

Innovation and educational changes: two e-Learning cases in aquaculture

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Abstract In this paper, we investigate the potential changes that education innovation can bring to education and training in aquaculture. When introducing Information and Communication Technology methods into new educational contexts, situations and/or practices, in the process teacher/practitioners will almost always make use of innovatory technology which in itself can lead to a measure of change within the relevant educational system. Nevertheless, it should not be forgotten that the use of technology is not an end in itself, its use is only justified as a tool to achieve the educational goals that have been set. It is in this spirit that two case studies are presented from current aquaculture curricula, which make use of innovative teaching methodology in the form of e-Learning: one case study is from the Open University (Universidade Aberta) in Portugal [distance teaching in a Master's programme (Second Cycle)]; the second is from the NAFC Marine Centre, Scottish Qualifications Authority accredited courses in Scotland, UK. We report the pedagogical models on which these courses were built, the tools required to achieve the intended educational objectives and the teaching and learning resources used. We also report the creative stimulus inherent in the innovation processes that allowed the two teachers/instructors to achieve the same, or better, results than traditional teacher-led classroom methods, by using a technology-enhanced teaching process without the need for face-to-face interaction.

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Abbreviations

FAO	UN Food and Agriculture Organisation
ICT	Information and Communication Technology
IT Staff	Information Technology Staff
HE	High Education
LMP	Learning Management Platform
PDF	Portable Document Format
SCORM	Sharable Content Object Reference Model
SQA	Scottish Qualifications Authority
WebCT	Web Course Tools

Innovation and educational changes

New technologies, globalisation and the information revolution have affected the world economy, shortened the production cycle and improved productivity. Advanced technologies have replaced many human tasks, resulting in increased demand for the ‘knowledge worker’ and higher-level skills (Wang 2012).

As a result, the world has become more integrated, and, with more mobility, people are more aware than ever before of new business opportunities or new jobs according to their skills and competences. In Europe, as in all parts of the world, aquaculture is seen as an important food resource which the UN Food and Agricultural Organisation (FAO) has said must be increased (FAO 2011). For this to happen, much more work is required in this particular subject area. Therefore, many countries need to adjust their education and learning systems in response to these demands for human resources in the global economy. The World Bank reinforces this idea in its ‘Education Strategy 2020’ document, identifying education as its main goal towards the achievement of ‘Learning for All’ during the next decade. This document has three key messages: invest early, invest smartly, and invest for all (World Bank 2011).

Wang (2012) reaches the conclusion that students these days, when they enter the working world, need to be flexible, employable and competent. In order to make this possible, national education systems must adopt a more realistic view and provide education that is much more responsive to the needs of national economies.

Meeting the real needs of the labour market in the increasingly important European aquaculture industry provides an incentive for those countries concerned to make innovative changes to their education systems, in order to prepare students for the challenges that await them.

In this respect, new technology can provide the necessary tools to improve the teaching and learning processes, creating new opportunities, particularly in the customisation of students’ learning needs. This educational role is better understood when seen as the means to prepare students for their lives as well as their livelihood, providing them with the necessary skills to join a society where knowledge of and competence in technologies have become virtually indispensable. Today, societies in the developed and the developing world are ruled by a knowledge economy that is driven by technology (OECD 2010).

The introduction of digital media has challenged education/curriculum design, hitherto dependent on a traditional body of knowledge. The exponential spread of digital technological advances has created possibilities for increasing sophisticated interactivity with information technology.

The rapid and continuing rate of change in technological developments and innovations makes it imperative that similarly rapid changes also take place in educational systems. Nevertheless, Fleischmann (2013) strikes a cautious note in concluding that it is essential to find a way to manage the increasing complexity of technology within the design curriculum. He confirms that this is the key issue in effective and relevant curriculum design, regardless of evolving technological advances, in agreement with David (1990) ‘When new educational technologies are overlaid with old methodologies, it can be to the detriment of both’.

Educational innovation

Pedagogical innovation is said to occur when a process, introduced for the first time in a given context, changes a pedagogical practice for the better. Since the format to measure whether the change was pedagogically innovative is related to the success/impact among the students, educational innovation can be defined as ‘any dynamic change that aims to add value to the educational process promoting measurable results, either in terms of partner satisfaction, or in terms of educational performance’ (OECD 2010, p. 12).

In educational innovation, when technology is introduced into an educational process, it requires a shift in the ways of teaching and learning and teachers are obliged to adapt their teaching methods to this new reality.

