Promoting Sustainable Aquaculture, Building the Capacity of Local Institutions and Online Teaching (elearning)

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Abstract

Purpose - This paper reviews a number of recent initiatives to promote sustainable aquaculture development through improvements to education and training capacity, and innovations in the use of eLearning.
Design/methodology/approach - The authors share their experience in these initiatives and demonstrate how e-learning has been developed in specific cases to better serve the needs of the aquaculture sector, while addressing the pedagogical issues of distance learning and finding the best use of new Internet-based technologies.
Findings - These examples show how to respond to the needs of adult learners who may have a substantially different learner profile to typical campus students and have a more diverse range of needs and background knowledge. Greater focus is needed on defining, enhancing and accrediting knowledge and skills acquired informally and "on the job" so as to develop more effective formal education interventions.
Practical implications - Adults engaging with job-related education are not empty vessels requiring to be filled with the correct mix of knowledge and skills by teachers who know all the answers. They are active learners seeking a supportive and enabling structure involving access to appropriate resources, engagement with fellow learners and more expert practitioners, and appropriate challenges and rewards to maximise effort and achievement.
Social implications - There is substantial social benefit in promoting an innovative and sustainable aquaculture industry that contributes positively to food security and human health. Continued Professional Development involving eLearning and other innovative approaches can make an important contribution throughout the sector.

Keywords
Aquaculture, Education, European projects, E-learning

Paper type
Case study

1. Introduction

1.1. Importance of the European aquaculture industry

Fishery and aquaculture products constitute a significant part of human nutrition as a source of protein-rich healthy food, with global consumption making up 16.4 kg/person/year or 15.6 % of animal protein intake, in 2005 (FAO data).
In the 27 nations forming the European Union, the average consumption of fish is 22.3 kg/person/year, Portugal heading the list with 55.6 kg/person/year and Bulgaria at the bottom with 4.2 kg/person/year (EU, 2010).
One FAO report has estimated that the average consumption of fish in Europe in 1998 was 22 kg/per capita/year but by 2030 this should reach 24 kg/capita/year; the estimated two additional kilograms per capita means that the net supply will have to increase by 1.6 million tonnes (Mt) (Failler, 2007). Some studies also showed that the consumption of fish in several EU countries was below the recommended values for human health.
Because half of the wild fish stocks is fully exploited, about one third is overexploited or rebuilding and only 15% is not yet fully exploited, it is clear that aquaculture must be the source of this increase. However, it should be noted that the growth of aquaculture also increases the demand for fish meal.

Aquaculture now accounts for around 50% of seafood supplies globally and is expected to increase substantially as population growth continues. Development in Europe however has been constrained by concerns over sustainability, leading to a lack of competitiveness and investment. European Union aquaculture production has remained fairly stagnant over the last decade, contributing around 10% of EU seafood supplies. However, over the same period, seafood imports have risen substantially from a little over 30% imports in 1997 to almost 60% in 2009. Since a significant proportion of the imported seafood is from aquaculture, the current balance of seafood supply in Europe is around 25% from aquaculture (Paquotte, 2010). Failler (2007) predicts that imports to Europe would rise to 11 Mt in 2030, increasing the dependence of Europe on the rest of the world.

Another important aspect is that aquaculture is a major source of sustainable economic growth and jobs in rural and coastal areas, which are feeling the brunt of resource depletion and fleet reduction problems.

The rapid development of aquaculture has given rise to some controversy through new pressures that have been exerted on natural resources and additional impacts on the environment and conservation interests. These are being addressed through technology progress and improved management practices that build on research, education and capacity building. The aim of improving sustainability must also include economic aspects for business to thrive, and arguably it is this aspect which requires the greatest innovation and cross-sectoral cooperation.

The European Union, through various instruments managed by the European Commission, has provided impetus and support for the development of sustainable

aquaculture. Important policy backgrounds include COM (2002) 511, *A Strategy for the Sustainable Development of European Aquaculture*, and COM (2009) 162, *Building a sustainable future for aquaculture: A New Impetus for the Strategy for the Sustainable Development of European Aquaculture*. The strategy to achieve the objectives mentioned in this document include three key elements: i) helping the sector become more competitive through strong support for research and development; ii) ensuring it remains sustainable by maintaining its environmentally-friendly production methods and improving governance; iii) ensuring there is a business-friendly environment in place at all levels.

More recently proposals for a Revised Common Fisheries Policy (COM (2011)425) contain strong support for aquaculture and a proposal for the creation of a stakeholder consultation body: an Advisory Council for Aquaculture. That said, it is expected that development will take place in accordance with other policies, which include those concerned with environmental protection (e.g., The Water Framework Directive, Natura 2000, Action Plans for Biodiversity, Integrated Coastal Zone Management, etc.). The European Commission highlights the importance of developing a sustainable European aquaculture industry (EC, 2011).

