# Output 7:
# Guidelines demonstrating how Scotland apply e-learning training methods

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# ASK for Better Practice

## ASK for Best Practice

# Content

# Summary

Section 1 explores E Learning definitions to set the scene, before Aquaculture E Learning practices in Scotland and the 'Ask for Best Practice' partnership are elaborated in section 2, identifying some key lessons, and culminating in general good practice guidelines.

Section 3 provides comprehensive guidance for those who are relatively new to E learning development, largely derived from the Scottish experience. This starts with the development of learner profiles to underpin a learner centric approach to E Learning design, before considering general design principles. Detailed guidance on the diverse range of communication media that must be considered when creating high quality interactive E Learning, follows. The use of text, images, audio, graphics, and video within E Learning are all given full consideration, revealing many important practicalities and good practice pointers.

This section concludes with a comprehensive evaluation of leading learning technologies, including Learning Management System (LMS), E portfolio and the authoring software developers use when programming SROM compliant E Learning courses. The full details of the LMS evaluation from technical and user perspectives are provided in appendices 1 and2.

Section 4 starts by describing the principles of 'instructional design' and the benefits of story boarding, a discipline central to the creation of quality assured E Learning courses and instructional videos. The storyboarding process is presented in detail and illustrated by the three exemplars provided in appendices 3, 4 and 5. The essential individual roles that make up an E Learning development team are outlined.

In conclusion, the section encourages any new E Learning development initiative and/or partnerships to rigorously evaluate their E Learning development capability with a strong emphasis on staff skills and experience, to ensure that their ambitions are realistic.

# Introduction

The application of E learning has been accelerating globally this century and has helped to widen access to tertiary education. There have been many reasons why organisations have adopted E-Learning, ranging from the banal "me to" mentality of institutional leaders wanting to be seen as more educationally progressive than their peers, through to those taking a more serios and strategic approach, seeking genuine improvement to their educational offer and/or VET business model.

As the purpose of this report is to develop guidelines in the application of E learning to Aquaculture VET, it is important to understand how educationists define "E -Learning". According to some observers, the term "E-Learning" has only been in existence since 1999 when the word was first utilized at a CBT systems seminar. Other words also began to spring up in search of an accurate description such as "online learning" and "virtual learning". However, others claim E-Learning has a much longer history.

As illustrated below, the term is characterised in many ways. However, within the plethora of definitions available, some facets are commonly recurring.

## E learning definitions

Many definitions are simple summaries, as exemplified by this list below:

a) *E-Learning is learning techniques by utilizing electronic technologies to access educational curriculum outside of a traditional classroom.*
b) *E-learning, also referred to as online learning or electronic learning, is the acquisition of knowledge which takes place through electronic technologies and media.*
c) *In simple language, e-learning is defined as "learning that is enabled electronically".*
d) *E-Learning is the use of technology to enable people to learn anytime and anywhere.*
e) *E-Learning includes training, the delivery of just-in-time information, and guidance from experts.*
f) *E-Learning includes numerous types of media that deliver text, audio, images, animation, and streaming videos, and includes technology application and process such as audio or videos tap, satellite TV, CD-ROM, and computer-based learning as well as local intranet/extranet and web-based learning.*
g) *E-Learning uses technology to enhance and expand the learning experience. These technologies are used to create and deliver individualized, comprehensive dynamic learning that facilitates learning anytime and anywhere*

Most refer to the application of digital technologies. Some go further to describe the wide range of media that can be used within E-Learning. One refers to the individualised nature of E-Learning and its convenience, whilst another refers to providing access to learning away from the traditional classroom.

The following definition widens the scope further:

> *"E learning encompasses everything from traditional classrooms that incorporate basic technology to online universities. E-learning in a traditional setting may include educational films and PowerPoint presentations"*

Contrary to the (a) above, traditional classroom-based learning can be the setting for the application of some forms of E learning according to this definition. However, all of these 'different perspectives

help to 'characterise' E-Learning' and the true diversity of its application within the world of education.

## Blended learning

It should be noted at the outset, today, E Learning has rarely been adopted as a complete learning strategy. Within the confines of this study, other than one Scottish exception, elaborated in section 2, Aquaculture VET E-Learning has been applied with other VET approaches as part of a 'blended learning' strategy. Whilst many early pioneers last century often portrayed E-Learning as an alternative and 'straight swap' for conventional face to face delivery, over time, the limitations of this approach for most learners and VET institutions became clear. Today, blended learning, with E-Learning as a significant component, is widely accepted as more effective in most situations. VET learners have a wide range learning styles but 'learning by doing' (kinaesthetic learning) is often a dominant feature. Therefore, underpinning knowledge must be applied and explicit within VET delivery, as opposed to abstract and theoretical, for learning to be effective.

Before the E-Learning component of a VET delivery system can be designed and developed, an over-arching learning strategy must be formulated and target learners with known needs. Following a needs analysis, most VET providers choose to adopt E Learning within blended learning, as their chosen direction of travel.

Typically, most tertiary education providers in the 'VET space' gain experience of conventional attendance-based delivery, before progressing to E learning. The drivers mostly fall into one of two camps: improvements to VET quality or widening access. Both learners and institutions can benefit, as a virtuous cycle of VET improvement and expansion is synergised. However, VET practitioners making the transition from conventional attendance-based VET delivery to delivery which depends, partially or entirely on E learning need to recognise that excellence in one field does not automatically transfer to the other. An entirely new skill set, process and team effort is required for effective E-Learning development and its application.

## The emergence of Aquaculture E learning

In the context of meeting the challenge of delivering Aquaculture VET and Higher VET to work-based learners, E learning is a particularly exciting prospect. Most countries with an aquaculture industry are recruiting a large proportion of staff locally who are untrained and unqualified, and the nearest aquaculture VET provider is often too distance for attendance-based VET delivery. Therefore, unconventional delivery modes become a necessity. Employers often do take responsibility for staff training and development and a lot can be accomplished through company schemes. However, those farming in countries with a mature VET system, prefer to work in partnership with their Aquaculture VET providers. This incentivises innovative industry/VET provider partnerships and VET delivery systems, with E learning as an essential element within a blended learning strategy.

This study starts with a search for examples of good practice in Scotland. The recognition of Scotland's Aquaculture VET E Learning experience grew from 2016 onwards during EU funded Aquaculture VET innovation projects. The first of these, the BluEDU Sector Skills partnership revealed the relative strengths of the main Aquaculture VET providers in northern Europe, including Scotland and the Nordic countries. It became clear that whilst Norway led the field with its school-based provision for young entrants who accessed well-equipped farms for training through industry partnerships, Scotland had a flexible unitised work-based qualification system and more experience

of E learning within VET delivery to service geographically remote learners. The European partnerships exposure to the Scottish VET system was consolidated within the Norwegian led Optimal VET innovation Strategic Partnership, culminating in Scotland being asked to share their E Learning experiences and lessons more fully within the Ask for best practice partnership.