Clearly, innovative teaching must have a positive effect and make a real difference for students. Yet, the effects of the use of technology in pedagogical practices, concerning quality, integration and performance, still remain poorly defined. It is unclear whether this lack of definition is due to the fact that it is considered that ‘technology is a blind artefact that can be used for a variety of purposes’ (OECD 2010, p. 14). It is also because of the lack of effective evidence. Pedagogical changes require an enormous effort to be made by teachers, both individually and collectively. That the specific use of technologies does improve student performance is still not sufficiently reported by teachers, and without such confirmation from their peers, there is little real incentive to change.

One successful teaching and learning model, e-Learning, is described in detail in this paper with reference to two separate e-Learning case studies.

Educational change

Educational change not only means the implementation of innovatory methods and techniques but also encompasses other factors such as the ability to search for, identify, critically select and evaluate new ideas, and then incorporate the appropriate ones into teaching practices (Fullan 2007).

During the initial introductory phase of such educational changes, the teacher’s role is very important. While it is true that most teachers do not innovate on a large scale, teachers, either individually or in small groups, make thousands of small innovations on a daily basis. If these small-scale innovations are not taken up by other teachers, it will not lead to change for the organisation, whether it is a single school, college, university or a network such as AQUA-TNET.

New meanings, new behaviours, new skills depend on teachers working either alone or together. That is why sharing experiences in teaching aquaculture by e-Learning is important. The quality of labour relations, based on open communication; trust, support, and help; work learning; achieving results; and the moral satisfaction deriving from the work performed, can promote stimulating work environments that seek constant improvements and thus promote educational change (Fullan 2007).

‘Educational change depends on what teachers do and think; it can be simple and complex at the same time’ (Fullan 2007). One way to achieve it is by taking part in communities of practice where issues are discussed, best practice disseminated and difficulties overcome. Communities are organised by relationships and ideas, creating social structures that gather together people by their values, feelings and beliefs, creating a sense of togetherness in and for each member. These members are connected to each other with moral ties such as mutual obligations and duties, shared traditions, and respect for colleagues within the educational institution (Sergiovanni 2000). Innovative teaching is more likely to happen in environments where teachers collaborate with one another, an important mechanism for sharing teaching practices and for mutual support (ITL research 2011). This is one reason why AQUA-TNET’s exchange of experiences has been so important.

To achieve an innovative teaching profession based on these assumptions, it is necessary to have leadership at all system levels, a leadership that promotes learning and focuses on the results (Fullan 2007). Innovative teaching happens more in environments where teachers have access to strong programmes of professional development, in a culture of educational institutions that support innovation. In both case study presentations, the teachers concerned had previously undergone training in e-Learning and pedagogical methods of designing courses.

Enhanced learning as e-Learning

In order to increase the work productivity in aquaculture in the marketplace, there is a need to improve the skills of aquaculture personnel and the best option is to achieve this is by education. To give relevant and appropriate training to aquaculture personnel, it is necessary and advisable to use asynchronous instruments that allow them to study and work at the same time. e-Learning is clearly the most appropriate method for this target audience.

Electronic learning, commonly designated as e-Learning or computer-based learning, is a form of distance learning. Distance learning through e-Learning is of real benefit to students who live in remote areas (often where fish farms are located) as they do not have to make expensive journeys to attend a class in person. Normally, most part-time learners have either a full-time or a part-time job or other commitments. e-Learning is convenient for people who often have to move from one place to another. e-Learning enables learning to be more flexible, and the learners are able to make choices as to how and when to learn. The use of ICT tools can also help by offering a variety of learning activities that help to initiate learning and also to adapt learning as per individual learning style.

‘e-Learning was initially defined as “learning facilitated and supported through the use of information and communications technology (ICT),” though it is now considered more as “enhanced learning” using computer and technological tools’ (Joint Information Systems Committee 2014). ‘The e-Learning and Pedagogy programme’ aims to ensure that e-Learning should be ‘pedagogically sound, learner-focused and accessible’ (Joint Information Systems Committee 2014).

Saadé et al. (2012) stated that the learning management system includes tools that fall into three categories: (a) learning tools (resource, implementation or both subsystems), (b) assessment tools (resource, assessment, human or any combination) and (c) support tools (human subsystem).

The process of learning is very much shaped by the learning activities and the tools used in the process. The use of ICT tools and the World Wide Web have had a huge impact over the last 15 years. Interaction using Web links by computers, laptops, mobiles and tablets as learning electronic tools encompasses several types of interaction between learner–content, learner–teacher and learner–learner.