The eco-label and certification in aquaculture is considered to be very important in guaranteeing the sustainability of aquaculture and in improving the trust of consumers.
The certification of GLOBALG.A.P (also known as EUREPG.A.P) has gained wide acceptance. It has established itself as a key reference for Good Agricultural Practice (G.A.P.) including aquaculture. It appeared in 2007, deriving from EUREPG.A.P, having been started in 1997 by retailers belonging to the Euro-Retailer Produce Working Group (EUREP). This certification takes into account food safety, occupational safety and the protection of the environment and animals.
In aquaculture today, the eco-labels with most exposure in global markets are:

- ASC (Aquaculture Stewardship Council) founded in 2009 by WWF and IDH (Dutch Sustainable Trade Initiative);
- Best Aquaculture Practices Certified (BAP Certified) established in 2003;
- Friends of the Sea which was established in Italy in 2005, follows the FAO guidelines, and now has aquaculture products certified in several countries;
- Marine Stewardship Council (MSC) was created in 1997 by Unilever and World Wildlife Fund (WWF) and has operated as an independent entity since 1999;
- The Soil Association provides certification for very low stocking density, with fat content of feeds regulated, total ban on toxic anti-foulants and control of veterinary treatments.

There are local certifications in Europe such as:

- Crianza del mar – Spanish certification for marine aquaculture production
- Debio - a Norwegian certification for organic aquacultures.
- BIOHellas - a Greek certification that controls and certifies food companies from animal farms to food retailers and export industries.

For organic aquaculture there exists other certifications in Europe such as Bioland Germany, Bio Austria, Naturland (Germany) and Krav (Sweden).
The emergence of an extensive number of certification schemes and accreditation bodies caused some confusion among the various actors in the supply chain, but particularly among consumers and producers (Washington and Ababouch, 2011).
EU committees and stakeholder associations, such as FEAP (Federation of European Aquaculture Producers), defend the creation of a European certification based on European laws that consumers recognize and prefer. A report on *De-Coding Seafood Eco-Labels: How the European Commission Can Help Consumers Access Sustainable Seafood* mentioned several problems with eco-labels currently in the market (FWE, 2011). This would give EU products a competitive advantage and bring transparency to a market with too many private certificates.

1.2. The need for curricular and methodological changes in aquaculture education

Most aquaculture companies recognise the need for high standards in corporate social and environmental responsibility, so in addition to legislation, most now participate in a variety of voluntary standards, several of which involve independent certification. These include business-to-business schemes such as GlobalGAP and several consumer eco-labels. All of these increase the knowledge and management skill requirements for aquaculture companies. Added to this are new developments in specific technologies or the emergence of new disease threats which make lifelong learning within the sector a growing priority. This links in with wider EU policy such as the Lisbon Strategy for a more dynamic and competitive Europe focused on jobs and growth, and the more recent Europe 2020 Strategy for smart and sustainable growth. Two key elements of this are *Youth on the Move* (COM (2010) 477), focusing on student mobility, and *An Agenda for New Skills and Jobs* (COM (2010) 682) which covers the acquisition and recognition of learning throughout general, vocational, higher and adult learning, and the implementation of the European Qualifications Framework.

The industry is well aware of the necessity of updating and upskilling employees in respect of legislation and new techniques. The decline in the market price of some species, e.g. sea bream, must be compensated for by improving production methods and technologies. Aquaculture research must take the lead in reducing the costs of production but also of increasing production. There is also a need to look at the market, and to invest in the production of new species. The rapidly changing skill needs of employees must be met by formal or informal training on a continuous basis. It follows that the design of aquaculture courses must follow market trends and needs.

However, training needs in aquaculture companies do need to be met at different levels, and these differing levels of competency requirement are addressed in the eight reference levels of the EQF (European Qualification Framework).
The establishment of a European Credit system for Vocational Education and Training (ECVET) (recommendation of the European Parliament and of the Council of 18 June

2009) associated with the EU LLL (Life Long-Learning) Programme may well contribute to an increase in certificated aquaculture courses.

2. EU Support for Aquaculture Education

2.1 Background

Various consortia of European education providers have sought to support the aquaculture sector with initiatives that implement these policies in both vocational and higher education. With regard to vocational training, the **WAVE** Project (Working in Aquaculture Validation of Experience) [1]under the EC Leonardo Da Vinci Programme mapped the competences required within the aquaculture sector, making those available to training providers and investigating the importance of skills acquired through experience rather than formal training. This theme was subsequently taken up in the **VALLA** Project (Validation of All Lifelong Learning in Aquaculture) [2]which examined the formal recognition of knowledge and skills acquired "on the job" rather than through formal training courses and how they can be recognised within the European Qualification Framework. Additional collaborations have taken place through a series of two LEONARDO da VINCI **PESCALEX** projects[3] [4]which created an open source Fish Health Toolset with 11 multilingual units on fish health and selected fish diseases, supported by an vocationally-oriented language package whose scope ranges from beginners to seasoned practitioners. In tertiary education, two **AQUALABS**[5] projects (2009-1-TR1-LEO05-08641) provided training for early stage researchers. Another example is the **Aqua-tnet** Thematic Network for Aquaculture, Fisheries and Aquatic Resources Management under the EU Socrates Programme. This Thematic Network, averaging in its three phases[6] roughly 100 member institutions, has a programme of work that encompasses student mobility, innovations in teaching and learning, implementation of EC policy objectives in M.Sc. and Ph.D. programmes and linkages with vocational and lifelong learning and agendas for promoting language diversity.

