In the case of learning objects, the next step is software that provides tools for combining learning objects into courses, and managing user interaction with the teaching materials. The key concepts are:

- **Metadata.** Learning content and catalog offerings must be labeled in a consistent way to support the indexing, storage, discovery (search), and retrieval of learning objects by multiple tools across multiple repositories.
- **Content packaging.** The goal of content packaging specifications and standards is to enable organizations to transfer courses and content from one learning system to another. Content packages include both learning objects and information about how they are to be put together to form larger learning units. They can also specify the rules for delivering content to a learner.
- **Learner profiles.** These standards allow different system components to share information about learners across multiple system components. Learner profile information can include personal data, learning plans, learning history, accessibility

requirements, certifications and degrees, assessments of knowledge (skills/competencies). In addition, systems need to communicate learner data to the content, such as scores or completion status.

Examples of this are given in the following diagrams. Learning objects are aggregated and sequenced to form lessons and then courses.

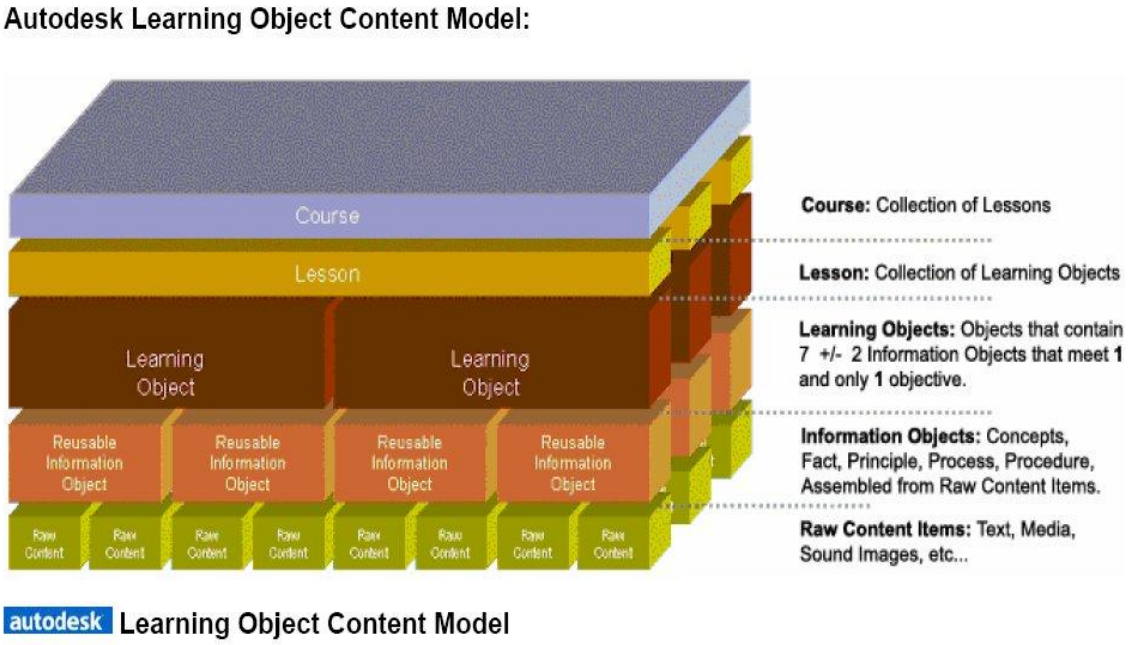


Figure 16: Example construction of courses using learning objects. Source: MASIE Centre eLearning Consortium: Making Sense of Learning Specifications & Standards: A Decision Maker's Guide, Second Edition 2003

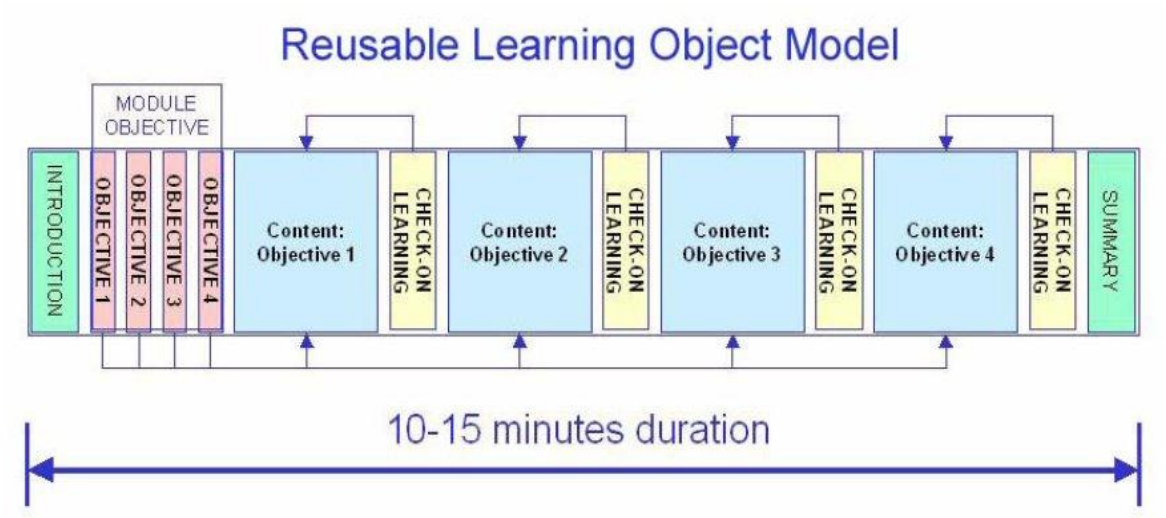
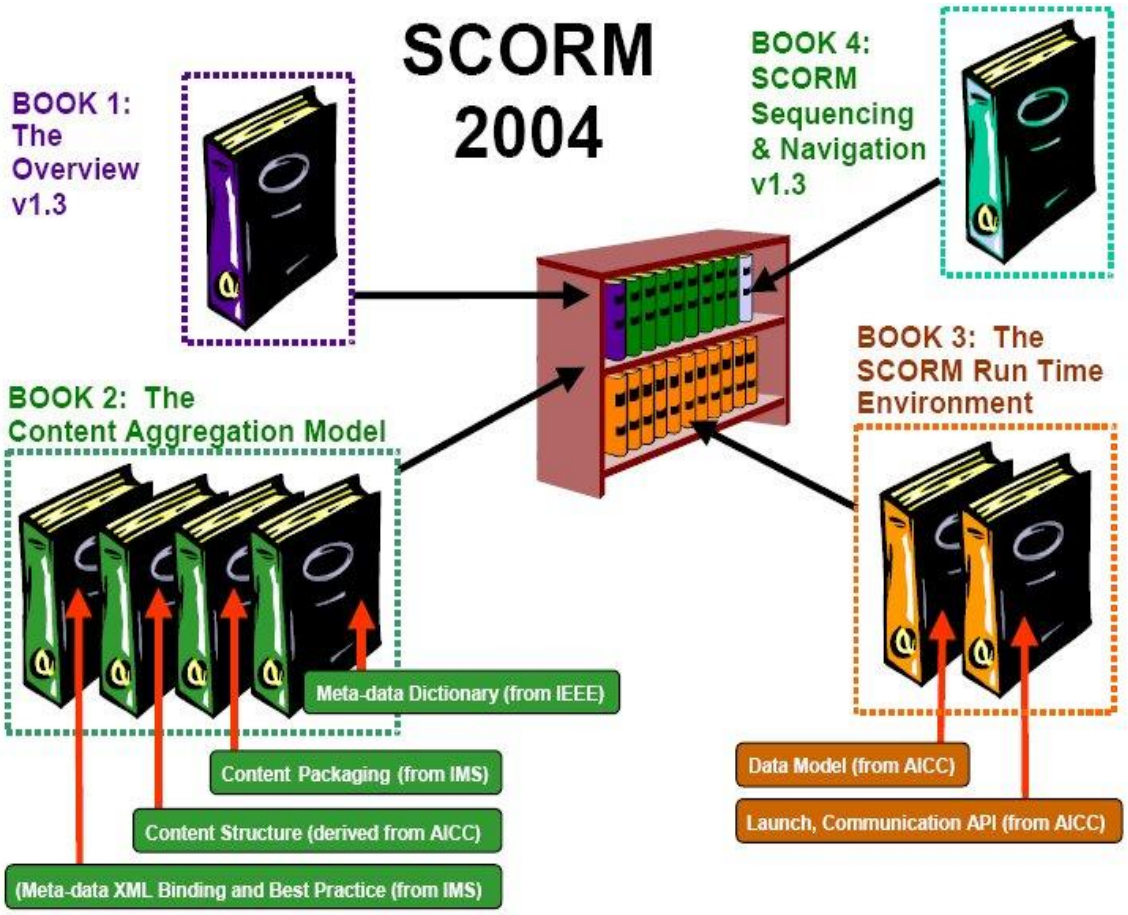