Interestingly, Pereira et al. (2008) mentioned computer-mediated communication as socioemotional involvement, in many respects as not inferior to teaching face to face. A study conducted by Biasutti (2011) demonstrated several benefits in collaborative activity participation in virtual classes such as the development of teamwork skills, a positive attitude to collaboration, the development of cognitive processes such as analysing and integrating different points of view, understanding of one’s own and the limits of others, the development of a sense of responsibility, and respect for others. Palacios-Marqués et al. (2013) also mentioned that social competences play a crucial role in the development of e-Learning.

It is claimed that today’s Internet generation is so used to technology in daily life, with ICT tools being an integral part of their lives, that our educational system has to change to utilise the skills they have acquired (Prensky 2001). Though there is some truth in these findings, nevertheless academic practitioners are obliged to make sound pedagogical justification in their choice of ICT tools. For example, teachers cannot simply upload the course materials designed for face-to-face learning and expect learners to accept these materials in an online learning environment because ‘learners are no longer seen as passive consumers’ (Oblinger and Oblinger 2005). Learners require genuine engagement and interaction as part of their learning activities. Thus, teaching by e-Learning is not only about adding texts, videos, audios and putting in a LMP but also necessary to consider the students within a learning community and their interaction in the virtual classroom.

An important component of all teaching activities consists of effective planning and designing. The initial assumption for teachers is that planning and designing mean ‘a plan for teaching’ but they soon realise that it has more to do with a ‘plan for learning’ than for teaching as such (Siemens and Tittenberger 2009). However, with the recent trend in online learning or technology-enhanced learning, the design for learning has taken on more importance than ever. What we expect from the design for learning is to show an ‘effective pedagogic practice’ (Joint Information Systems Committee 2008), so we need to ask ourselves the question, what do we mean by pedagogy. Generally speaking, there is little difference in pedagogy in classroom learning and online learning: they have the same motives such as engaging the learner in the learning process, encouraging learners to develop independent knowledge and skills, motivating learners (Joint Information Systems Committee 2008) and so on, and that practitioners should have the creative skills in exploring new ways to deliver knowledge.

Designing e-Learning systems is very useful in deciding how learning materials should be organised and presented to the different types of learners (Katuk and Kim 2013).

For example, delivering a course online, as Tacclé (2009) mentions, must focus on the learning objectives, be simple, clear, concise, and strip out anything that is unnecessary; should use the active voice; should address students directly, using familiar words and explaining abbreviations; should respect gender; use summaries and offer concrete examples, listing references, and highlighting important aspects.

Accessibility is a key area that many academic practitioners have failed to give importance to in course design. Making learning accessible for all types of learners is vital for successful course delivery whether it is face to face or online course delivery.

One of the approaches to learning is making students ‘learn how to learn’ in their learning environment (Demos 2004). However, making students ‘learn how to learn’ and success in online learning relies heavily on how students interact. Alongside innovations in technology, a new theory has emerged called the connective theory by Siemens (cited in Anderson and Elloumi 2008) where learners in this digital age are exposed to changes in innovations and learning environments, and it is the networking and interaction which drives the learning. Online interaction gives the freedom and flexibility for learners to interact at their own pace and time.

Another important aspect to consider is the choice of the appropriate assessment in order to achieve the required learning outcome. According to Livingstone and Matthews (2000), assessment is the driving force in learning; it helps to motivate learners through self-feedback, and to monitor their learning contract, while it helps the tutors to monitor their teaching practice and monitor students’ learning trajectory.

Case studies

The present study describes two different case studies in two different countries.

The first concerns an e-Learning course running in the context of a unit of Marine Resources Management (6 ECTS) and forming part of the Master’s degree in Environmental Citizen and Participation (100 ECTS, 3 semesters) awarded by the Open University of Portugal (Universidade Aberta). The methodology used follows the pedagogical model adopted by Universidade Aberta (Pereira et al. 2008). This is based on the use of e-Learning methodology and the intensive use of new tools for online communication. The platform used being the Moodle Learning Management System, the university offers permanent support for teachers in respect of Moodle problems and difficulties. The Pedagogical Virtual Model of the university has been validated by the International Advisory Board, and in addition, it has obtained the EFQUEL-European Foundation for Quality in e-Learning Award and the UNIQUE—The Quality Label for the use of ICT in HE (Universities and Institutes) certification.

Before starting the Master degree programme, all students have to complete a module on how to deal with learning tools and learn about the pedagogical model being used.

The second case is an e-Learning course taking place in the Shetland Islands that are located in the northernmost part of Scotland in the United Kingdom, very well situated in the North Sea for cold-water aquaculture activities such as rearing salmon.

According to a recent report, the seafood sector in Shetland is worth £300 million (Shetland News 2013) and the industry is always in need of skilled and qualified personnel.