2.2 AQUA-TNET

2.2.1. Background

Aqua-tnet, a multidisciplinary Thematic Network in the field of aquaculture, fisheries and aquatic resources management, is a tightly-knit collaboration of university departments and research institutes.
Aqua-tnet, originally founded in 1996 as a SOCRATES Thematic Network, was merged with the Demeter Thematic Network in 1998 and became part of the AFA-NET Thematic Network (Agriculture, Forestry and Aquaculture from 1998 to 2004. As part of AFA-NET, Aqua-tnet continued to assess and analyse the aquaculture higher education sector and to identify key curriculum development and assessment objectives, publishing its "Higher Education in Aquaculture and Related Sciences - Guide to Courses within Europe" (1998).
Aquat-net also published the "White Paper on Education and Training in Aquaculture for the New Millennium" (2000), addressing the long-term education and training needs of the European industry for the new millennium.

Aqua-tnet's ground-breaking work in educational reforms led to a steady expansion and by 2005 it had become the largest multidisciplinary European Education Network in the field of aquaculture, fisheries and aquatic resources management. It continues its leading co-operative role between higher education institutions and other partners such as academic organisations, research institutions and industry, aiming to enhance quality and to define and develop a European dimension within its academic disciplines.

2.2.2. AQUA-TNET 1

The stated aim of Aquat-net 1 was to unite the academic and vocational aspects of the Bologna reforms and the establishment of the European Higher Education Area in the field of Aquaculture, Fisheries and Aquatic Resources Management.

This aim was carried out by means of six work packages: WP1- *M.Sc. curriculum development and assessment*; WP2- *Ph.D. curriculum development and assessment*; WP3- *Proposed transparency measures (including Qualifications Frameworks) and quality assurance*; WP4- *Measures to improve student mobility*; WP5- *Innovation in teaching (e-learning and ICT technologies and their role in joint degrees)*; WP6- *New methods of language training and promoting language diversity.*

The network then consisted of 109 partners, representing universities, training organisations, associations and research performers working in aquaculture, fisheries and aquatic resource management.

2.2.3 AQUA-TNET 2

Aqua-tnet 2: Socrates Thematic network for Aquaculture, Fisheries and Aquatic Resource Management had 120 partners from 25 countries.

The aims of this project were:

- To contribute to the current Bologna priorities: mobility, Masters & doctoral programmes, HE/VET & lifelong learning
- To further enhance and promote innovative course provisions for both Bologna cycles, keeping abreast of latest developments
- To further promote the Bologna recommendations (May 2007) to include LLL in the overarching Qualifications Frameworks by working on mechanisms to enable partners to provide suitable lifelong learning within their systems
- To disseminate information on state-of-the-art developments in new pedagogy and technologies and quantify potential uses as flexible pathways giving life-long learners access to learning opportunities. (Council Resolution 2001/C 204/02)
- To implement the EU recommendations for language learning in higher education in the light of the Action Plan for Language Learning and Linguistic Diversity
- To encourage a substantial increase in student and staff mobility, both through increasing uptake of EC opportunities (LLP, Marie Curie) and improved interaction between sending and host organisations using the updated web portal
- To strengthen communication between teaching and research (EHEA and ERA) in order to transfer ideas, knowledge and skills through research institutes taking an active part in the network

- To provide a forum for all stakeholders to have input into the development of the workforce helping to maintain a sustainable sector

These aims were met by its six core work packages: WP1- *M.Sc*., WP2- *Ph.D*.,WP3- *Student mobility*, WP4- *New generic skills and competences approaches*,WP5 - *Innovation in teaching methods*, WP6- *Positioning lifelong learning*. There were also three supporting cross-cutting work packages: WP7- *Multilingual issues in international cooperation*, WP8- *ICT advisory group*, WP9 -*Dissemination and outreach*. There were four stakeholder work packages: WP10 - *Research Institutes*, WP11 - *Industry Partners*, WP12 - *Consumer and societal Issues*, WP13 - *Student Associations*. Last but by no means least, in such a complex project involving over 100 partners, were the two management work packages: WP14 - *Project management*, and WP15 - *Exploitation of results.*
Aqua-tnet 2 completed substantial analyses of the current state of teaching and learning in aquaculture and fisheries and initiated several worthwhile practical collaborations.

2.2.4 AQUA-TNET 3

The third Aqua-tnet project involved 82 organizations, from 26 different countries, to create a comprehensive European network for innovative lifelong learning in the field of aquaculture, fisheries and aquatic resources management. The members are universities, institutes, student association, producers and recent technology platforms: EATiP (European Aquaculture Technology and Innovation Platform) and EFTP (European Fisheries Technology Platform). The AQUA-TNET domain links teachers, students, researchers, employers, employees and consumers.
The principal aim of the network in its latest phase is to support the progress of the European aquaculture, fisheries and aquatic resources management sector towards the EC policy goal of greater and sustainable output by stimulating and supporting innovation through enhanced lifelong learning opportunities.
This aim has been furthered by means of its core work packages: WPs1and 2- *European M.Sc. and Ph.D. Collaboration*, respectively, WP3 – *Mobility*, WP4 – *Generic skills for future success* and WP5 – *Innovating Lifelong Learning*. Ongoing work has primarily been carried out by smaller working groups comprised of representatives of the wider network membership. WP 6 has attempted to coordinate the input of different stakeholders. WP 7 is concerned with *Multilingual Issues in International Cooperation and Lifelong Learning*. WP 8 is responsible for dissemination and exploitation of results. WPs 9 and 10 are transversal, covering Quality Assurance and management.