However, during the development of the study, it was recognised that the lessons from Scotland should presented in a wider context of E-Learning practices within the partnership. The aim being to ensure the study had relevance to the emerging Nordic led Aquaculture Centre of Vocational Excellence being developed from November 2020.

## Scope of the study

The widest E-Learning definition has been applied to the initial evaluation of existing practices described in section 2. Scotland, and the Ask for Best Practice partners have many valuable E Learning experiences, including some successful attendance-based practices. The important lessons highlighted throughout section 2 have informed the good practice guide to E Learning development in section 3. Section 4 concludes with a self-evaluation framework based on the good practice guide which can be used by institutions and partnerships to assess their E Learning development strengths, weaknesses, and readiness. The output from such an evaluation can be used as a 'gap analyses to inform action planning during the early stages of an E Learning development initiatives.

# E Learning practices in Scotland and within the partnership

The aquaculture sector in Scotland, Norway and Iceland all set ambitious growth targets for the next two decades. As the sector becomes more reliant on technology, it will need a range of staff, some with a general fish husbandry knowledge and understanding and others with more specialist operative skills. All staff will need to be good problem solvers, collaborators, and team workers. Currently all three countries struggle to recruit qualified and experienced staff and skills shortages are growing in key areas such as aquaculture engineering, due to competition within the wider labour market.

## Scottish Aquaculture E-Learning lessons and experiences

The Scottish aquaculture education arose in the 1970's as the industry was being established and the University of Stirling, 'stepped up' to develop post graduate courses in aquaculture and related fields. Subsequently, several Scottish colleges started offering aquaculture VET in the 1980s, targeting the husbandry operative, followed eventually by Higher VET to serve the needs of aspiring farm unit managers. Concurrently, government funded work-based training schemes providing pathways to National Qualifications that required little to no college attendance were established by the UK government.

Research by the Blue EDU Strategic partnership in 2017 revealed that the Scottish industry had become very reliant on in-company training, designed to ensure staff followed company Standard Operating Procedures (SOPs). This was bolstered by external training to ensure staff were able to safely operate machinery and were compliant with national or international regulations and quality assurance schemes. By this stage, the only currently active NQ at VET level was the work-based Modern Apprenticeship (MA) in Aquaculture (Levels 2-4).

Some important workforce knowledge and skills gaps were revealed by the industry, including fish biology, health and welfare and the aquatic environment, as well as a dearth of preparation for staff stepping up from husbandry level to become site managers. Although many companies had developed comprehensive 'in house' training through necessity, innovative approaches to staff development, were seen as increasingly valuable, including E Learning, to complement in company training and MA delivery.

Under Scottish Qualifications Authority (SQA) governance, the Aquaculture Scottish National Occupational Standards (NOS) inform the development of attendance and work-based Aquaculture NQs within VET and Higher VET. Industry consultation regarding National Occupational Standards (NOS) and their updating is managed by LANTRA, the Sector Skills Council for the 'Land and water-based industries'. Each NQ is composed of a prescribed set of mandatory units. Additional optional units must be selected to make up the required credit value. This allows qualification designers, learners and their employers, flexibility, and choice. The prescribed learning outcomes and assessment criteria ensure standards are consistently applied by all providers. This unitised VET system is conducive to the application of E learning as shared frameworks of learning outcomes can underpin the development process.

**Key lesson 1**

Framework of learning outcomes

*"A nationally recognised framework of learning outcomes can support the collaborative development of E Learning resources, making it easier to share the development responsibility and outputs"*

E Learning has been developed and incorporated by Scottish Aquaculture VET providers in several different contexts considered below, including some ongoing initiatives.

## University for the Highlands and Islands (UHI)

The UHI provides Degrees and Higher VET across Scotland and has an expansive 'estate' and wide range of facilities and to serve the Scottish Highlands and Islands. Due to the dispersed nature of their learners, remote learning methodologies, including video conferencing and E learning have been a vital from the outset. The experience gained within the UHI network has benefited their Aquaculture VET providers.

The North Atlantic Fisheries College (NAFC) have served the Shetland Isles and Inverness College the Scottish mainland for many years However, BlueEDU research in 2017 highlighted some issues. Although E learning was at a well-advanced stage of development at the NAFC this was of limited benefit to the mainland industry, making up two thirds of Scottish production. The MA delivery system requires regular tutor visits to develop and maintain a close working relationship with the farms trainees and to monitor and support trainee progress. This makes the NAFC Shetland geographically unsuitable to serve all of Scotland. As there was no formal collaboration and a 'competitive spirit' prevailed, the NAFC Aquaculture E Learning resources have not benefited the rest of the UHI network. Consequently, Inverness College, the only provider on the mainland, had no E learning capacity.

Today, Argyll College lead the development of the new National Maritime Academy at Oban and have recently taken Inverness College's place as the mainland lead provider. They are developing their E learning capacity and are keen to collaborate with other European Aquaculture VET providers.

Before considering each of the UHI providers, there is an important overarching lesson to take from the UHI experience. Despite their obvious capability as an organisation in the development and delivery of E-Learning, they failed to establish collaborative development within Aquaculture E-Learning. A collaborative culture is often a pre-requisite to successful E learning developments, particularly within a VET sector composed of small institutions with resource constraints. This is one of the most valuable lessons for any ambitious emerging E Learning partnership to take from the UHI experience, and a mistake to avoid repeating.

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**Key lesson 2**

Benefits of collaboration

*"When small institutions with limited staff capacity aspire to develop a high-quality Aquaculture E Learning resource, the development process needs to be 'scaled up'. Formal collaboration is often the best way to achieve this.*

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- The Inverness College legacy

UHI Inverness College has the longest history of Aquaculture VET and established a training centre for salmon and shellfish aquaculture at Kishorn on the west coast in the 1990s to support the delivery of college attendance-based courses.

When the recruitment to full time courses eventually declined, the Kishorn training centre was closed. The one remaining lecturer and a part time assessor focussed on delivering the Modern Apprenticeship in Aquaculture (Level 2-3) for employed status industry recruits. They designed a low-cost, but sustainable delivery system which heavily relied on work-based assessment and a paper-based e portfolio system. There was no attempt to develop E learning at the outset as they did not have the staff capacity, skills or institutional support to do so.

The MA trainees never attended college and the delivery was 100% work based, supported by the lead tutor, work- based assessors and farm supervisors. Trainees were encouraged to access basic learning resources, which tended to be a list of useful web site references to support Investigative learning tasks based on farm's practices. This 'open book' form of knowledge assessment provided the portfolio evidence required to complete the MA. The practical skills training was delivered by employers, normally as an integral part of company training schemes, and employer witness testimonies, underpinned the assessment of practical competence by the VET provider.