At the North Atlantic Fisheries Centre (NAFC) in the Shetland Islands, various certificate courses and short courses are designed and delivered to meet the industry needs such as fishing and aquaculture. The aquaculture section runs several Scottish Vocational Qualification (SVQ) courses and Professional Development Awards (PDA). The present case study describes and shares the NAFC experiences in delivering a PDA course as e-Learning for distance learners.

In both cases, teachers had previous experience in e-Learning by themselves undertaking e-Learning training and courses as students. The teacher from Universidade Aberta completed a 3-month course of teacher training in e-Learning. The teacher from North Atlantic Fisheries Centre participated in a course as part of his Continuing Professional

Development activities. The experience of both teachers is crucial in that it was a major factor in enabling them to design the courses presented in this paper.

e-Learning case study in Portugal

Case study description

The e-Learning experience occurred in the context of a unit of Marine Resources Management (6 ECTS), in the second semester of first year (between March and July). The course had teaching modules on fisheries (3 ECTS) and aquaculture (3 ECTS).

This course, which was created according to the goals of Bologna Process, was started in the academic year 2011–2012. Thus, the experience described in this paper is taken from the last two academic years.

The students enrolled in this course lived in different parts of continental Portugal, the islands of Madeira and the Azores, with some Portuguese-speaking students from other Portuguese-speaking countries (Brazil, Cape Verde, Angola). There were also students from other countries who speak Portuguese either because they are Portuguese or descendants of Portuguese families. The average number of students, per academic year, was 16.

Though the course was delivered in Portuguese, it was assumed that the students could understand (reading and listening) English and so many of the digital learning resources were in English.

The reason for implementing this course within the Master is because of the Portuguese government's assurance that aquaculture has a great potential for the country. Portugal has the capacity not only to supply the domestic market and but also to export to the rest of Europe. At present, aquaculture production is very low partly because consumers seem to think that aquaculture products are not high quality, especially, when compared to products from wild fisheries. This means that effective action is needed in more than one area to allow aquaculture to improve its image as well as its production capacity.

Course design

The objective of the course was to give an idea of the potential of aquaculture, to know the different ways of cultivation as well as the advantages and disadvantages that aquaculture faces at present.

There are several forums open during the whole course:

- News—where teacher/tutor puts the news items about the course
- Help Forum—which has final explanations, doubts about access to contents and questions related to assessment (their doubts about subjects are not permitted, however)
- Biology Forum—allows students to put questions related to the biology of the different species

The course includes a 'learning contract' where the competencies to be developed, contents, methodology, learning resources, sequence of learning activities, assessment instruments and timetable are explained to the students. To allow flexibility, this learning contract is discussed and negotiated between students and teacher during the first week of the course. This is followed throughout taking into account unexpected problems with students, such as health problems.

The course is divided into the following units:

- A. Systems of production: extensive, semi-intensive and intensive
- B. Bivalve aquaculture: clams, mussels and oysters
- C. Crustacean aquaculture
- D. Fish aquaculture:
 - a. Different systems: cages, inland tanks
 - b. Specific examples involving salmon, sea bream, sea bass, turbot, cod, etc.
- E. Advantages and disadvantages of aquaculture: environmental aspects, health problems, certification, fisheries *versus* aquaculture, etc.

Tools used and reasons for choice

The tools used for teaching aquaculture in the virtual class were as follows:

- Texts
- Videos from Internet
- Videos made by professor
- Slideshare
- Forum
- Skype meetings

We used *texts*, some sourced from the Internet, others from books and some written specially for this course. Feedback from students indicated that the learning notes written by teachers were more useful, because writing for distance learning is very different from writing for the printed page, i.e. the books and text used in face-to-face teaching, as students commented after finishing the course. In e-Learning, the text must be very clear and all details must be focused. The same is true if the student has to watch a video where he/she can see how a task is carried out or to watch the behaviour of an animal in its environment. Links to external European resources were also given and details were provided.

Videos were used to explain different aquaculture practices and the ways in which they are operated. Descriptions of each cultured species and their natural behaviour are much easier to understand when seeing it in real time. To achieve this objective, we made 25 links to free videos on the Internet. For the aquaculture part of the course, we used ten videos to explain bivalve aquaculture, two for crustacean aquaculture, seven to demonstrate the more common type of cultivation of fish, three to visualise the advantages and disadvantages of aquaculture, and four to explain the compliance certifications and the advantages of obtaining this.

All the videos were selected from those available freely on the Internet. Most of the videos are hosted on YouTube, but some were found on other sites, for example on enterprises' sites. So, the benefit to the teacher is that there are a good deal of free videos available via the Internet free of charge, allowing the teacher to use them without economic constraints.