All Aqua-tnet projects have provided valuable services for dissemination results and essential information, such as:

- Training News Newsletters (currently almost 6000 subscribers)
- AQUA-TNET Newsletters
- BibMail and information of interest
- Dissemination events at sectoral tradeshows/conferences
- Leaflets, brochures for individual events, including Aqua-tnet Annual Events and network map
- Its very well-designed website www.aquatnet.com contains all the above, and all project information, and also acts as the electronic heart of the project where:

  *questionnaires are set up and responses analysed

*discussion groups open to all members debate relevant issues
*the M.Sc., Ph.D. and Student Mobility portals are housed
*results of surveys, internal reports, core group minutes are available
*resources such as opensource software for e-learning can be accessed,
*multilingual glossaries, fish health courses, language lessons are found

The network conducts its business and develops its deliverables by means of core group meetings convened by WP leaders, work package discussions taking place electronically or via Skype and through dedicated WP website pages. Each year, an Annual Event is organised where progress is reported, deliverables are demonstrated and evaluated, and future targets are set for all members as well as core groups. In addition, much investigative effort has been expended on gathering data in the form of needs analyses (completed electronically, thus eliminating much of the tedium normally associated with this task) relevant to each of the designated work packages. These data have generated several valuable and comprehensive reports concerning M.Sc. and Ph.D. courses, Generic skills and Student mobility needs, as well. The Aqua-tnet database of European aquaculture and marine science courses has been a much-used resource, for both staff and students alike. The M.Sc. portal gives details of Master courses currently running throughout the entire network, while the Ph.D. portal publishes Ph.D. theses from students within the network. The entire multilingual resources of the PESCALEX website are also freely available.

In addition, European Teaching staff can exchange experiences and incorporate the latest research findings into their teaching which leads to students becoming aware of the latest techniques which can facilitate their entrance into the workforce.

2.3 The WAVE project

The WAVE (Validation of All Lifelong Learning in Aquaculture) project (selected by the LEONARDO da VINCI programme in 2003) addressed the need for a major sectoral initiative in line with identified EU priorities, well before the establishment of the European Qualifications Framework in 2008. The aim of the EQF “to relate different countries' national qualifications systems to a common European reference framework” so that “individuals and employers can better understand and compare the qualifications levels of different countries and different education and training systems” is directly relevant to the issues of work-based training and the need for transparent validation and accreditation, had already been recognised as a priority issue by the European aquaculture industry. Using previous work done in Scotland (SCOTVEC Fish Husbandry modules) and working in close cooperation with the industry, the WAVE project developed an original competency protocol, in the form of a Master List which identified the knowledge, skills and competences used in the industry. This was the first step toward developing an accepted procedure for the validation and accreditation of education and training at all levels, including practical training and work experience in the industry.

In order to draw up a valid and reliable Master list of knowledge, skills and competences (KSCs), WAVE targeted the full range of the European aquaculture industry: the workers and employers in SMEs, trade associations, universities, colleges,

training organisations and regulatory authorities. To this end, the WAVE partners interviewed 151 individuals working on aquaculture farms in 10 different European countries and adjusted the Master List taking account of their detailed feedback.

As consultations and discussions on the Bologna and Copenhagen reforms continued from 2004 through 2006, it became clear that the WAVE outcomes had to be capable of integration into the proposed National Qualifications Frameworks, as well as the European Qualification Framework.

The WAVE Master List thus became a catalogue of technical competence which demonstrates the diversity and multi-disciplinary nature of the sector. It highlights the relationship between primary food production, local traditions, work practices and marketability. It recognises variations in work practices and variations according to species, types of farms and farming methods across Europe.

In addition to the Master List of competencies covering all species, production techniques and technologies (248 competencies, 16 groups, 10 EC languages); and the printed Guidelines for five different target audiences on how to use the Master List (in English, French, Spanish, Italian, Norwegian, Greek, Danish, Dutch, Czech and Hungarian), the WAVE project produced valuable tools specifically designed to aid in the development of an agreed transnational list of knowledge, skills and competencies:

a) the WAVE competency database (online), developed by the partnership and essential in managing the extended discussions concerning the draft competency lists. It is still available for general use and its features include: online editing, tracking, historic archives, comments section, remote translations, online surveying and results.

b) an online tool giving users the opportunity to generate an individualised list of WAVE competences (from a total of 248), which is then emailed to them (available in 10 languages.