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**Key Lesson 3**

Senior management support

*"When Aquaculture VET practitioners work in isolation with a paper-based distance learning system and lack the necessary time and skills to innovate, delivery can become antiquated and no longer 'fit for purpose'.*

*This self-perpetuating cycle can be difficult to break as an individual VET practitioner, or small institution, without senior management support"*

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The staff found that the MA worked well for motivated mature trainees aspiring to be well rounded' husbandry persons, but less well for those seeking a more specialist role, such as the disease treatment boat operators. The level of maturity and self-motivation had an impact on the suitability of this low input distance learning strategy for some learners.

Information and Communications Technology (ICT) was assumed to be embedded within the MA Award and does not have to be taught or assessed. Although only half of the learners engaged with ICT, this was not a barrier to them completing the MA at Level 2 (husbandry). The lack of emphasis on ICT was unconducive to an increasing reliance on 'E Learning' or developing the digital skills required by the future workforce.

The lead tutor believed that their own personal development would be best supported by improved 'aquaculture technology foresight'. They made no reference to their need for E-Learning development and delivery skills, probably because they had become accustomed to paper-based systems. However, when asked what the most useful additional aquaculture leaning resources would be, they acknowledged that keeping technical reference material current was difficult and the lack of up-to-date textbooks an issue. An up to date 'Aquaculture E book' was seen as a big advantage. The less ambitious and interim approach was the use of 'pre-vetted' web-based information from suppliers, which could help to save tutors some development time. This was indicative of an extremely low level of E-Learning ambition from the lead tutor at the time.

> **Key lesson 3**
>
> Choosing technology
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> *The Optimal pilot showed that modernising MA delivery was beneficial as learners responded well to RPL delivered through Response Technology (RT).*
>
> *However, RT was not the most appropriate technology to deploy within the Scottish work-based learning system or within online learning.*

When Inverness College joined the Optimal project in 2018 as an Associated Partner, attitudes started to change. The staff supported a pilot, deploying 'Response Tools' (RT) to support the Recognition of Prior Learning (RPL). Based on their RPL result, learners were provided discrete targeted 'learning episodes', so as they could address the knowledge gaps identified. The initial trials were encouraging and well received by learners and VET practitioners, despite some difficulty with the technology itself.

It was concluded that the RPL and personalised learning approach would have worked more effectively by departing from RT and converting to an online delivery format within a Learning Management System (LMS).

- Argyll College and the mainland UHI provider network

Argyll college now leads Modern Apprenticeship delivery on the Scottish mainland and will be developing pilots following the imminent updating of the MA framework in 2022.

They have established a more comprehensive approach to E-Learning, which also includes E-Assessment and have the necessary software in place. The Brightspace LMS is deployed to host learning resources, and is used it as a repository, and for embedding quizzes, video, and formative assessments. However, the LMS is not well populated with aquaculture learning resources, due to staff constraints. Consequently, Argyll college are keen to join future collaborative development initiatives.

The LMS is not used for summative assessment as the functionality is limited in this respect, consistent with most commercial LMS. They deploy vendor supplied software called the 'Learning Assistant E Portfolio' superseding the laborious paper-based portfolios employed by Inverness College. The system is populated with the MA assessment standards and is accessed by learners, their lead tutor, work-based assessors, and verifiers, to support the assessment of practical skills and competences gained on farms.

> **Key lesson 4**
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> E Assessment
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> *"Commercially available LMS do not have a sufficiently comprehensive E portfolio that is capable of supporting the digital evidence gathering and validation process underlying quality assured work-based assessment.*
>
> *E Portfolios from specialist vendors or a bespoke system developed by a software programmer are required to support work-based assessment"*

The system can accept a wide variety of files, including text, audio, visual images, and video. These files can be posted by the learner as evidence to support the attainment of specified practical competences. The assessor enters the system to judge the assessment evidence and provide feedback as well as determine when there is sufficient evidence to meet the competence criteria. Over time the portfolio evidence can be built up to demonstrate that all assessment criteria have been met. The system is also accessed by the assessment verifier who ensures standards are being applied correctly and consistently by the assessor. Once they have approved the assessors work, the portfolio is submitted to the SQA contributing to certification and the award of the Modern Apprenticeship.

Argyll College collaborate with Inverness and West Highland College, and all three providers use the Brightspace LMS. This group are all mainland UHI members, which will allow mainland MA learners and their farms to choose the nearest centre offering the MA. The learners are supported by a lead tutor and assessors who service all the mainland provision and are mobile, working between the centres.

The ongoing modernisation of work-based delivery through increased use of the LMS, and E Portfolio applications will limit the travel requirements for staff and learners in the future. The future MA learners will be trained to become proficient users of their LMS and E portfolio, encouraging them to drive the assessment process, with staff accessing their portfolio evidence remotely and able to operate over a wider geographic range on the mainland.

- NAFC Shetland

The NAFC team of 4 VET practitioners are the most advanced regarding E Learning applications within Aquaculture VET. They deliver the MA in Aquaculture at levels 2-4 (husbandry operative, supervisor and manager levels) to Shetland farms and employed status learners, heavily supported by E-Learning, using the Brightspace LMS, which has become the UHI standard. They have also used E Learning to deliver uncertificated specialist short courses to industry on both Shetland and the mainland.

Although they have had a lot of experience in both development and delivery of Aquaculture E Learning, unfortunately they are not collaborative and the resources and lessons learnt are not available to other VET providers, including the mainland UHI network.

## University sector

The Universities, most notably Stirling, were first to offer comprehensive tertiary education, by providing Master of Science Degrees and pHDs in aquaculture and related veterinary science. These courses were designed for natural science graduates from the UK and overseas, some of whom found employment in their emerging aquaculture industries on completion. The decline of Scottish VET provision this century has helped some Universities to increase their Aquaculture online presence and St Andrews University now occupy the Higher VET space.

- St Andrews University

The St Andrews University E Learning programme in 'Sustainable Aquaculture' is the only comprehensive Aquaculture distance learning offer available from a Scottish University. The program is 100% 'on- line learning' and the development of practical competences is not a requirement to complete University certification.

**Key lesson 5**

Online learning commercial partnership

*"Through commercial partnership, an interdisciplinary team with technical expertise in both aquaculture and E-Learning development can be established.*

*This can lead to a technically current, high quality online learning experience for aquaculture learners."*

It arose from formal partnership with 5M, who belong to a larger parent company with a sustainable food production remit, Benchmark Holdings. The formal collaboration provides access to 5M expertise, allowing the university to develop a much higher-quality learning platform and E Learning presence than would be possible independently. The partnership also provides access to aquaculture expertise from the globally renowned Fish Vet Group who are also part of Benchmark holdings.