The videos for inclusion in the virtual class were chosen by the teacher, though with some difficulty as the teacher was obliged to view many hours of video, paying very close attention to what is said in order to avoid videos with out-of-date classifications or which contain errors. It is also necessary to choose a video that shows exactly what needs to be illustrated, a time-consuming process. If the video is too long, the teacher must find and

refer to the time interval in the clip of the section or video frames that he/she intends the students to view, to allow them to find that section directly. To achieve the desired aim of teaching and learning, it is not a good idea to choose long and unedited videos that can have unnecessary information and can be boring for the students.

Students click on the links provided and proceed directly to the site where the video is hosted. These videos are never hosted on University servers to avoid problems of copyright. It is of course necessary to verify regularly and systematically whether the links still work and that the videos have not been deleted.

One disadvantage noted by a few students was that most of the videos and some texts were in foreign languages, principally English (though some were in Spanish and French, if we were not able to find an English version).

Videos made by the course teacher are also good teaching tools. It is not too difficult to make a video by inserting slides and recording an explanation, by using software such as moviemaker (free software), and then to make a video with the teacher's comments using a programme that records the computer screen and the teacher's voice (for example with programme ScreenR that is freely available on the Internet). This can also be used at the start of the course to describe the course structure to the students and explain the different modules they have to complete. Another way to use this method is to explain some part of a film in a foreign language. The teacher can record it from screen with the explanation in the course delivery language or make his/her own legends. This allows exclusive attention from the students with regard to some aspects of the video and leads to a better understanding of the subject than previously.

The numbers of accesses to the videos were high in both years, verifying that students watched each video more than once. The feedback given by the students was that they would not have been able to understand the subject matter so well without videos on the behaviour of animals and the different ways that various aquaculture activities are carried out. Sometimes, it was very clear that students understood the subject areas better after watching the videos.

Slide sharing presentations were included from some aquaculture projects, for example the Seacase project. Sometimes, enterprises, in order to advertise their production, made their own videos and slide presentations of high quality.

There is also an online *forum* for each subject, to allow students to interact and discuss the theme. It is very interesting to have students from different regions of the world because they share their experience with their colleagues and this enables students to learn other types of cultivation and to solve the problems that occur related to aquaculture.

If the teacher ignores the students and does not interact or intervene in the forum, then the students do not participate much in discussions. The teacher may then notice that students have just added some short messages about the subject or have started introducing themselves in the forum. Quite often, the forum will not be used as a discussion point but just to leave messages. When this occurred, it was necessary for the teacher to intervene in order to promote the discussion. This can be done with a comment or by adding questions. To promote discussion between students, it is necessary to have the semi-permanent attention of the teacher accompanied by teacher interventions.

Sometimes, students need to discuss face to face with the teacher as written posts may have become too difficult. In this case, the teacher should propose setting up a *Skype meeting* and a discussion in real time. This has to be arranged in advance to allow the presence of all interested students, who may live in different time zones. Normally, this would occur when students were not at work, usually at night or over weekends. The Skype meeting is optional and should take place only at the request of the student(s). It can

however be very productive and in general students who participated found it very helpful. It is also a way of having some feedback concerning the students' opinion of the course.

Assessment method

In this course, the instrument used was continuous assessment, with evaluation of participation in several forums as well as two digital written assignments during the semester (one on fisheries and the other on aquaculture).

Written assignments accounted for 60 % of the final grade. Participation in the forum (each has a time limit, defined in the learning contract) accounted for 40 % of the final grade.

Ability to participate in discussions on subject areas and the way they contribute to the forum is evaluated. Sometimes, the teacher posed questions to which the students must respond, justifying their opinions with the appropriate theoretical foundations.

The purpose of the written assignment part of the assessment of the aquaculture module (delivered in LMP) was to allow the students to undertake work experience in an aquaculture facility in nearby locations; this can be offshore at sea or in a freshwater location, or onshore tanks depending on where the students live. If they live in a place with no aquaculture facility, then we allow exceptional cases to demonstrate their knowledge in alternative ways.

First, they must post in a forum reports from each fish farm they have chosen. The work consists of describing some activities carried out in aquaculture such as

- localisation and characterisation of what type of aquaculture (extensive, intensive, outdoor and so on)
- species cultivated, the equipment used and techniques for on-growing the species, including the type of food
- level of production and the management strategy used
- the reaction from the population living in the vicinity of the farm (agree/disagree).

Normally, students visit the farms, take photographs and will have contacted the site staff to allow them to carry out their work placement. This is one way of helping students to be in contact with stakeholders. A good number of students go more than once to a specific aquaculture facility and as a result have gained valuable work experience.