Figure 17: Example of sequencing leaning objects into a lesson. Source: MASIE Centre eLearning Consortium: Making Sense of Learning Specifications & Standards: A Decision Maker's Guide, Second Edition 2003

The main standard developed for enabling the management and exchange of packaged learning materials is SCORM (Shareable Content Object Reference Model), primarily developed by ADL, a US government sponsored organisation that researches and develops specifications to encourage the adoption and advancement of e-Learning. The SCORM specification combines the best elements of IEEE, AICC and IMS specifications into a consolidated document.



Source: ADL Technical Team

Figure 18: The Sharable Content Object Reference Model (SCORM) - standard for learning object packaging

In practice, tutors do not need to know too much about the technical details of SCORM, Many Virtual Learning Environments are now SCORM compliant (e.g. Moodle) and can import teaching materials (e.g. lessons) that have been packaged to this standard. The ability to export content from VLEs as a SCORM compliant package however is less common. There are a growing number of content authoring packages that are designed for producing SCORM compliant learning modules. Examples include Adobe Captivate (http://www.adobe.com/products/captivate/), SyberWorks Web Author (http://www.syberworks.com/product_sa.htm), Epistudio (http://www.epistema.com/en/page.php?rubrique=pages_solutions_en&page=10), ToolBook (http://www.toolbook.com/) the XStream suite of products (http://www.xstreamsoftware.com/products.htm) and many others.

With web-based software delivering teaching materials and assisting in assessment etc., the next logical step is to link this more directly with records of individual student progress and performance (Student Profiles). Standards for learner profiles are less well developed, but the expected advantage is increased transparency and the ability for student progress records to move easily between institutions (and therefore information systems), helping to promote greater mobility in European education. Standards for this are emerging out of initiatives such as European Qualification Framework, EUROPASS, European CV, and the Diploma Supplement etc. In the UK, a draft British Standard has been developed (DD 8788-3:2006 UK lifelong learner information profile - UKLeaP), but is not regarded as comprehensive and is expected to interact with emerging European or wider international standards and be further developed.

It is possible that most if not all of these standards will eventually become sub-sets of a wider initiative for making the Internet more accessible for software applications. At present, most information on the Internet is presented as web pages that are designed to communicate to human readers, but are difficult for software to properly interpret and use. "The Semantic Web" is an initiative to embed machine-readable data into web pages or documents etc., so that the meaning and context is also accessible to software agents. Substantial progress has been made in establishing appropriate standards, but so far adoption has been very limited. The concept is of wider interest to academic organisations as it includes a formalised structure (Web Ontology Language) for mapping concepts, terms and relationships within specific knowledge domains.

Further information

Presentation on standards for learning object repositories and content packaging (John Bostock) - http://www.aquatnet.com/client/files/WP5BostockLearningObjectsCrete07.pdf
Article on E-Learning standards by Ryan Ellis - http://www.learningcircuits.org/2005/jul2005/ellis.htm
Advanced Distributed Learning (US Department of Defence Initiative) - http://www.adlnet.gov/
Centre for Educational Technology Interoperability Standards - http://zope.cetis.ac.uk/
SCORM (Sharable Content Object Reference Model) - http://adlcommunity.net/course/view.php?id=25
IMS Global Learning Consortium Inc - Content Packaging Specification - http://www.imsproject.org/
IEE Standards - http://ieeeltsc.org/
BECTA - Packaging and publishing learning objects - http://www.becta.org.uk/page_documents/industry/content_packaging.pdf

Wikipedia entry on the Semantic Web - http://en.wikipedia.org/wiki/Semantic_Web
W3C Semantic Web page - http://www.w3.org/2001/sw/

5. Issues and future perspectives for ICT in Education

5.1 Web 2.0 applications and social networking

The WorldWide Web is constantly evolving. It started as a means of creating links between text documents on different servers and quickly developed to include images and then increasingly sophisticated formatting. The "web" was constructed from documents coded in Hypertext Markup Language (HTML). The limitations imposed by this approach soon frustrated developers and designers, and tools emerged to embed code in pages (e.g. java script), link with databases (e.g. php) and embed animations and video (e.g. shockwave and flash). A guiding principle of this second generation of web tools is the separation of content from formatting and delivery. This means content can be delivered to different computing devices in a way that is appropriate for its display capabilities. It also makes updating content simpler, without affecting page layout etc. As the power of software that could be delivered via a World Wide Web interface increased, and uploading content became easier, a new range of web-based services emerged aimed at allowing anyone to upload content or create their own pages on the web. The ease with which this can now be done and the opportunities for linking different elements has led to the concept of "Social networking" where people share their thoughts, diaries and many other aspects of their lives online. This mix of technology and mass participation has been labelled "Web 2.0" and is challenging not only many previous business models (especially for broadcast media and software), but also raises important questions about the organisation and delivery of education.