More recently it includes provision offered at a Higher VET level, as well as graduate and post graduate levels, and partially prepares prospective new entrants to industry for employment by providing a theoretical grounding, as well as preparing those already employed for progression via the graduate and post graduate pathways.

For those learners already in full time aquaculture employment, the theoretical nature of the programme is not a disadvantage. Some have already undertaken company specific training courses which they can cross reference. However, as most are attendance based, there is no assessment process and evidence of knowledge gained. Consequently, learners welcome St Andrews emphasis on concepts and problem-solving and the opportunity to gain a prestigious university qualification to improve their prospects for career progression or employment at another company. For some mature learners, the main purpose is to gain a theoretical grounding in aquaculture to help them to decide whether to pursue a career change and enter aquaculture.

The Sustainable Aquaculture LMS is based on an open-source Moodle platform, developed, and maintained by a team of 5M technicians.  The LMS hosts webinars and skype is used to support synchronous 'real time' individual tutorials. Peer support is not actively encouraged, although

students do discuss subjects via the LMS discussion forum and may email each other outside the Moodle platform.

Most E Learning tutors have degrees and/or post grad degrees and are admitted as honorary lecturers. The University monitors their work and supports their development as online tutors. Some are from industry and others are part of the Benchmark Animal Health Fish Vet Group and have high-level scientific expertise. Most have undertaken applied research within industry, keeping them up to date with their specialisms. They are seen as the most important information source as they are at the cutting edge of their specialism, often due to their industry R&D. This provides a lot of industry experience and flexibility, as learners can always find staff able to help them with their studies. Honorary lecturers update their own learning materials on an ongoing basis, but the E-Learning instructional design and multi-media expertise is all provided by 5M.

> **Key lesson 6**
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> Development of online tutors
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> *"Staff at the leading edge of aquaculture development can be recruited and developed into effective online tutors, despite their lack of previous teaching experience."*

Multiple-choice short answer questions are used a lot at Higher VET level for assessment, with open book exams invigilated via skype at the graduate and post graduate levels. There is a time limited response to questions asked and invigilation is conducted via skype. Every module has two pieces of course work, (extended review, problem solving). The first module is assessed by exam (60%), and course work (40%). For the next two modules the ratio is the other way round-40:60. Plagiarism is effectively countered and managed through the deployment of plagiarism software.

> **Key lesson 7**
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> Multiple choice assessment
>
> *"Well-designed multiple-choice questions can be used at Higher VET level to support the formative and summative assessment of knowledge and understanding."*

Whilst generic digital skills are developed, aquaculture specific digital skills are not. However, green skills are embedded throughout all modules as sustainable aquaculture is a horizontal theme.

- University of Stirling Institute of Aquaculture (IOA)

The IOA have long established Master of Science Degrees in Aquaculture and Fish Pathology. These post graduate programmes serve a global audience and are delivered from the IOA facility on the Stirling University campus. There have been some bespoke Aquaculture courses developed in the past within projects and delivered online to specific countries, but they were short duration. There was an attempt to convert the entire Master of Science Degrees in Aquaculture to an online format, but this ambitious project was not completed.

## Private sector consultants

Scotland has also had a role in the development of Aquaculture E-Learning good practice through the activities of a private sector consultancy. Pisces Learning Innovations provide a range of services, including the development of innovative learning strategies, qualifications, learning resources and teaching staff development. They have been instrumental in establishing an 'Academy' for an emerging new global salmon producing company to support the development of staff in eight countries. A blended learning strategy was developed for the company, with E Learning at the heart, to offer company Diplomas at three occupational levels.

Standard Operating Procedures (SOPs) were developed, levelled, and used to derive the company Diploma and its constituent units. The core units will be undertaken by all, and options selected according to the role and production cycle phase staff are involved with, including hatchery and grow out.

The technical content for each unit was developed with reference to the SOPs and incorporated within story boards to provide the E learning specification. This included the architecture as defined by the incorporated links, text, images, graphics, learning activities, multiple choice formative assessment and videos. The more comprehensive instructional videos are carefully designed to demonstrate company procedures and their specification is presented as a video story board.

The market leading Articulate software was chosen as the SROM compliant E-Learning 'author ware'.

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**Key lesson 9**

Storyboarded specification

*"Story boarding is central to instructional design, specifying all of the text, graphics and visual media that need to be incorporated, as well as the interactions and architecture of the course.*

*The technical aspects of course and resource creation to be outsourced once storyboards have been created and approved."*

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Articulate courses were programmed, as specified by the story board scripts, and the graphics outsourced to a company specialising in E Learning course development, including associated visual resources.

Moodle Workplace has been selected as the company LMS and may be complemented by an E Portfolio to support the competence-based assessment process for practical skills. Alternatively, the required E portfolio functionality may be programmed within the open-source Moodle.

Although E Learning is at the heart of the learning and assessment strategy, on farm skills training and assessment, and other approaches including guest lecturers are included, within a blended learning approach.

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**Key lesson 8**

SOP foundations

*"When a company is adopting E Learning, Standard Operating Procedures (SOPs) provide the foundations to the design of E Learning courses and resources, such as instructional videos.*

*SOPs can also inform the assessment of practical competence and knowledge at each occupational level."*

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## Lessons from the Nordic 'Ask for best practice' partners

Although the two Nordic partners share some of the same challenges when it comes to providing remote mature learners access to Aquaculture VET, their aquaculture industry and VET sectors are at different stages of development.  Norway has by far the largest industry and Aquaculture VET sector in Europe, where as the Icelandic salmon farming sector is at a relatively embryonic stage. The planning system is being navigated to address regulatory barriers to the expansion of farm site licences, assisted in many cases by Norwegian parent companies. Both countries have had some valuable experience of VET innovation including a range of Learning technology applications, to try and overcome the VET access issues they face.

## Norwegian tertiary education

Norway has excellent cooperation between industry and its 14 Schools provide VET to young entrants of the highest quality. Farms in the locality of each school provide young learners access to their sites for farm-based training on a regular basis. Once they have completed a period of full-time attendance and enter employment, they progress to the apprenticeship stage. However, Norway faces many of the same challenges as Scotland and Iceland when providing mature learners access to Aquaculture VET. Learners are spread across a wide geographic range, and many are too far from their nearest Aquaculture VET provider to take part in attendance-based courses.

Mature learners cannot follow the conventional school-based pathway to qualification and employment. More innovative delivery systems and new partnerships between the VET sector and industry are needed to cater for this diverse group with differing levels of aquaculture knowledge and experience.