Until now, this methodology has given good results, and the feedback given by students is very positive. For teachers, it is also positive because they learn more about aquaculture practices in other countries. During the study, if a student feels it necessary to get support from the teacher, they can do so by posting in the forum or requesting a Skype meeting to discuss the work. The aquaculture site staff have been very supportive, and so far, the students have had only good experiences.

Results and feedback

The success rate for this course is 77.4 % of approvals, but if we take out the dropouts [those who abandoned the course and did not participate and did not submit written assignments for evaluation (seven)], then the success rate rose to 96.0 %.

The students commented on the usefulness of the knowledge acquired in the course and commented that their opinion about aquaculture had changed. These comments were made to the teacher in either the help or another forum, or by Skype conversation. 20 % of

students carrying out this Master course wrote their thesis related to the course materials on fisheries and aquaculture.

e-Learning case study in Scotland

Delivering courses to learners coming from within the aquaculture industry is considerably more challenging than to learners engaged in conventional higher education courses because of the varied age groups, varied ICT skills and their time-consuming work at sea.

The course developers opted to use the open-source Moodle platform, principally because it is more cost-effective and also gives the freedom to design the course exactly as required. There are some disadvantages of using open-source platforms such as Moodle, for example, compatibility with external software tools and plugins and the issue of upgrading from one version to the next advanced version which has been challenging at times.

The first e-Learning course was successfully launched in 2012 using Moodle, and as a result, a few other courses are currently being developed for online delivery. The majority of the learners were from the west of Scottish mainland, Orkney and the Shetland Islands. If a student were obliged to travel (ferry or plane) between these islands, it could be very expensive and time-consuming, hence e-Learning offers flexibility in learning and removes both physical and geographical barriers.

Course design

The course material (previously written for face-to-face delivery) was provided by the tutor responsible, which allowed time for reflection on the unit description, learning outcomes, performance criteria and the choice of appropriate assessment instruments. The course design had to embrace the same learning activities and assessments as the face-to-face delivery course in order to achieve the intended learning outcomes. The challenge for the online developers was to make the design simple but to make use of tools requiring minimal support when in use. The Moodle software was installed and later used in the design of the course layout. The design was finalised after several modifications and trial runs after receiving feedback from the tutor and other peers. The design is such that after logging into the Moodle website, the learner is directed to do the e-Learning induction first; the same is available on the main course page so that the learners do not have to navigate back. The course menu is split into simple sections as follows:

- Course information: e-Learning induction, course summary, course handbook and a study plan
- Theory: learning resources for each learning outcome
- Assessment: practice assessment (mock) to be done first and marked final assessment to be done later to complete the course
- Grade report
- External resources: links to other websites
- Frequently asked questions: all questions and answers to help students with general queries related to the course
- Contact details.

From the developers' own experience as online learners, they were able to recognise potential obstacles that exist for first-time users in certain online tools. For example, being

a confident Internet user does not necessarily make one a confident online learner. Studies conducted by Peacock and Murray (2009) on learner experience in using ePortfolios in the early stages have found that there was a lack of engagement from students and there was no perception of ownership of learning among the students; this could be linked to the fact that students and tutors not only had to learn new skills but also that the purpose of ePortfolio had not been made clear from the start. To avoid similar situations, the developers focused on creating awareness about e-Learning, the learning outcomes of the course as developed by the tutor and the course induction instructions to learners showing how to navigate easily or to find their way around the course materials. e-Learning instructions were given as a brief summary with a detailed Portable Document Format (PDF) document, and learners were encouraged to download it as a stand-alone copy. The tutor also sent the same material with login instructions to every newly enrolled student. A video induction was also available with instructions from the login page. Feedback from learners and peers showed that they appreciated both modes of induction.

Tools and plugins to facilitate learning

The learner experience surveys are important factors for the teacher or course developer to consider while designing a course and mapping the tools. The quality of learning does not depend directly upon the tools directly but as to how the tools can make an impact on the learners' learning experience. There was very good IT support from the NAFC IT Centre which often reminded the developers about the perils of adding too many graphics, images and videos with high memory usage, which affect the download speed for the learner. It comes as a surprise for academic practitioners to realise that not all learners are able to use a relatively new version of operating systems and hardware on their computer systems. This also made the developers aware of and alert to the need for reducing the file size by compressing images, file size and using formats that use less memory space. At the same time, the tutor was always consulted to verify that the quality and integrity of all course resources and assessment materials were maintained in the Moodle.