The WAVE project successfully led the way for the European aquaculture industry to produce an agreed occupational map and to further describe these functions in terms of their knowledge, skills and competencies. The problems and difficulties arising from managing an informed and often erudite professional discussion on the intricacies of creating a Master List of agreed aquaculture competencies, was only made possible by the simple but easy-to-use partner discussion forum. The online WAVE tool with its capacity to generate a customized (and therefore unique) individual list of competences for any specific job or function was a genuine breakthrough for the aquaculture industry. Not surprisingly, its deliverables and findings formed the basis of the VALLA (Validation of Lifelong Learning in Aquaculture) project.

2.4 The VALLA Project

As referred to in the section on the WAVE project, one challenging area in the validation and accreditation of aquaculture training is linked to the fact that some training provided in the vocational training sector falls outside current formal qualification systems. This can make it difficult to prove that any individual worker has indeed gained the requisite knowledge, skills and competences acquired through such specialized training. The introduction of the EQF (this “translation device to make national qualifications more readable across Europe, facilitating their lifelong learning” was intended to address this challenge. However, the EQF system, with its eight levels,

each described in terms of specific knowledge, skills and competence, is not easy to negotiate; the course provider must know, and know how to use, learning outcomes for course descriptions. This task can impose a heavy burden on the staff involved, and the VALLA (Validation of Lifelong Learning in Aquaculture) project has developed a methodology which can provide an excellent solution in this situation.

A major aim of the VALLA project was to develop tools and methods which could describe and evaluate unaccredited sectoral training using the Learning Outcome format.

The VALLA online Tool is able to create descriptions of sectoral training in terms of Learning Outcomes, taking users step by step through a process which generates a template covering the following areas:

- identification of the Learning Outcomes covered by the subject areas of a specific unit or course
- information as to how the Learning Outcomes can be acquired
- information as to how these Learning Outcomes are assessed.

The choice of case studies (mobility placements, short-term training, workshops/conferences, on the job training) was made in consultation with industry, educational and awarding body representatives, taking into consideration the range of job roles of differing levels of complexity and these are at the heart of the project and its most important justification. They show that it has been possible to establish common reference points across a sector and the generated course descriptions should enable qualifications authorities to use the reference grid of the EQF as intended. The process was tested through an extremely valuable consultation process with the Greek, Irish, Norwegian and Scottish qualifications bodies which authenticated both the VALLA process and its products.

The VALLA methodology and guidance tools, existing at the national, European and sectoral levels, can both implement and further the learning outcomes approach and help to develop flexible pathways between general education and VET, possibly even leading to the provision of ECVET credits. For though the VALLA online tool was developed for the aquaculture sector, it is already in use by other sectors such as European History.

2.5 PESCALEX 1 & 2

The two previous LEONARDO da VINCI projects described above were concerned with the validation and accreditation of aquaculture courses throughout Europe and not only contributed in a major way to one of the chief goals of the EQF, namely the promotion of mobility and flexibility of the European work force, but also towards the up-skilling of the fast-growing innovative European aquaculture industry, whose continuing success relies on a joint practical and theoretical knowledge base.

The PESCALEX projects, however, had very different aims and objectives as they focused on one specific area of the industry, fish diseases, from the perspective of the language needs of a wide target audience. Both projects were involved in developing the PESCALEX Fish Health Toolset, which is almost entirely based on multilingual online learning units, resources and language learning lessons delivered mainly, though not exclusively, via the Internet.

A major motivating factor in the real life context means that inability to handle some fish disease events can lead to severe financial losses. In real life, managers, farmers, technicians and workers rely on other people both for communicating disease details accurately and getting expert advice quickly. But this quite often means that accurate information has to be given, and relayed, in a second or even a third language.

The PESCALEX concept started from the premise that while there can be a need for complete beginners to understand and to convey vital pieces of information concerning potential fish diseases, in a new language, there is also a need for accurate and up-to-date information at a much higher level, concerning the fish diseases themselves.

The PESCALEX Fish Health Toolset is much more than the sum of its parts (though these are considerable in their own right) comprising several different levels of language and subject competence within its framework. Its wide range linked to its focused and selective coverage enables complete beginners as well as serious students to make steady and incremental progress in both language and content acquisition.

- There are 24 language lessons, freely available online in 9 languages important for aquaculture, containing native speaker audio recordings.
- There are four sets of course materials, also freely available online with the Aquatic Pathology materials available as downloadable pfds, all in 9 languages important for aquaculture.
- There are two major aquaculture and fish diseases glossaries which have never before been freely available in the 9 aquaculture languages (considerably more than the FAO glossary which is available online in 5 languages (3 European only).
- There is the PESCALEX Diagnostic Tool, a breakthrough for farmers experiencing problems, since it allows remote interrogation using the PESCALEX languages, with the capacity to deliver confidential and accurate information to and from client and expert in the required language.

The PESCALEX Online Multilingual Fish Health Toolset offers a genuinely innovative way of streamlining the help process.

Stimulus for beginners

Because the entire package is freely accessible online, users can learn what they need, using familiar terms from the workplace, and acquire some communicative competence at CEFR levels A1 & 2, by listening as often as necessary to the audio input. The language lessons will also enable them to pick up some basic English. Because these essential first steps are presented online in an attractive and incremental way, beginners can spend as much time as they require for mastery.