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**Key Lesson 10**

Recognition of Prior Learning (RPL)

*"RPL is a transferable concept that can be incorporated within online learning to inform learners of their strengths and weaknesses at the start of a new topic. This can help focus their mind and motivate them to study."*

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- Rapid Response Tools and Recognition of Prior Learning

The Guri Kunna school started to embrace VET innovation eight years ago, as a solution to managing large mixed ability groups of learners more effectively. A positive experience by a teacher who was an early adopter of Response Technology (RT) catalysed the EU funded Strategic Partnership known as Optimal. This project provided more staff the opportunity to innovate and develop their classroom-based teaching practices through the application of Response Tools (RT) and the Recognition of Prior Learning (RPL). The initial motivation was to gather RPL data from mature learners to help teachers better organise their classes. By prioritising the right topics according to the individual and group needs revealed by RPL, the learners' attendance-based classes became more relevant. This was a very effective use of learning technology and the RPL concept is very transferable to online learning.

- Multiple Choice Questions (MCQs) to support RPL

An analysis of the Norwegian NQ informed the development of multiple-choice questions by PLI for Guri Kunna to use within RPL, prior to the start of each new subject to establish the range of prior knowledge in the group before they attended the class. Thereafter, the Response Tool was used successfully before the start of a new topic and during many classes, to stimulate discussion and enhance course delivery and learner engagement.

The quality of the questions asked was very important when using the RT. If learners were presented relevant issues in a thoughtful and stimulating way, they remained positive regarding response tools and RPL in VET. Unprepared or unthoughtful questions that appeared irrelevant and contributed little to their learning, can lead to the application being dismissed.

Note that this also applies to the use of MCQs within formative assessment within online learning. High quality questions provide learners regular and valuable feedback on their progress, which can bolster motivation. The lessons learnt by Gurri Kuna school within Optimal are transferable to the development of online learning.

- Digital whiteboards

Gurri Kunna School integrated the application of response tools with a digital whiteboard to streamline the RPL process and make it more 'user friendly for teachers and learners. The teachers control of the RT interface from a digital board designed for ease of operation. All the buttons were large enough to be easily operated, and all functions required few finger taps. However, the digital board was not essential to RT applications, but helped the teacher to 'tell the story' and give the best possible flow to their teaching. Digital whiteboards are an especially useful classroom-based learning technology

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**Key Lesson 11**

Video conferencing

*"Geographically dispersed disparate groups of learners can be connected by videoconferencing for tutor led interactive classes. This method of delivery can also effectively complement asynchronous online learning within blended learning."*

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- Video conferencing

From 2020 during the pandemic, it became increasingly difficult for mature learners to attend conventional classes in Norway. Video conferencing was invaluable and enabled Gurri Kunna School to form an audio visual and communication link between several groups of farm based at learners to a group attending conventional classes at the school. They were able to share the teaching delivery, including the interactive use of using RT and RPL approaches. The synchronous delivery system established through video conferencing technology increased learner access and allowed Gurri Kunna to aggregate larger groups of learners as one cohort, thereby increasing the efficiency of their delivery.

- Online learning

The Norwegian salmon farming sector have made it very clear that they are keen to increase the application of online learning for mature learners within a blended learning strategy, to reduce school attendance. However, due to the high volume of young learners attending their schools, VET staff have not had the time to invest in online resource development and this priority requires more attention.

In the past, online learning has often been seen as problematic in Norway by many VET practitioners. Learning Management Systems (LMS) have been changed frequently by the Authorities with inadequate staff preparation. Consequently, many staff are demotivated from engaging with the technology, unless compelled to do so by their VET institution leader. Most continue with their traditional teaching practices and do not readily adopt online delivery. Some more experienced and progressive VET innovators can circumvent the system and 'link up' their resources to any new LMS with minimal disruption.

Gurri Kunna has access to the proprietary 'Canvas' LMS but has remained reliant on attendance-based delivery models for both their young full-time learners and mature learners within mainstream delivery. Some opportunities arose within the Optimal

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**Key lesson 12**

Online learning development

*"Online learning development requires senior management commitment to an innovative teaching and learning culture and institutional level support for the development of carefully selected individuals and teams. Unassisted, innovative teachers can only make slow and spasmodic progress."*

Strategic Partnership project to explore online learning methodologies. The process of online learning development through 'instructional design' and teamwork was introduced, leading to the development of a new digital learning object by Pisces Learning Innovations (PLI) called the 'interactive fish' utilising Gurri Kunna's high-quality salmon anatomy images. Before the development commenced, working closely with Guri Kunna's teachers, a story board was created and approved. The aim was to provide learners the opportunity to prepare for practical classes in fish dissection by independently using the learning object to familiarise themselves with salmon anatomy.

Although the use of their Canvas LMS and online learning within mainstream delivery has been limited at Gurri Kunna, a lot of the experience gained in video conferencing and RPL to motivate mature learners is transferable to online learning, within a revised blended learning strategy. With the addition of well-designed learning resources and an induction to using the LMS, mature learners could continue learning between classes, whether attending by videoconferencing or in person.

## Icelandic experience

Iceland by comparison has a 'fledgling' salmon farming sector that faces major staff development challenges. Unlike Norway, they do not have no steady supply of young people qualified in aquaculture leaving Icelandic schools to enter employment. The demand for Aquaculture VET is growing, but composed of thinly spread, widely scattered mature learners already in aquaculture employment. The fish farming companies are keen to work with the Icelandic School of Fisheries to develop a coherent and formalised aquaculture VET system. An innovative industry partnership approach to delivery is essential to resolving the challenges they face, which are similar in principle to those faced by Norway.

During its developmental phase, Aquaculture VET has been delivered via a blended learning system from the outset, which includes:

- RPL and credit recognition leading to VET personalisation
- Attendance based classes on aquaculture subjects
- Video conferencing to groups and individual learners
- Online learning with Moodle LMS
- Multiple choice formative assessment
- Skills development whilst in employment on a commercial farm

The Icelandic School of Fisheries has had a lot of very relevant previous experience of using video conferencing and online learning to support both individuals and groups of fisheries students who were being prepared for entry to the capture sector. Their main aquaculture lecturer has had considerable E Learning experience. With limited technical assistance they have posted aquaculture resources and multiple-choice questions (MCQs) on the schools Moodle LMS for work-based learners to access.

**Key Lesson 13**

Transferable E Learning experience

*"The experience of E Learning and the application of learning technologies within a similar sector makes it easier to start-up Aquaculture VET courses, especially when supported by partners willing to share learning resources freely."*

The Icelandic Fisheries School have translated the resources provided from the Optimal project in either Norwegian or English so as they can use them more easily in Iceland. As there are very

limited resources available in Icelandic, the access to Optimal project resources has helped to accelerate Icelandic Aquaculture VET development.

Feedback indicates that learning resources and multiple-choice questions have both been well received by staff and learners. Ongoing collaborative development of online learning and assessment will further improve the emerging Aquaculture VET system.

# Summary of Aquaculture e learning good practice

The E Learning examples from within Scotland and the wider partnership above include successes and some shortcomings. The good practices summarised below are an interpretation and distillation of the key lessons and offer general guidelines based on these real experiences.