The course resources were offered in different formats so that the learners had the choice of adopting or adapting their individual learning styles such as

- Course Web pages—text and images
- PDF file document
- Web pages (SCORM) with navigation to individual topics and inbuilt quiz
- PowerPoint as flash video format
- Induction video uploaded in Youtube with private link
- External resources given as links to open in new Web page.

The *PowerPoint* presentation used more file size so it was converted into a flash video format that offered better navigation to slides and notes for the learner and was quick to download. External software was used to develop *SCORM* packages to upload into the Moodle platform, as well as several blocks and plugins available free of cost from the Moodle website. For example, the 'Study Progress Bar' was a very useful tool for students and tutors. Each topic, tasks and learning activities in the course page are automatically registered as a series of blocks appearing as 'red' in colour to begin with and each time the student completes a task it changes to green. This means that the student can simply look at the study progress bar to be reminded how many more blocks are still in red (when the mouse/cursor is pointed at each block, it gives the title of the task or activity and the learner can click on the link to navigate directly to that task to complete it). This is also

useful for tutors as they can have an overview of all the students' progress levels in just one page. Other blocks were used in developing quiz questions, such as drag and drop options that again give more variety in developing interactive questions. The student feedback received showed that they enjoyed the quiz very much and that the study progress bar was useful to monitor their learning.

Accessibility

It is difficult to cater for learners with various special needs (such as dyslexia and colour blindness) and learning styles but the effort must be made in order to make the learning resources as accessible as possible. The NAFC Marine Centre has the responsibility to provide support for learners with extra needs and to ensure that they are treated fairly. For example, on the Moodle, the developers made sure that the navigation is kept simple, clear and visible so that learners do not waste time or feel frustrated by being lost. Similarly, PDF documents and Web pages were made with contents page with hyperlinks for headings and subheadings, background was matched to creamy white, font style (such as Calibri and Verdana) and font size as per accessibility guidelines given by the University of Highlands and Islands and other agencies. There were no headings in full upper case or lengthy sentences in italics which can make reading difficult. Podcasts with audio transcript are to be made available for certain topics in 2014.

Assessment

There were two parts to the assessment, a mock self-assessment (Photograph id Quiz, multiple choice, short answers and so on); except for the short written answers, all other questions were computer-marked so that the learner was immediately aware as to whether h/she has given the correct answer. The mock self-assessments were marked to assess the learner's knowledge and preparation, so that the tutor could give suitable support and enable the learner to undertake the final marked assessment.

One of the challenges in online learning is trying to simulate classroom learning, where the tutor and learners interact through questions and discussions, or having a pause after a brief session to recap the completed session. The tutor was consulted about this, with the aim of recreating classroom scenarios with the questions and answers that come up during face-to-face teaching. The software used (such as Wimba-SCORM and PowerPoint video converter) has the capacity to build quiz questions into the course learning material so that the learner is prompted to have a pause and answer the quiz questions before moving to the next session. The adaptive release technique was used so that the screen locks and the learner cannot skip the quiz without answering. The quiz question gives instant feedback for the chosen answer and support notes to the learner before proceeding to the next page. Such activities reinforce the learning process and ensure that the learner has an active participation with the learning content.

Tutorial support, communication and feedback

The course developer was responsible for the design, maintenance and support for the Moodle platform; it was the course tutor, a very good teacher and facilitator of learning, who communicated directly with the learners. The tutor was always in communication with students through regular messages and sometimes by phone offering tutorial support and

feedback. For example, the tutor might verify each learner's self-assessment (mock) grades to check whether the learners were ready for the final marked assessment in order to complete the course successfully and if not the learner would be advised to revisit the learning resources pages to read further.

Instant feedback from computer-marked questions and the tutor feedback helped learners to reflect upon their learning. The formative feedback given through tests, activities and discussion encouraged students to reflect on and self-regulate their learning (Nicol and Macfarlane-Dick 2006). In this way, students were able to take responsibility for their learning. Furthermore, in virtual learning environments, students develop a relationship with their peers as well as their tutor and, over time, the group becomes a community of practice with knowledge-sharing and support. This can be of real benefit in further education, especially for the courses of short duration, where the diversity of learners coming from the aquaculture industry and continuous enrolment do not give them enough time to engage in discussion with their peers.

The e-mail notifications and message options were enabled in the course for the tutor and learners to receive notifications and messages; for example, a learner completing a quiz activity was notified automatically to the tutor.

The Professional Development Award offered online was well received, and the NAFC had good feedback from all the students and other agencies. There were challenges at times: some of the learners based on remote areas had poor broadband connections; a few older students lacking in IT skills took more time to complete the course; for some others, full-time jobs and family commitments made it difficult for them to allocate enough time for the part-time study. At the NAFC, we have found that part-time study requires a lot of planning to fit in with work, family and social commitments.