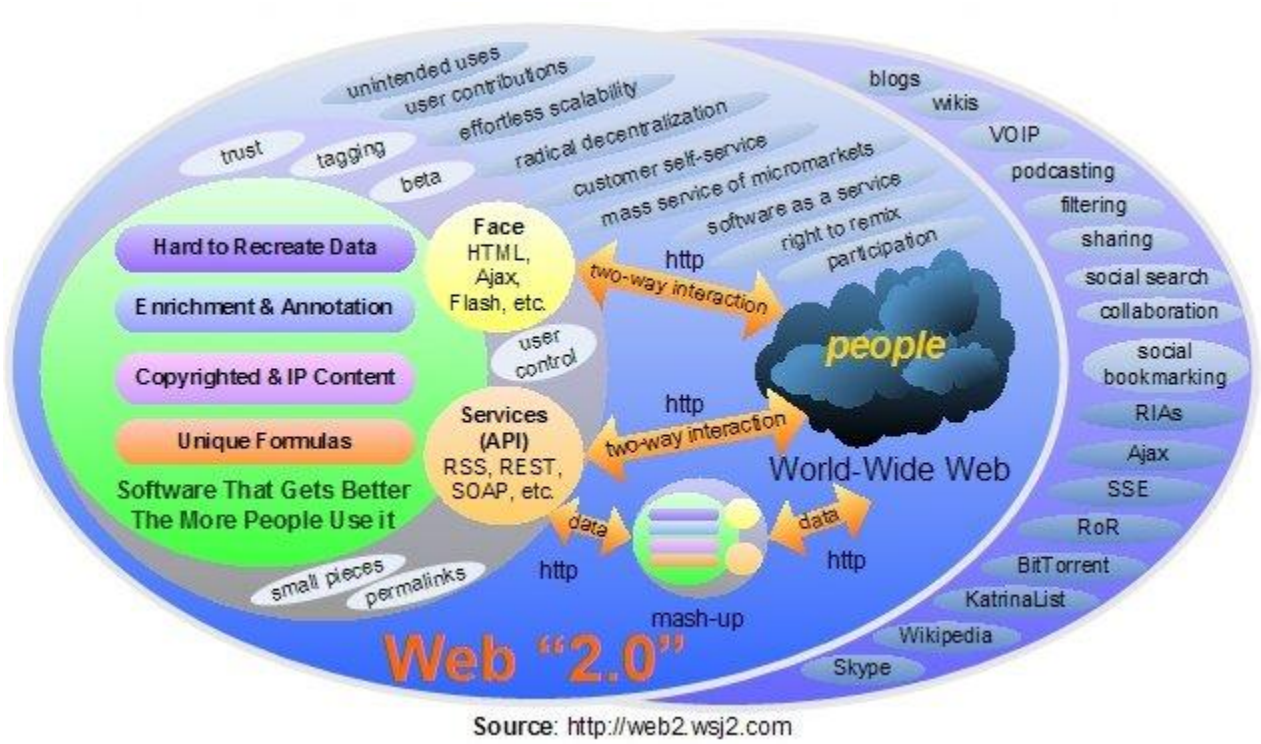


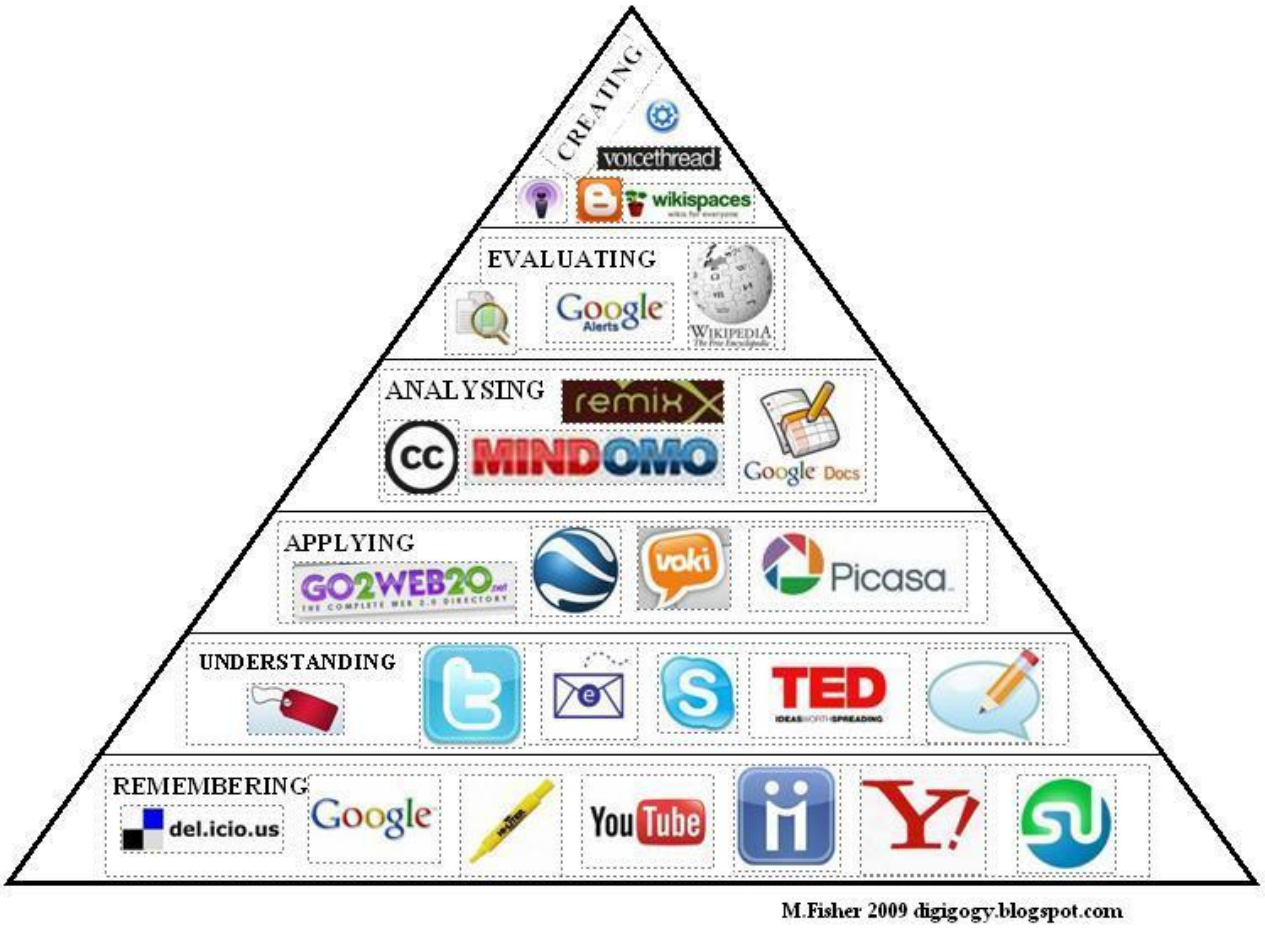
Figure 19: Conceptual diagram of Web 2.0 (From http://web2.wsj2.com)