Stimulus for trainers

Most of the course material has been adapted for internet delivery, with an emphasis on keywords, all presented at about intermediate level (CFER B1 & 2). This methodology not only enables swift comprehension, but resembles the note-taking process and leads to a more thorough understanding and retention of the course content which was designed explicitly in line with the Brunerian concept of the Spiral Curriculum[7]. Trainers can use the course materials to develop their own customized, perhaps more sophisticated course materials covering fish health areas.

Stimulus for students

The glossaries in the PESCALEX website give the best available information on the subjects concerned in an accepted academic format (CEFR C1 or C2 levels).

The PESCALEX Fish Health Toolset thus uses its eLearning components to help build a framework for a future multilingual scientific community.

2.6 AQUALABS

The first Aqualabs project was established under the EU Marie Curie Conferences and Training Courses support for RTD[8] in 2004. The key focus was on providing training to early-stage researchers in more advanced research or practical techniques, in particular giving the opportunity for participants to visit leading facilities in particular topics, and receive practical training from leading experts. Six short courses (approximately one week each) were organised, plus an extra event focusing on more generic skill training:

- Molecular biology and ecology in aquaculture
- Freshwater aquaculture and the environment
- Fish welfare
- Aquatic animal disease diagnosis
- Design and operation of recirculation technologies
- Student conference

All the events utilised face-to-face training, supplemented with course materials made available via manuals and CD-ROMs

Following the success of the first Aqualabs project, a second funding application under the LEONARDO da VINCI Programme led to the commencement of the Vocational Aqualabs[9] project in 2009. In contrast to the first project, this focused on generic skills for researchers. Separate surveys were carried out among researchers and users of research (including employers of researchers) to identify which generic skills were considered most useful for researchers to acquire. This was assessed with respect to the successful advancement of researchers within academia and for successful transfer to industry. Two separate surveys were carried out with research users (stakeholders); the second with a simplified format to improve the response rate.

Generic Skill	**Ranking by researchers**		**Ranking by research users (For industry)**	
	For Academia	For Industry	1st Survey	2nd Survey
Project management			2	1
Team management		1	4	2
Scientific writing	1			3

Networking capacity				4
Team working skills				5
Effective behaviour in the workplace				6
Laboratory skills (best practice	4	2		
Entrepreneurship (Business awareness)		3	5	
Budget management		4		
Experimental design	2	5	1	
Philosophy of science	3			
Grant applications & research funding	5			
Data management			3	

Table 1 - Generic skills ranking by researchers and by research users (for industry).

From this analysis, the following courses were selected for development by the partners:

Title	**Course content**	**Delivery methods**
Experimental Design	Scientific method, experimental design, development of hypothesis, appropriate analysis	Face-to-face and online
Entrepreneurship	Business awareness, enterprise and entrepreneurship, marketing, innovation and technology transfer, presentation skills, teamwork	Blended – Face-to-face and distance learning via real-time and asynchronous Internet tools. International business plan competition involving team work and industry mentors.

Data and Statistical Management	Best practice for managing research data, selection and use of statistical analysis	Face-to-face
Scientific writing	Principles of scientific writing, structure of journal articles, common pitfalls	Face-to-face
Project management	Project management, team management	Face-to-face
Research Funding Procurement	Sources of funding, consortium building, proposal development	Face-to-face and online
Networking – key for a successful career	Networking skills, teamwork, effective behaviour in the workplace, presentation skills	Face-to-face and online

Table 2 – Courses: title, contents and delivery methods.

Materials were developed for each course and then piloted with a test group of target researchers (mostly early career) at various locations including Turkey, UK, Greece, Spain and Ireland. The most innovative of these courses was the Entrepreneurship course, because of the following elements:

- Strong motivation of the participants due to the pressure/encouragement of the competition and the need to present final outputs in a public conference
- Peer support and pressure through the need to work as a team
- The involvement of senior industry mentors and judges (providing real expert tutoring and feedback and raising the status of the programme)
- Use of virtual classroom technology to deliver many of the teaching inputs and for student meetings and tutorials
- Integration of other online learning materials such as videos from YouTube

A web platform was established for this course (www.aquaculturetalent.com) consisting of three main elements: A Joomla content management system for the public site and overall integration, a Moodle virtual learning environment for course materials and a BigBlueButton site for virtual classrooms. Experience with the virtual classrooms was mixed as successful use depended on network speed and the use of headsets by participants (to avoid echo). However, overall it was felt to be a very valuable tool and the disadvantages were counterbalanced by the advantages of immediate international communication and involvement of relevant industry experts.

3. Contribution of e-learning

Much of the aquaculture sector is located in rural and more remote coastal areas, which by their nature are less well served by further and higher education establishments. E-learning therefore has considerable potential to improve learning opportunities for participants in the sector. For example, there is little need to travel when pursuing an e-learning course, thus making considerable savings in terms of time, effort and money. When workers can participate while remaining in the workplace, work flow will suffer less interruption. In addition, learners from different regions can participate and interact within a single virtual classroom, which can help in the exchange of experiences and ideas. An online individualised course allows flexibility, because the user can access the materials when it is convenient

As aquaculture is a global activity, substantial scope also exists for more rapid dissemination of innovations through e-learning. The challenge is how to translate the promise of "potential" and "scope" into substantive and cost-effective benefits for the industry, and for the consumers of their production and the society and environment in which their activities take place.