1. Formal collaboration by small specialist VET providers allows the development responsibility to be shared and can lead to the creation of more resources of a higher quality.
2. A shared framework of Learning Outcomes can make collaborative E Learning development easier to manage and more productive.
3. VET provider/industry partnerships can lead to very effective E Learning development initiatives.
4. The establishment of E Learning development teams with the necessary skill set allows E learning development projects to be much more ambitious.
5. The commitment and support from VET institution senior managers is essential to establishing sustainable E Learning development and VET innovation.
6. The right technologies must be chosen and deployed with technical assistance, to support both the development and delivery of E Learning.
7. Practical skills assessment can be managed more effectively by deploying a specialist E portfolio system, as opposed to relying on the functionality of a commercially available LMS.
8. Investment in the development of staff with a strong aquaculture background can create an effective team of tutors dedicated E Learning development and delivery.
9. Standard Operating Procedures (SOPs) are the foundation to E Learning development when working with aquaculture companies, as opposed to National Qualification frameworks.
10. Multiple-choice questions are very effective for formative and summative assessment within VET and Higher VET and can be readily automated within an E Learning system.
11. 'Instructional design' and storyboarding are essential disciplines to creating specifications for high quality interactive E Learning resources
12. The Recognition of Prior Learning (RPL) can be incorporated within E Learning to guide learners as they study and could be used to personalise VET programs.
13. Videoconferencing can complement E Learning, by providing valuable opportunities for social interaction through tutor led and peer learning.

# E Learning development good practice

The development of high-quality E Learning is a major challenge which often requires VET practitioners to acquire new skills and E Learning development teams to be formed. This section describes the design and development of E Learning in depth, informed by good practices gleaned over many years of experience within the Scottish VET system.

The way the E Learning component is to be delivered and supported within a blended learning strategy has a major bearing on E Learning design criteria and development plans. The level of reliance on learning resources, formative assessment, and feedback to support learners is inversely corelated to the level of tutor support that learners will be provided. Learning is a social activity, and the most effective blended learning strategies include ample opportunity for tutor led and peer learning activities. This may be through the inclusion of attendance-based classes, farm-based

training, or conferencing technologies when learners can't access a VET facility. The overall blended learning strategy and learner needs need to be fully understood by the E Learning development team.

It should be recognised at the outset that a wide range of skills are required to develop high quality E Learning. Whenever a new E Learning initiative is being considered, the available staff time, skills and experience and the organisation's ICT infrastructure and technical support should all be evaluated. The level of ambition must be realistic in the light of the time and resources available. If there are major staff and resource constraints, opportunities for collaboration should be fully explored. This may provide a viable way to establish a development team with the collective skill set required.

Finally, E Learning design and development planning should be 'learner centric'. The nature of the VET learner must first be well understood and should drive the pedagogical thinking. The design and development process underpinning the E Learning component follows.

# Learner profiles

The VET delivery team developing E Learning should start by developing 'learner entry profiles' that represent the diversity of learners within the anticipated cohort. In most cases, when Aquaculture VET providers consider their learners needs, they are reminded of the wide range of learning styles they are catering for.

These descriptions can then be used to inform the design proposal and brief.

Throughout the development process the course design team will need to constantly ask:

➢ Is the language I am using appropriate to the learner?
➢ Is the learner equipped with appropriate study skills to undertake the task?
➢ Is the learner able to use ICT independently?

It can be helpful to get learners input to the entry and exit profiles and to involve them in any plans to introduce E Learning. Learner profiles can be created and recoded using several different tools, such as flip charts, mind maps or a simple word document.

• Learner entry profile

The following questions will stimulate discussion about the learners and lead to the creation of a learner entry profile.

a) What is the learners' age range?
b) What level of support might learners need to cope with learning?
c) Why will learners want to enrol on the course?
d) Will the learners be full or part time?
e) How many learners will there be in the cohort?
f) Where are the learners likely to be located?
g) What are the learners' educational backgrounds, and do they have any specific learning barriers such as low literacy or numeracy levels?
h) What language level will be appropriate for their course and is there likely to be an issue around jargon?
i) Are there any ethnic, gender, disability, or other issues important to the group of learners?
j) What will the learners get from completing the course? (E.g., gaining a qualification, better job prospects and career progression)

k) What types of activity will engage the learners?
l) Conversely, what kind of activities will act as disincentives to learners?
m) Will learners have access to the technologies they need and sufficient digital skills to access and complete the learning activities
n) Will learners have the discipline and study skills required?
o) Will there be any barriers to learners partaking in planned, tutor led synchronous activities?

Once a clear picture of the learners at entry has been gained, it helps to confirm their 'exit profile' to define what they hope to gain from the course.

Aquaculture VET is normally aiming to prepare learners for the next stage of their lives and exit profiles can be defined on this basis, reflecting a National Qualification (NQ) being completed. If there is no NQ being offered, as is often the case with company training schemes, a competency-based approach to programme design may be needed. Job descriptions can provide the best place to start when defining occupational skills. A functional analysis of the job role may need to be conducted with reference to company Standard Operating Procedures (SOPs) to provide further details.

- Learning styles

There are a wide range of learning styles that have been investigated and defined by pedagogical experts Honey and Munford and widely accepted and applied within psychometric tests. They defined four learning style, namely, activist, reflector, theorist, and pragmatist. Whilst most of us apply more than one style, many of us do have a preferred style.

➤ Activists

Activists are very effective E Learners and many VET and Higher VET learners are activists. They like puzzles and role play, and the use of scenarios work well for them, especially if they are introduced as being a part of the scenario by setting the scene with, "You are…etc", rather than looking in from the outside.

➤ Reflectors

Reflectors need time to digest the learning before they are ready to use it, particularly when preparing for summative assessment. Reflectors are not best suited to E Learning.

➤ Theorists

Theorists like to be able to refer to background information to validate what they are learning, which means the addition of links to additional theory to back up the summary information and practice is valuable to them.

➤ Pragmatists

Pragmatists like learning through case studies as it allows them to apply their learning to new situations. They want to test 'How do we make this happen in reality?

# Designing for different levels of learning experience

Six levels of adult learner were identified by N Lasher in his 'More than Instructional Design course' (March 2007). As VET practitioners we tend to be dealing with the first three levels defined below for most of the time.

**Level 1** School leaver

They are characterised by having minimal qualifications and can be childlike in their approach to learning and respond well to the 'gamer' approaches being applied more frequently now within E Learning, to hold their attention, as this introduces a lot of interactivities.

They tend to be able to cope with no more than three bullet points on a page and single syllable words and clear images work best. They are not really engaged by realistic video and cartoon animation can work best. Ideally, E Learning episodes need to be no longer than 10 minutes long.