Web 2.0 services provide many of the tools found in the VLEs discussed earlier, at least with respect to content delivery and participation. Some lecturers and teachers are turning to these as they are easier to use, more flexible and in many cases, already used by students. For instance, a tutor can easily compose a lecture using a blog site, which includes embedded photos from a photo sharing site, video from a video sharing site, audio from a podcast site, and which invites discussion via a text-based forum, or a live chat via another video/chat hosting service. Students can likewise construct assignments using tools found in social networking sites and e-mail a a web link to their tutor. The main element that is missing compared with a VLE, is the student management system, and overall institutional control. There is therefore potential for some of the traditional institution-based learning to be replaced by collaborative learning via the Internet. One sign of this is the emergence of Wikiversity - an attempt to build study courses using collaborative wiki tools. So far, there is little replacement for the validation of learning carried out by academic institutions through student assessment, or the kind of quality control that is built into formal educational systems. However, there is no reason why these functions might not develop within the Web 2.0 sphere in due course.

Some of the defining Web 2.0 services and their potential for use in aquaculture education include:

- *Social networking sites* - where students (or tutors) can introduce themselves to the world, post photos, articles and videos, and create links to their friends, colleagues and other contacts. Can be used in eduction to encourage self-expression and as a platform for composing and presenting assignments
- *Blogs (Weblogs)* - Where students or tutors can publish frequent short articles for discussion, including links to other sites of interest, and others can leave responses
- *Social tagging sites* - where people can share their favourite "bookmarks" to different Internet sites
- *Wikis* - sites where people can collaborate to compose an article, with previous changes and comments stored for discussion
- *Photo sharing sites* - sites for sharing and discussing photographs and other images (or for storing photos for linking into blogs etc)
- *Video sharing sites* - for sharing short video clips (used as part of lectures, or for student assignments and submissions)
- *Presentation sharing sites* - for sharing PowerPoint style presentations (lectures or student assignments)
- *Application sharing sites* - for sharing word processor documents, spreadsheets and presentations, allowing multiple users to access and make changes at any time. Useful for student group work for instance

Technologies such as RSS (Really Simple Syndication) provide tools for notifying interested subscribers of new content to social networking sites, whilst GeoTagging provides links between physical locations and web pages - e.g. the Flickr photo sharing site provide facilities for finding photographs through a map interface. A "Bloom's Taxonomy of Web 2.0 tools has been put together by Mike Fisher (http://digigogy.blogspot.com/), and a more complete Blooms digital taxonomy by Andrew Churches.



The UK JISC have a project on academic social networking which is developing social networking tools for integration with common VLEs. An example of academic social bookmarking is CiteULike which provides tools for bookmarking journal and other articles and sharing them with peers (sponsored by the publisher Springer).

Further information

Vidipedia Explanation of Web 2.0 - http://www.vidipedia.org/Special:Video/234
Wikipedia entry on Web 2.0 - http://en.wikipedia.org/wiki/Web_2.0
Tim O'Reilly article on Web 2.0 - http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html
EC JRC IPTS- Learning 2.0: The impact of Web2.0 innovation on education and training in Europe (workshop) - http://ftp.jrc.es/EURdoc/JRC50704.pdf + review report - http://ftp.jrc.es/EURdoc/JRC49108.pdf
Blooms Digital Taxonomy by Andrew Churches - http://www.scribd.com/doc/8000050/Blooms-Digital-Taxonomy-v212
JISC Academic Social Networking project - http://www.jisc.ac.uk/whatwedo/programmes/institutionalinnovation/academicsocialnetworking.aspx and blog - http://academic-networking.blogspot.com/
Dion Hinchcliffe's Web 2.0 blog - http://web2.socialcomputingmagazine.com/

Classroom 2.0 - Web 2.0 technologies in teaching - http://www.classroom20.com/
Creative Commons - copyright for the Internet age - http://creativecommons.org/
Wikipedia entry on social networking - http://en.wikipedia.org/wiki/Social_networking
Wikipedia list of social networking sites - http://en.wikipedia.org/wiki/List_of_social_networking_websites
Andrew Keen blog (critic of Web 2.0 and author of "The cult of the amateur") - http://andrewkeen.typepad.com/
(See review at http://www.bbc.co.uk/blogs/newsnight/2007/06/the_cult_of_the_amateur_by_andrew_keen_1.html)

Example services
Facebook (social networking) - http://www.facebook.com/
Blogger (Blogging) - http://www.blogger.com
Slideshare (Presentation sharing) - http://www.slideshare.net/
YouTube (Video sharing) - http://www.youtube.com/
Flickr (Photo sharing) - http://www.flickr.com/
Zoho (Collaboration applications) - http://www.zoho.com/
del.icio.us (social tagging) - http://www.delicious.com
CiteULike (academic tagging) - http://www.citeulike.org/
Wikiversity (Wiki for collaborative learning) - http://www.wikiversity.org/
Podcast.com (Podcast broadcasting) - http://podcast.com/

5.2 Assessment and quality assurance issues

5.2.1 Assessment

Keywords: Ordinary exams, On-line (distance) assessment, Automated assessment

In order to determine whether a student has reached the learning objectives of a particular course or course element, assessment of the student's abilities is necessary. The most common (and oldest) are oral and written exams, traditionally performed at the end of the course or semester/term. In some cases essays, problem solving, reports or other forms of assignments during the course may substitute or supplement the more traditional forms, in particular, when learning objectives or the format of course delivery favours such methods. As long as the choice of method demands the presence of the student in person, the means by which the student acquires his/her skills is indifferent, that is, the student may choose his/hers preferred way of studying including the new opportunities that the development of electronic devices provide. However, the technologies involved in the establishment of virtual learning environments and the associated asynchronous teaching also offers the potential of developing new assessment methods. Options already practised are oral examination via video-link and automated grading. In Denmark, legislation allows examination via video-link; however, such examination should be performed at an official Danish representation in that country, or if not possible, an official Danish representative should be present at the examination. All costs associated must be endured by the university, which currently may be prohibitive for extended use.