As outlined in Section 1, there are strong drivers for continued growth in aquaculture production. From a policy perspective, the main issues are where the development will take place and the form it will take. These are largely determined by fundamental economic factors including the needs of the market, the key factors of production (land (including all natural resources), labour (including skills), capital, and entrepreneurship), the competitive mechanisms of the market and the constraints and limits imposed by national and international regulations.

Know-how and skills of the labour force play an important role, but there is no simple correlation between aquaculture production and education levels. In 2008, 88.8% of world aquaculture production was in Asia (62% in China), 4.5% in Europe and only 1.2% in North America (FAO, 2010). On the other hand, in the USA over 31% of the population aged 25 or over have completed tertiary education compared with only 4% in China (Barro and Lee, 2011). There is a greater correlation between educational levels and labour productivity. In Asia productivity per person per year is estimated at 2.4 tonnes whereas in Europe it is ten times greater at 24 tonnes (172 tonnes in the Norwegian salmon industry) (FAO, 2010). This reflects the structure of these economies and prevalent labour rates (no doubt influenced by overall education levels) rather than a direct measure of the impact of education and training, or specific skill levels.

A mix of technical know-how and entrepreneurial skills is required to start an aquaculture business. As they expand and become more complex, a wider range of expertise is inevitably required. Academic (research and teaching) organizations play an important role in supporting innovations and training competent staff. However, it is not a one-way channel. Zhou (2000) describes how major reform of Chinese aquaculture education was required in the 1990s as the course content and approach fell well behind commercial developments within the sector. A key advantage of e-learning therefore, in addition to reaching out to more geographically remote participants, is the potential for it to better network and aggregate different sources of expertise to improve its relevance and enhance quality. This is particularly the case for adult work-based learning where participants may have valuable experience and insights to share with both fellow course participants and teachers.

In common with other sectors, there is a growing appreciation within the aquaculture sector of the need for more responsive, flexible and collaborative approaches to learning

and the accreditation of learning that properly respond to the needs of the industry and individuals. Innovating these new approaches is becoming a more practical proposition with the improving availability of learner resources, teaching and collaboration tools provided through the Internet. Concepts of e-learning are gradually evolving from early models based on correspondence courses or simplified models of classroom courses to more complex approaches that draw on the success of "communities of practice" and on research highlighting the importance of informal and social learning. The increasing sophistication of learning management systems (virtual learning environments) allows a wider set of Web 2.0 technologies to be integrated into a managed learning environment. This frequently includes YouTube videos, Flickr photos, various blogs, wikis and other interactive and public services.

E-learning is considered to have substantial potential for enhancing lifelong learning and is now being offered by a number of academic institutions including the Universities of Stirling and St Andrews in the UK and Universidade Aberta in Portugal. These have to address the pedagogical issues of distance learning and also to find the best use of new Internet-based technologies. They also have to respond to the needs of adult learners who may have a substantially different learner profile than typical campus students and have a more diverse range of needs and background knowledge.
The Institute of Aquaculture at the University of Stirling has worked with a number of e-Learning approaches and courses, ranging from short stand-alone continuing professional development courses to full degrees at Masters level. The most successful has been a Masters level course in Aquatic Resources Development run in partnership with Mymensingh Agricultural University in Bangladesh (with funding from the Commonwealth Scholarship Commission). The students are generally all employed in government and NGO projects concerned with aspects of aquaculture, fisheries and aquatic resources management. This is a key factor as the materials, examples and discussion between participants are all focused on their daily activities and enhancing on-the-job performance. Participants are continually asked to relate the learning materials to their professional activities through maintaining a personal learning diary, discussing activities and events via an online forum, and completing assignments that require them to draw on practical experiences or conduct a short piece of local research. Each participant is also issued with a simple water quality test kit, digital camera, field microscope and laptop computer to enable practical work to be carried out in their location and the results uploaded to the virtual learning environment for discussion with tutors and peers. Course cohesion is further built through an annual summer school involving practical work, discussions and examinations. Internet connectivity is a problem in many rural areas of Bangladesh, but overall, the approach has worked well and provides access to international standard training to individuals who due to location, job and family commitments would not otherwise be able to participate.

The introduction of virtual learning environments/learning management systems into all taught courses is stimulating cross-over of approaches between mainly campus-based and mainly e-learning based courses. This has led to the introduction of wikis and discussion boards as tools to be used on-campus as well as in e-learning, and the use of virtual classroom (video conferencing) technology to bring external experts into the campus lecture rooms as well as to connect distant students with campus lecturers. This blended approach was used very effectively in the short course on entrepreneurship run under the Vocational Aqualabs project (discussed in the previous section). It is

anticipated that the use of blended learning will lead both to future adult learners who are better equipped for e-learning, and teaching institutions that are more comfortable with online tools and with better developed online materials.