**Level 2/3** Workers and management

They can cope with 4 or 5 bullets, but it is best not to add a paragraph of text underneath each one. They tend to prefer less animation and engage with realistic video and enjoy scenario-based learning.

The three-layer learning system below works well for them. The learner must close the window to go back up to the main learning path at the top.
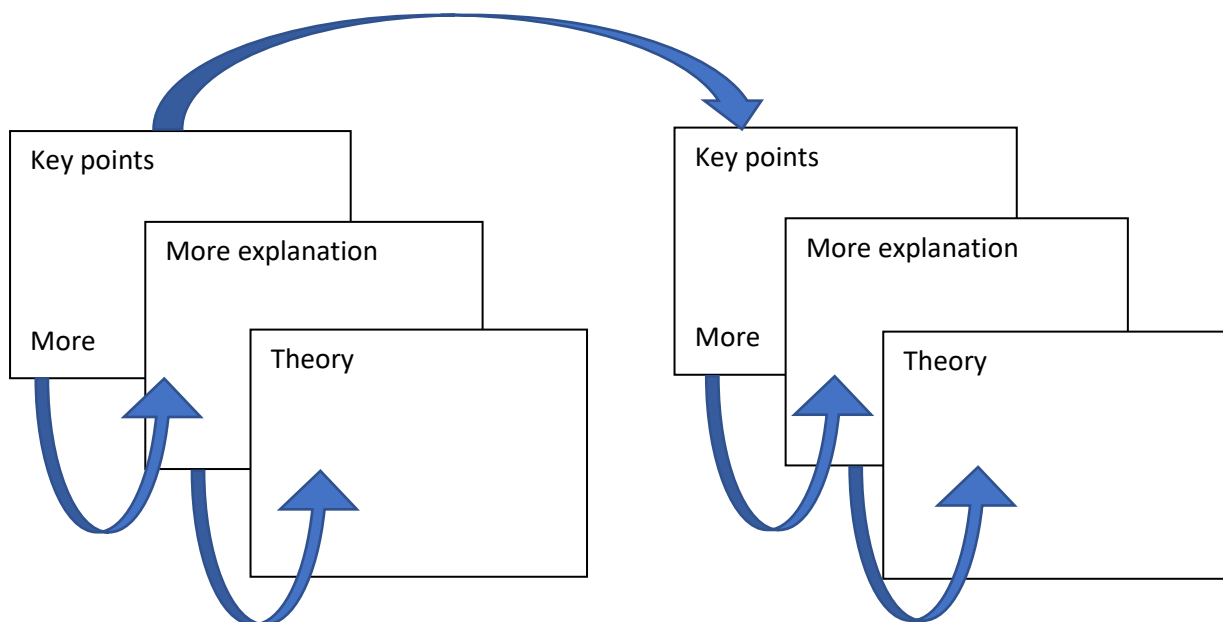
## Program design

VET programs are designed to help learners to develop the right knowledge, skills, understanding, and behaviours required to complete their training and qualification. Whenever E learning is a component within a blended learning delivery, it's role must be carefully defined before the instructional design process can commence.

When delivering a National Qualification, the assessment requirement, whether based on continuous assessment, final assessment, or more commonly a combination of the two, will be pre-determined and well defined. Therefore, along with well-defined learner profiles, the VET assessment strategy and the actual 'Instruments of assessment' if available, all provide a sound basis for program design. In the absence of a detailed curriculum definition, it may be necessary to

develop a 'shared framework of learning outcomes and associated performance criteria. This can be a vital stage of the program design process when partners are collaborating, and each has a different VET awarding body and assessment system to comply with. By identifying the 'common ground' in this way, a collaborative E Learning development process can become much more manageable and productive.

## House style – look and feel

Once the program structure is defined, and before the E Learning content is designed, the 'house style' should be agreed.

A consistent use of onscreen visual elements and cues, such as navigational icons and mini pictures, can serve as attractors to engage learners, whereas plain text may be ignored. They provide a visual clue as to why the learners should look at the material and add to the overall look and feel of the online learning environment. This helps to quickly familiarise the learner, making the system intuitive and user friendly.

An agreed house style is essential to the instructional design and story boarding process as many common interactions and linkages are repeated to define the architecture of the E Learning program. Some company-based E Learning incorporates the company colours which may be in their logo, helping to reenforce their brand to new recruits, as well as the outside world.

## E Learning design overview

The success of E-Learning will be determined by design as much as by the content. Design is a combination of layout (text and visual elements), typography (typeface, line spacing and so on) and selecting a writing style that helps learners to learn. All are involved in creating effective communication and learning materials.

There are a range of design guidelines and features to consider.

a) Intuitive. - Each E Learning pack should be intuitive and should not have to contain instructions for use. You should never have to force learners to press a button, and a button should never appear after a set time.

b) Quick - Each episode should be relatively quick to finish. Users gain the best knowledge transfer and longer-term retention from shorter tasks. Three 5-minute episodes with a single point will be far more effective than one 15-minute episode covering all three points. The content should be granularized in this way.

c) Accessible -The design should allow the learner to quickly get to those things they want to know about. The underlying theory to support the information should be available on a link, not part of the main learning route, making it clear that this is the theory that supports the information.

d) Up to date -To remain legally compliant, it is useful to keep history of when new information is put in or new courses replace old ones, as a pop-up. For example, "This has been removed and replaced with….."

e) Always re-findable - Don't change the entire look of an updated learning episode, as learners will not be able to recognise what they already know. If the look and feel is changes between visits they may get confused and start the episode afresh, wasting time.

f) Encouraging active learning - The learner must be motivated to apply the learning. It is best to avoid purely theoretical units, especially at VET level and encourage reflection and application wherever possible. When E Learning is a part of a blended-learning strategy, this may occur offline as opposed to online.

## Layout

When considering how to design the layout of each screen, it helps to think about how we take in text and visual information. The eye follows a natural path across the screen or sheet of paper. It works from the top left-hand corner, across and down the page to the bottom of the right-hand corner.

The following diagram illustrates how our eyes move across a page. This is based on western culture, reading left to right and top to bottom.

The eye starts at the top left-hand corner (the point of arrival) as this is what our training has taught us to do. The blue arrows show the paths that our eyes then follow (across and down the page) as that is the natural desire of the eye (reading gravity) eventually coming to the terminal anchor at the bottom right-hand corner. The dotted line on the left is the area the eye returns to after each left to right sweep.

The wavy lines show backwards movement that the eye resists, so as you go further down the page, it becomes more difficult to get the eye to the left-hand side as reading gravity continues to pull the eye down. The crosses in the top-right and bottom left corners indicate fallow areas that the eye does not so readily go to.