A major concern where the examination is based upon evaluation of an essay or another larger written document (e.g., article, report, thesis, and dissertation) is plagiarism (Mason

and Rennie). While electronic information is easy to access and copy plagiarism is likely to increase (intended or unintended). The workload and time involved in scrutinizing for plagiarism may be substantial; however, if such work is delivered in electronic format, it may easily be inspected electronically. A number of software programs are available at variable costs and efficiency. One school at Aalborg University, Denmark, offering a number of master programmes in engineering require that project reports and theses are delivered electronically, and routinely inspect these using …(software programme), and more schools are expected to follow.

With new opportunities new problems also emerge. Of particular concern is that an (on-line) exam taken by a student is solely this students own accomplishment, and that it is that student who is actually accredited. Obviously, such challenges should concurrently be addressed and, eventually, incorporated in a quality assurance system.

5.2.2 Quality assurance

Keywords: learning objectives, level, student satisfaction, competencies, accreditation

Several initiatives have been taken In Europe, to increase and ease student mobility as well as mutual recognition of degrees (professions) to facilitate free mobility and employability within Europe. These include transparency and recognition of programmes in higher education within Europe, and as an outcome of the Bologna process has led to the establishment of the European Network for Quality Assurance in Higher Education (ENQA). This network has published a set of guidelines and standards for quality assurance in higher education in the European Area. Although still in its infancy, adhering to these standards ultimately should overcome national barriers with recognition of educations targeting specific professions. Adhering to these guidelines and standards requires university programmes to be accredited, that is, the university obtains a right to award degrees and issue diplomas within the validity of the accreditation. Furthermore, such accreditation may be compulsory in order to maintain basic government funding (e.g., Denmark).

While inter-university recognition of degrees may be facilitated fairly easily through the above accreditation, this may not as easily be the case when the labour market should recognise at least certain educations. Additional recognition or even certification may be required, e.g., for doctors of medicine, nurses, chartered land surveyors, and engineers to practice their profession in another country. With respect to the engineering profession, further approval is required to become a chartered engineer in certain countries. Achieving a charter ensures that the engineering education a person has achieved meets a minimum set of standards and is issued by an extra-university body (regional or national). E.g., in Ireland, Engineers Ireland holds the authority to evaluate and accredit Irish engineering educations. Currently, Ireland together with Australia, New Zealand, Canada, Singapore, Hong Kong, South Africa, UK, Japan, and USA has signed the Washington Accord. These countries each have an accreditation body like Engineers Ireland, and have agreed upon a set of standards (programme outcomes) that an engineering education should meet in order to be accredited. The benefits are among others mutual recognition of accreditation decisions and substantial equivalence of degree programmes. Thus, an engineer acquiring a degree from any accredited institution of any of these countries should be able to carry out his profession in any other of those countries without need for further recognition.

Tradition and culture in the educational system vary among countries and even among universities within a single country and are probably the major obstacles to circumvent. The task of harmonisation has just begun facilitated by mutual consent to the Bologna process

in Europe; however, as the Washington Accord illustrates harmonisation and mutual recognition is achievable also in global context.

Further information

The Higher Education Academy - Managing Effective Student Assessment - http://www.heacademy.ac.uk/ourwork/learning/assessment/mesa
The Higher Education Academy - Student Enhanced Learning through Effective Feedback - http://www.heacademy.ac.uk/ourwork/learning/assessment/senlef
Graham Mohl on Innovative Assessment - http://www.city.londonmet.ac.uk/deliberations/assessment/mowl_fr.html

5.3 Present conditions and anticipated future trends in e-Learning

E-learning or distance education is obviously becoming more popular across all society levels as more and more households, on a global level, obtain personal computers with a reliable connection to the World Wide Web. In a broad sense, any use of electronic media to acquire information about any subject can be considered as e-learning. For instance, look up in Wikipedia for a subject (as a substitute to read in a traditional encyclopedia) can be considered as e-learning. E-learning is naturally suited to distance learning and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used. Speaking in general, the options available have allowed the computer to be used for teaching any subject that can be imagined. With the quickly developing techniques and applications, this process will even be accelerated in the future.

One major trend in e-learning is the spread of distance education from traditional subjects to all areas of knowledge. Virtually any informational websites can conduct practical training in any subject, such as "Do it yourself manuals" which have entered the computer age, or videos that are accessible on the website to illustrate proper techniques. This trend has virtually spread to include everything from dog training to fishing lessons.

Just some time ago, the user of the www experienced a new level of communication, known as Web 2.0, a second generation of web-based communities and hosted services such as social-networking sites, wikis and blogs, which aim to facilitate creativity, collaboration, and sharing among users. Thus the web user has attained a new attitude; from a passive client, collecting information he/she is able now actively contributing at any time and any place. The use of these means will become increasingly significant with growing power of the technical components and improved bandwidth (e.g. YouTube, the most famous video portal to share videos among the community, has just tremendously increased the allowance for video size at their site).

The given description above concerns rather those users who have an occasional need for acquisition of specific information, related to leisure or professional activities. In a more narrow sense, e-learning, aims at replacing old-fashioned time/place/content predetermined learning with a just-in-time/at work-place/customized/on-demand process of learning. E-

learning needs management support (vision and plan for learning, integrating learning into daily work). It requires changes in organizational behaviour establishing a culture of "learn in the morning, do in the afternoon". An IT platform, which enables efficient implementation of learning infrastructure, is also needed. When implemented with the same care as effective face to face instruction, online education programs can be used to complement, enhance, and expand education options for students, at least at intermediate, middle, and upper grade levels.

At present, however, the implementation of online education is still in it's infancy and not yet well established on most educational facilities. The major obstacle which prevents distance education from being a regular part of educational activities is obviously the poor knowledge of teachers and students about the options which exits and the realisation in their environment. Computers, the Internet, and other tools offer the promise of significant improvements in teaching and learning, but fulfilling that promise can be difficult. From our experience, the first impression that most concerned people have is, that this is all very interesting but somewhat overwhelming. Thus, the best start is to talk to somebody who has some experience in applying those technologies in teaching and has an overview both of what is available and what works.