A greater challenge for the future of e-learning, especially in the context of lifelong learning, is to better recognise and value non-formal and informal learning and skill development and develop approaches that are more learner-centred and take account of the increasing availability and diversity of potential learning channels and materials.

Conclusions

The case studies presented (EU projects WAVE, VALLA, PESCALEX, AQUALABS, the AQUATNET Thematic network) and the examples of E-learning from academic institutions including the Universities of Stirling and St Andrews in the UK and Universidade Aberta in Portugal, provide ample evidence of its substantial potential for enhancing lifelong learning.

These examples also show how to respond to the needs of adult learners who may have a substantially different learner profile to typical campus students and have a more diverse range of needs and background knowledge. Greater focus is needed on defining, enhancing and accrediting knowledge and skills acquired informally and "on the job" so as to develop more effective formal education interventions.

Continuing Professional Development (C-VET) being promoted in Europe as part of the developing Copenhagen Process can make an important contribution throughout the sector, by involving eLearning and other innovative approaches. However, a greater challenge for the future of e-learning, especially in the context of lifelong learning, is to better recognise and value non-formal and informal learning and skill development and develop approaches that are more learner-centred and take account of the increasing availability and diversity of potential learning channels and materials.

References

Barro, R, and Lee, J.W. (2011), *Barro-Lee Educational Attainment Dataset*. http://www.barrolee.com/ (Accessed 29 October 2011).

Bruner, J. (1977), *The Process of Education*, Harvard University Press, USA.

EC (2011), "Aquaculture: a priority", *Fisheries and aquaculture in Europe*, **Nº** 52, pp.8.

EU (2010), *Facts and figures on the Common Fisheries Policy – Basic statistical data – 2010*, Edition Publications Office of the European Union. Belgium. 45p.

FAO (2010), *The state of world fisheries and aquaculture 2010*, Food and Agriculture Organisation, Rome, available at: http://www.fao.org/docrep/013/i1820e/i1820e.pdf (Accessed October 2011).

Failler, P. (2007), "Future prospects for fish and fishery products. 4. Fish consumption in the European Union in 2015 and 2030. 4 - Part 1. European overview", *FAO Fisheries Circular. Vol.* 972, Nº 4, Part 1, Rome, FAO, pp. 1-204.

FAO (2010), *The state of world fisheries and aquaculture 2010*, Food and Agriculture Organisation, Rome, available at: http://www.fao.org/docrep/013/i1820e/i1820e.pdf (Accessed October 2011).

FWE (2011), "De-Coding Seafood Eco-Labels: How the European Commission Can Help Consumers Access Sustainable Seafood", *Food & Water Europe*, available at: http://documents.foodandwaterwatch.org/EUecoLabels-web.pdf

Paquotte, P. (2010), *Aquaculture contribution to food supply in the EU*. Presentation to the European Parliament, Brussels Nov. 2010, available at: http://www.acuiculturainformacion.com/doc/67_EBCD_9_Nov_Paquotte.pdf accessed on 4/11/11

Washington, S. and Ababouch, L. (2011), "Private standards and certification in fisheries and aquaculture: current practice and emerging issues", *FAO Fisheries and Aquaculture Technical Paper*. 553. Rome, FAO, 181p.

Zhou, H-q. (2000), "Needs and development of aquaculture talent in China", Annex D15, De Silva, SS., Sim, S.Y. and Phillips, M.J., *Collaborative aquaculture education in the Asia-Pacific Region*, 171-174. available at: http://library.enaca.org/NACA-Publications/ReportExpertConsultation.pdf

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[1] **WAVE** LEONARDO da VINCI project: IRL/03/B/FP-153112 (Working in Aquaculture Validation of Experience)

[2] **VALLA** EQF Project -LLP137860/ 2007/ IE/KA1EQF (Validation of All Lifelong Learning in Aquaculture)

[3] **PESCALEX** 1: LEONARDO da VINCi (IRL/05/B/F/LA-1153810)

[4] **PESCALEX** 2 LEONARDO da VINCI project (LLP/LdV/TOI/2008-509)

[5] **AQUALABS –** Advanced Laboratory Training Courses in Aquaculture for Early-Stage Researchers, Marie Curie Conferences and Training Courses, MSCF-CT-2004-013325

[5] Vocational Aqualabs, LEONARDO da VINCI 2009-1-TR1-LEO05-08641

[6] **Aqua-tnet 1** - 2006-2008 - 225991 – CP – 1 – 2005 – 1 – BE – ERASMUS – TN
Aqua-tnet 2 - 2008-2011 – 142245-LLP-1-2008-1-BE-ERASMUS-ENW
Aqua-tnet 3 - 2011-2013 - 518700-LLP-1-2011-1-UK-ERASMUS-ENW

[7] *"A curriculum as it develops should revisit the basic ideas repeatedly, building upon them until the student has grasped the full formal apparatus that goes with them*". J.Bruner (1977), The Process of Education, Harvard University Press.

[8] AQUALABS – Advanced Laboratory Training Courses in Aquaculture for Early-Stage Researchers, Marie Curie Conferences and Training Courses, MSCF-CT-2004-013325

[9] Vocational Aqualabs, LEONARDO da VINCI 2009-1-TR1-LEO05-08641