However, it was the good teamwork within the NAFC that was the decisive factor in the successful delivery of the centre's first online course developed from an open-source platform. The very versatile Moodle software used has the flexibility of design and modification to suit the needs of the NAFC. There was a real challenge when it was necessary to upgrade from one version to the next advanced version, which often caused compatibility issues with installed plugins and blocks. Moodle which undergoes continuous development is now more user-friendly for students, tutors and course developers. The objective pursued by the NAFC Marine Centre in its course design is to create an effective learning practice to tap the learners' diverse learning styles and to offer greater flexibility in their learning experience.

Table 1 Levels at which the change was made in the two cases studies

Levels at which the change was made	Portugal case	Scotland case
Use of new materials or modified materials as teaching and learning resources or curriculum technologies	X	X
New approaches to teaching, such as the implementation of new strategies or teaching activities	X	X
Change in beliefs such as assumptions and pedagogical theories underlying some policy or new programmes	X	X

Conclusions

New and emerging technologies are provoking a re-conceptualisation of teaching and learning for innovative learning environments, while serving as catalysts for change and innovation (Groff 2013).

Educational change involves a change in pedagogical practice: the educational changes can be made at three levels (Fullan 2007), described in Table 1.

In the cases of e-Learning which have been presented in this paper, we were able to verify that learning resources created with the support of technological tools were well used (the creation of texts in PDF format, course Web pages with text and images, Web pages, quiz, videos, electronic presentations, and also in flash video format and forums). The flexibility associated with ICT communication removed both physical and geographical barriers. For example, Skype meetings, messages and e-mails helped students to avoid expensive and/or time-consuming journeys. In both case studies, the courses were structured on the platform LMS Moodle. This experience has demonstrated new approaches and strategies in teaching and new learning activities for teachers and students.

On the other hand, previous strengths can turn into weaknesses; for instance, compared to face-to-face interaction, online interaction is a delayed interaction. This can cause students to lose interest because of the time lapse in communication. There can also be potential deviation from the original point of discussion, something that has occurred in the authors' several years' experience of participation in a discussion forum (participation in a discussion forum was an assessable activity in some modules). Occasionally, a student might be trying to catch up with the class because of missing a week. Sometimes, there could be a gap of several days before the teacher/tutor replied to posts which had been completed on time. Being an online tutor (moderator or facilitator) is an important and distinct skill as he/she has to facilitate the discussion with appropriate activities (questions or tasks) and to intervene at the right time yet allowing students to initiate peer learning. On the other hand, however, a prolonged lack of tutorial intervention can affect the student's enthusiasm for the forum.

To allow teachers to incorporate ICT and various tools, teachers must change their beliefs so that they can experiment to realise the full potential of the methods employed.

For teachers, 'learning to do' is very important but it is also important for them to understand why they are involved. Such knowledge can make all the difference between the deepening of a new practice and its sustainability in new contexts (McLaughlin and Mitra 2001). In these *two case studies*, we have described not only what was done but also why it was done, which are the goals of this pedagogical model. We observed that in the Portuguese case study, the employed methodology was already part of the pedagogical model of the Universidade Aberta; therefore, the teacher could adopt it easily, using the technological tools necessary for its realisation. Sharing knowledge and skills in a community of practice among teachers from the same department can bring large-scale benefits for the whole university. Also worth mentioning is that Universidade Aberta, as the pioneer of distance learning in Portugal via e-Learning, shares its practices with other universities that started only a few years ago, complementing their classroom education with some e-Learning and blended-learning practices. The Scotland case study concerns an experience devoted to vocational courses in aquaculture and is not a generalised activity carried out by a university institution. Nevertheless, it is the initiative and effort that counts. How it is described here deconstructs the decision-making behind the methodology of a specific course that will in the future, like the Portuguese example, be used as a template to apply these innovative experiences to other contexts.

These cases studies provide us with an invaluable testament as to how to instigate and carry out innovative course development in e-Learning, using valid and reliable assessment instruments along with various tools demonstrating the creativity and the pedagogical innovation in certain parts of the teaching profession located in remote and geographically distant areas.

These two cases have also demonstrated the advantages of e-Learning methods in aquaculture training: such courses allow the participation of students from localities distant from universities or other training providers and/or also allow aquaculture personnel to continue to work during the course. This shows the reliability of what has already been stated by Seixas et al. (2012) that aquaculture is a global activity where e-Learning is a more rapid and efficient method for the teaching, learning and dissemination of innovatory techniques within the sector.

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