In order for the teachers to be comfortable with distance learning, they must first be comfortable with computers. Teachers often feel uncomfortable using computers and are unaware of the teaching and learning that computers and the Internet are able to support. Thus distance learning provides at present rather a substitute to traditional education rather than replacing it. In addition, the tools and environments that are available to lecturers are still determined more by service issues than academic ones. Nevertheless, many schools have developed the idea of the virtual classroom to a high degree and trade and vocational schools are entering into the e-learning field. The major advantage is that one instructor located at a central location and using video equipment can teach simultaneous classes in several satellite locations. There is no limit to the distance these satellite locations can be from the instructor. Computer based training can be done in much the same way.

The changes have not all been happening on the Internet or with students sitting in computer labs using computer aided learning packages. At present, rather well established measures such as mailing lists, chat rooms, threaded discussion lists, Usenet newsgroups, Internet telephony and videos are being used as part of the e-learning arsenal. Out in the classrooms and lecture theatres, data projectors have being introduced and packages like PowerPoint are being used to present directly through a computer rather than to create and print overhead projector transparencies. The setups have often been unreliable and under-supported and there has been a lack of technical confidence among lecturers and it is only within the last few years that this has started to change.

However, it can be expected that the future is going to bring innovations that can hardly be anticipated. Other presentation technologies such as electronic whiteboards, audience feedback systems and advanced digital video technologies are beginning to appear in teaching facilities and these will all require careful thought in integrating them into teaching practice. The rapidly increasing number of wireless access points combined with Internet access by means of mobile devices, and the wide spread use of affordable laptop computers is opening new opportunities for distance education and learning. The benefits of online education include but are not limited to the flexibility to meet specific needs, providing equity of educational opportunity to students in various locations, low cost alternatives, new learning experiences, and expanded resources. Some of the disadvantages of distance learning include sound and video that may be less than broadcast quality, reliance on learner initiative to work in a situation with less supervision than a

classroom, the need for technical skills to work with the delivery technology, and the possibility of social isolation. Distance acquisition of knowledge is often an expensive and time consuming process to start and especially to maintain. It is significant to identify whether it in fact improves student presentation. It is also critically important to know which distance learning education delivery methods and techniques are more effective, so students get the maximum benefit from the society's investment in distance learning technology.

One thing that will almost certainly not happen is that good teachers will be completely replaced by automated systems or even, that face to face education can be entirely replaced but for sure learning technology will find its way into anybodies teaching methodology. Moreover, the way in which teachers teach has not changed. Instructors must still understand and quantify what they are going to teach, ensure that students' needs are being met, and choose methods which will enable learning to take place, regardless of location. Important to note in that context, whatever sorts of technologies will be used, the user of those new (and sometimes cutting edge) technologies will need to develop new skills and recognise that their students also need to develop new skills.

The following list depicts some latest trends and techniques which we anticipate to become more significant in the future of e-learning, distance education and life-long learning. Some of those measures are partially already in use; others are expected to become more popular in the future, facilitating the wide spread of e-learning on all levels of education. **Please note:** rating is an estimation of the authors of this report to indicate the significance of the selected tools at present and in the future of e-learning (highest significance: 3 stars).

On-line educational animations and multimedia CD-ROMs [Rating: used (*) significant in the future (***)]: animations produced for the specific purpose of fostering learning. The popularity of using animations to help learners understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. This technology allows animations to be produced much more easily and cheaply than in former years. Previously, traditional animation required specialised labour-intensive techniques that were both time-consuming and expensive. In contrast, software is now available that makes it possible for individual educators to author their own animations without the need for specialist expertise (e.g. Matchware Mediator). Teachers are no longer limited to relying on static graphics but can readily convert them into educational animations.

Databases, Information Systems, Metadata [Rating: used (**) significant in the future (***)]: On-line databases, information systems and metadata services play a significant role in the e-learning environment. Reliable and peer-reviewed knowledge is a significant backbone for many products and tools used in the e-learning environment.

Simulation Tools [Rating: used (*) significant in the future (***)]: Simulation is often used in the training of personnel. This usually occurs when it is prohibitively expensive or simply too dangerous to allow trainees to use the real equipment in the real world. In such situations they will spend time learning valuable lessons in a "safe" virtual environment. Often the convenience is to permit mistakes during training for a safety-critical system. An example from the world of Aquaculture is AquaFarm, which is a simulation and decision-support software for aquaculture design and management planning. AquaFarm uses computer modeling and simulation as an analytical foundation for system design and performance testing. I can be used for purposes of aquaculture design and management planning, enterprise development, research, and education. The object-oriented software architecture of AquaFarm is shown below.

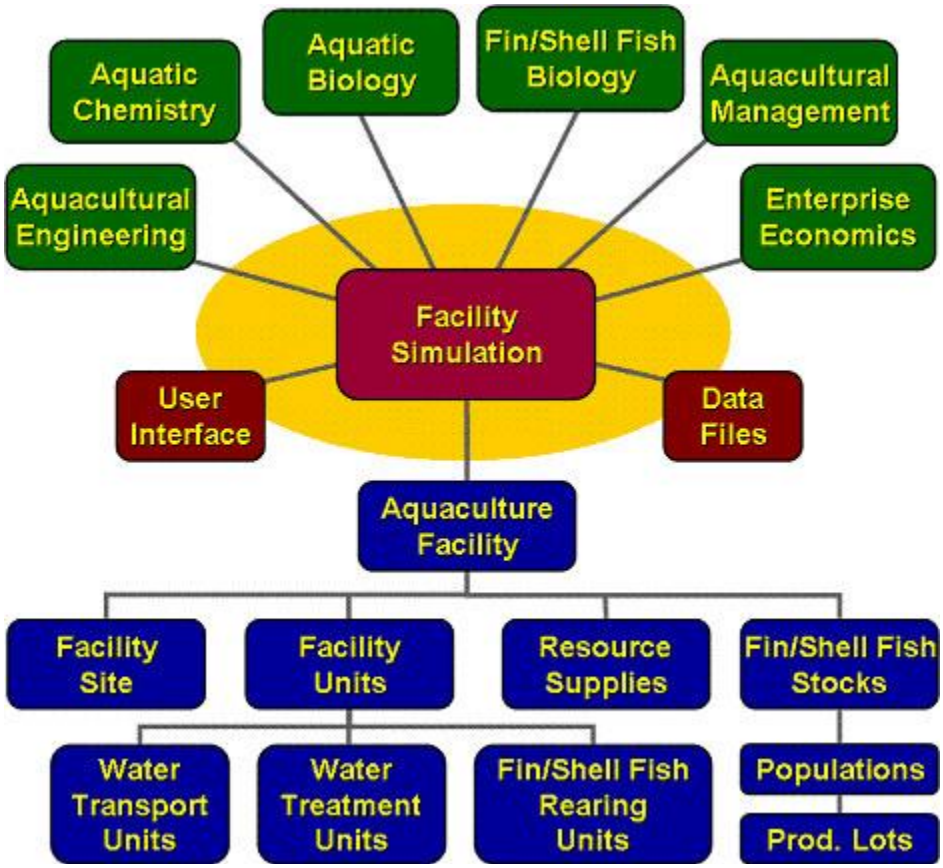


Figure 20: Conceptual arrangement of the AquaFarm simulation package

Learning Management System (or LMS) [Rating: used (*) significant in the future (***)]: software tools designed to manage user learning interventions. LMSs go far beyond conventional training records management and reporting. The value-add for LMSs is the extensive range of complementary functionality they offer. Learner self-service (e.g. self-registration on instructor-led training), training workflow (e.g. user notification, manager approval, waitlist management), the provision of on-line learning (e.g. Computer-Based Training, read & understand), on-line assessment, management of continuous professional education (CPE), collaborative learning (e.g. application sharing, discussion threads), and training resource management (e.g. instructors, facilities, equipment), are some of the additional dimensions to leading Learning Management Systems. Most LMSs are web-based to facilitate "anytime, any place, any pace" access to learning content and administration. LMSs are favoured by regulated industries (e.g. financial services and biopharma) where compliance training is essential. LMSs are based on a variety of development platforms, from Java EE based architectures to Microsoft .NET, and usually employ the use of a robust database back-end. While most systems are commercially developed and frequently have non-free software licences or restrict access to their source code, free and open-source models do exist.

Podcast [Rating: used (**) significant in the future (**)]: a collection of digital media files which is distributed over the Internet, often using syndication feeds, for playback on portable media players and personal computers. The term, like "radio", can refer either to

the content itself or to the method by which it is syndicated; the latter is also termed podcasting. The host or author of a podcast is often called a podcaster. Open source and Web-based software solutions are growing fast in the education and business world.

Web-based teaching materials [Rating: used (*) significant in the future (***)]: a subset of computer-based training or e-learning used to leverage the World Wide Web for the delivery to instructional materials. Several teachers and institutions provide access to Web-based teaching materials through links on Web pages. University professors and departments often provide similar resource pages to augment learning opportunities for their students. These resources are especially helpful when they provide an extension beyond what is covered in the classroom. Web-based teaching materials emerged as elements on personal Web sites with the proliferation and adoption of the Internet in the early to mid-90s. Beyond personal publishing, Web-based teaching materials were often published online as samples and supplemental materials by commercial entities experimenting with the World Wide Web.

Web 2.0: [Rating: used (*) significant in the future (***)]: a trend in World Wide Web technology, and web design, a second generation of web-based communities and hosted services such as social-networking sites, wikis and blogs, which aim to facilitate creativity, collaboration, and sharing among users. Web 2.0 is a knowledge-oriented environment where human interactions generate content that is published, managed and used through network applications in a service-oriented architecture. Although the term suggests a new version of the World Wide Web, it does not refer to an update to any technical specifications, but to changes in the ways software developers and end-users use webs.

Hypermedia [Rating: used ( ) significant in the future (***)]: The use of text, data, graphics, audio and video as elements of an extended hypertext system in which all elements are linked so that the user can move between them. A logical extension of the term hypertext, in which graphics, audio, video, plain text and hyperlinks intertwine to create a generally non-linear medium of information. This contrasts with the broader term multimedia, which may be used to describe non-interactive linear presentations as well as hypermedia.

Audience response [Rating: used (*) significant in the future (**)]: a type of interaction associated with the use of audience response systems, to create interactivity between a presenter and his audience. Systems for co-located audiences combine wireless hardware with presentation software and systems for remote audiences may use the telephone or web polls for audiences watching through television or the Internet.

Blogs [Rating: used (**) significant in the future (**)]: websites where entries are commonly displayed in reverse chronological order. A typical blog combines text, images, and links to other blogs, web pages, and other media related to its topic. The ability for readers to leave comments in an interactive format is an important part of many blogs

Wikis [Rating: used (*) significant in the future (**)]: software that allows users to create, edit, and link web pages easily. Wikis are often used to create collaborative websites and to power community websites. These wiki websites are often also referred to as wikis; for example, Wikipedia is one of the best known wikis. Wikis are being installed by businesses to provide affordable and effective Intranets and for Knowledge Management. Wikis were originally described as "the simplest online database that could possibly work".

Groupware or collaborative software (e.g. Lotus Notes, Skype) [Rating: used (**) significant in the future (**)]: designed to help people involved in a common task achieve their goals. Collaborative software is the basis for computer supported cooperative work. Such software systems as email, calendaring, text chat, wiki belong in this category. It has been suggested that Metcalfe's law — the more people who use something, the more valuable it becomes —applies specifically to such software.

Further information

e-Learning based on the semantic web - http://www.aifb.uni-karlsruhe.de/~sst/Research/Publications/WebNet2001eLearningintheSemanticWeb.pdf

6. Conclusions and recommendations

6.1 Conclusions

Higher education is under constant pressure for change. Although arguably more insulated than many other sectors, commentators such as Lomas (1997) have documented the evolution from from "collegial academy to corporate enterprise". Political, economic and educational drivers are behind this shift, which has been most evident in the UK. Academic freedoms are being eroded with the introduction of greater central management and the view that universities are providing an education and research service for society that needs to be better managed to become more effective and financially efficient. The market model of higher education promotes competition and encourages consolidation of expertise into key centres of excellence at the cost of a reduced number of subjects covered at individual institutions. Government policies to promote higher education have resulted in increased numbers of students, often placing greater pressure on teaching staff and facilities. Funding for researchers to follow their own interests is now very rare with most funding directed towards research that meets clear social, economic and scientific goals. Scientific research is increasingly seen as a key factor in the innovation cycle, which to be effective must be clearly linked with industry for exploitation. Likewise, tertiary education is expected to equip students with knowledge and skills that match the needs of industry and modern society. Requiring academic staff to meet strategic objectives reduces individual staff freedoms. Many would argue that this will ultimately prove counter productive and lead to a reduction in innovation (see Karran, 2007 for a review of the situation across Europe or the campaign by Council for Academic Freedom and Academic Standards). Policies to create centres of excellence in research in order to compete on a global level is evident in many national and EU initiatives. Through the RTD framework programmes, the EU is seeking to create a European Research Area with stronger capacity not least through better investment and linking of key research organisations and better orientation to meet the identified research needs of the European Community.

Key themes for education at the European level include the integration of different levels into a policy for Lifelong Learning - breaking down some of the barriers between school, further (vocational), higher and other adult eduction. One element of this for instance, is developing ways of recognising formal and informal adult eduction for incorporation into a better structured European qualification framework. Increasing student mobility and promoting the development of e-Learning opportunities is also important. Both of these policies could lead to consolidation and concentration as students will be more likely and able to follow courses perceived as providing the best quality or best value to meet their needs. The development of the Open Educational Resources Movement and formation of less formal learning communities (Communities of Practice) may also provide competition to some elements of higher education and encourage some separation between the creation of learning materials, the structuring and tutoring of learning, and the assessment and accreditation of learning and skills. In the future, especially with e-Learning, students may look for a more personalised mix of these elements to suit their learning style, career needs and budgets.

A further important policy area is innovation, which is seen as a key driver for economic development by the EU and national governments. The linkages between education, research and innovation are described as a triangle which needs to be better coordinated in order to achieve greater rates of innovation. Education needs to give people the skills and knowledge needed for innovation. One element of this is greater pressure for more inter-disciplinary education. Innovatory businesses need people who are adaptable and

understand a broader range of issues. People who are also better oriented to interdisciplinary collaboration. Traditional university education has tended to be relatively narrow, and at post graduate level, particularly driven by the research interests specific academic departments. Broadening the curriculum will always need to be considered in relation to depth and quality within the leading subject area, but particularly in applied areas, developing innovatory and interdisciplinary skills is likely to receive greater focus.

The development of the Internet, and especially the tools for interaction and collaboration that are being provided through Web 2.0 technology, is providing a powerful driver for social change that will increasingly impact on the higher education sector, offering both threats to existing models and new opportunities for innovation. The rapid developments in mobile devices and broadband communications will further increase usage and provide more universal access to the global knowledge base. This will change the skills that people need and in many cases, the way things are done. The Aqua-TNET project should therefore provide a supporting network and resources to help foster new associations and pilot initiatives that will help members to deliver the innovations in teaching that will certainly be required to meet the future needs of the aquaculture and aquatic resources management sectors.

Further information

Karran (2007) Academic Freedom in Europe: A Preliminary Comparative Analysis - http://www.palgrave-journals.com/hep/journal/v20/n3/full/8300159a.html
Lomas (1997) The decline of liberal education and the emergence of a new model of education and training - http://www.emeraldinsight.com/10.1108/00400919710164116
Council for Academic Freedom and Academic Standards (CAFAS) - http://www.cafas.org.uk/
The European Research Area - http://ec.europa.eu/research/era/index_en.html
European policy for Lifelong Learning - http://ec.europa.eu/education/policies/lll/life/index_en.html
Open Educational Resources Commons - http://www.oercommons.org/
Wikipedia entry on Open Educational Resources - http://en.wikipedia.org/wiki/Open_educational_resources
Wikipedia entry on Communities of Practice - http://en.wikipedia.org/wiki/Community_of_practice
EC policy on innovation - http://ec.europa.eu/enterprise/innovation/index_en.htm
Mike Moulton "Reflections on Screenagers, Faculty Development and Net-supported Learning" - http://tojde.anadolu.edu.tr/tojde30/pdf/notes_for_editor_1.pdf

6.2 Recommendations

Recommendations for action are developed below at three levels. Firstly for individual tutors involved in aquaculture and aquatic resources teaching. Secondly to individual institutions who may be considering their overall strategy and developing educational programmes, and thirdly to the collective membership and secretariat of the Aqua-TNET network.

6.2.1 Individual tutors

Recommendations for individual tutors include:

- If you have come into teaching without any formal training in teaching (e.g. from a research background) take some time to read up on theories of learning, learning styles, and approaches such as learner centred, problem-based, or social learning etc., and consider whether you can try different techniques and broaden your approaches to be more effective.
- Consider what learning outcomes you are trying to achieve and ensure that the teaching helps students to achieve these and the assessment properly evaluates these outcomes
- Students expect increasingly high standards of supporting materials. The use of photographs, graphics and increasingly video, audio, virtual reality and other interactive media can greatly improve effectiveness over plain text. The barriers to producing reasonable supporting materials are falling as devices become cheaper and software easier to use. More media is also being shared via the Internet - although tutors should set a good example in terms of avoiding plagiarism and respecting copyright.
- Having said that, think about whether you need to "spoon feed" students with customised materials and whether it is sufficient, or even preferable for their learning, to provide initial links and encourage them to explore and find relevant information and media on the Internet - the ability to search for information, interpret it, structure and make good use of it is an increasingly important skill for students to learn
- If "Learning is a social process" consider also the value of collaborative teaching and drawing in experience where possible from the workplace (research, government or industry).
- Sharing teaching materials via specialist, or public websites can benefit all tutors - but check your institutional policies as they may have specific rules about this

6.2.2 Educational institutions

Recommendations for educational institutions include:

- Institutions are under a wide range of pressures for change - from EU policies on lifelong learning and the provision of more transparent and consistent qualification frameworks to increasing international competition. Successful institutions will be those that recognise the need for change and develop appropriate strategies
- Institutions could often better support teaching staff with respect to developing skills in creating and using digital media and raising awareness of best educational practice
- Institutions need to develop a ICT infrastructure and policy to support the development of eLearning and blended learning
- Tertiary education institutions are usually organised and courses taught by academic discipline. Most jobs in aquaculture and aquatic resource management however require a range of interdisciplinary skills. Institutions could give greater emphasis to enabling collaborations between departments to the benefit of students

- Teaching collaborations (particularly joint courses) between institutions can create many administrative difficulties, but can be beneficial to students and support EU educational policies

6.2.3 Aqua-TNET project

Recommendations for the Aqua-TNET project include:

- Develop user-friendly guides for tutors to encourage and enable better use of ICT resources
- Encourage greater sharing of learning objects through formal and informal repositories
- Help bring together individual tutors and institutions with shared interests and complementary skills or resources
- Pursue opportunities to develop open educational resources, particularly case studies and simulations
- Help develop stronger links between industry, research and teaching, through collaborative lifelong learning

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