Point of arrival

Terminal Anchor
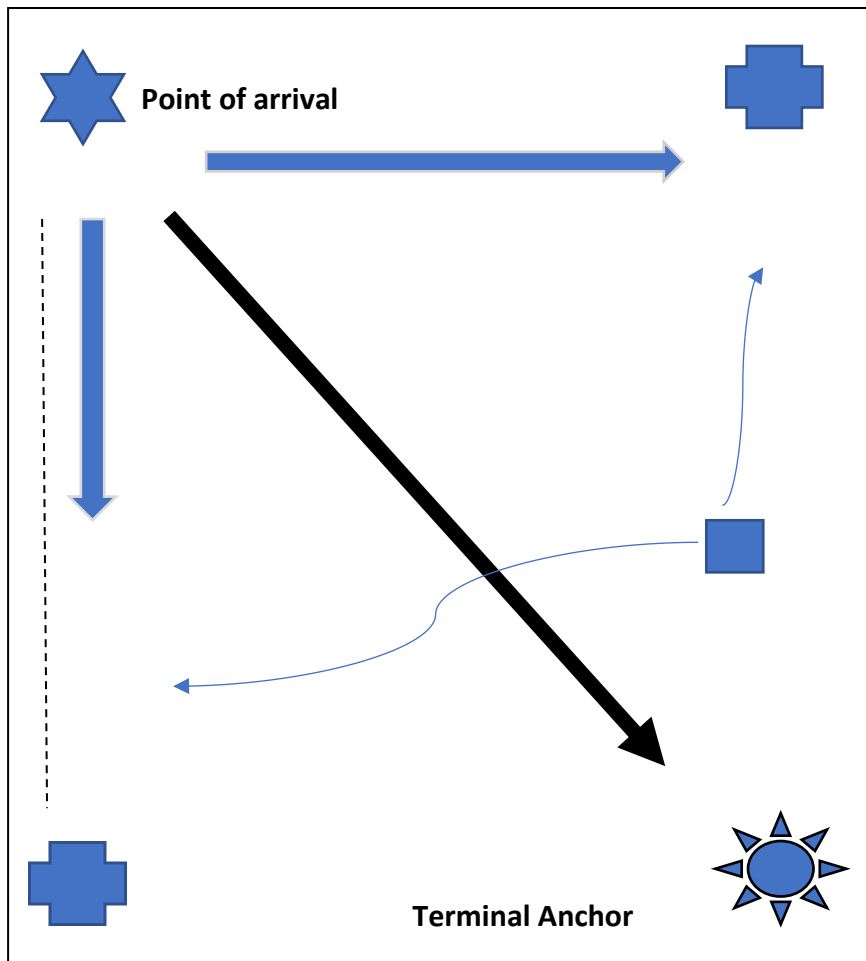
Although the top left and top right-hand corners are both anchor points to which the eye is naturally drawn, there are other important features that can anchor the eye.

➢ **Animation** is a master anchor and takes priority over all others. The eye is immediately drawn to animation and then works down the screen. Anything above the animation, including other anchor points are ignored.

➢ Red is a master anchor. The eye is drawn to this word first if it is used on screen or in print.

➢ **A full stop** means 'end of information'. So, a full stop in a title tells the eye to go no further and is best avoided.

➢ **Pictures** are also anchors. The text must be associated with the pictures correctly, otherwise it is less likely to be read. The picture must be placed to the left and the text to the right, as the eye is drawn to the anchor and then naturally goes from left to right. If the picture is on the right, then the eye must go backwards to read the text. Text associated with a picture must not be placed above it, as they eye must then go back up the page, which is less comfortable.

# Increasing learner engagement

E Learning has been criticised by some observers in the past as 'second best', compared to conventional attendance-based learning, as there is often no tutor immediately available to ask and answer questions, confirm understanding, and help build the learners confidence. But what some critics fail to acknowledge is the fact many classrooms are dominated by a minority of vocal learners, whilst the less confident quietly switch off. If anyone switches off during E Learning within a monitored LMS, it soon becomes apparent, and a remote tutor can intervene to assist and motivate. There are fewer places to hide within well designed E Learning.

The first two screens in E Learning are critical as they set the scene and must draw the learner in and engage them. For example, an ice breaker, such as a series of true false questions with automated feedback can get the learner in the right frame of mind, as well as give them an indication of their prior knowledge before embarking on the learning episode'

Although text is often the foundation to communication in E Learning, it must be used sparingly and in partnership with some of the other approaches below to increase learner engagement.

- Visual media

Images, graphics, and video are all vital and commonly deployed additions to text within effective E Learning. As the saying goes, "a picture can sometimes say more than a thousand words". With the addition of interactive elements, the power of images to engage the most reluctant VET learners can be further amplified. Well designed, media rich learning resources are generally worthwhile investment, especially when catering for VET learners.

- Audio

If audio is used to complement the text on screen, it can be used to tell more of a story (unless providing a literacy support system). It should be precisely aligned with the text, as any continuity errors will be picked up on, distracting learners them from their learning.

Audio can be very effective when combined with visual resources, either images or video. As with text on screen, timed audio should not be used.

- Using questions

Formative assessment allows learners to check their own learning and does not have to be linked to scores and results. Model answers to problems or scenarios can provide a good way for learners to check their own responses.

Multiple choice questions and other more visual 'drag and drop' type tasks are commonly used formative assessments which can be linked to automated feedback. (E assessment is covered in more depth in Section 4.2)

- Using games

Games can be stimulating, but if included, they must have a clear purpose and learning objective. If the learners are simply enjoying playing a game, without developing their skills or improving their knowledge and understanding, then the game is a distraction.

Following a game with formative assessment is a good way for learners to measure improvements in skills or knowledge, because of the game. It should also be noted that whilst some games are simple and affordable, others can be more specialised and prohibitively expensive. However, there is a growing interest in this field currently which is sometimes referred to as 'edutainment'

- Relating E learning to real problems

If learners are encouraged to follow up their learning away from the computer, by investigating a topic or problem in their workplace, then 'real world' application can be used to consolidate learning and help to achieve the planned outcome.

The range of media deployed within E Learning will be influenced by the

- ➢ learner profiles,
- ➢ development team's skill set,
- ➢ available technology, and,
- ➢ development budget.

The creation of text is relatively cheap and requires subject experts and instructional designers only, with an awareness of the level of language to be used, determined by the learner profiles. However, visual, media rich learning resources are far more engaging, and an entirely text-based approach to E Learning would be doomed to fail for all but the most motivated and mature VET learners.

Once more ambitious interactive learning objects are included, input from graphics specialists may be essential, alongside the need for a more meticulous planning and instructional design process. As the ambition, complexity and skills requirement increases, so does the development cost!

## Text

There are several considerations when creating text, and perhaps the most important of all being, to write with your audience in mind. If you have been thorough with learner profiling and the subject experts in the development team know their learners and their academic level well, this will greatly assist.

There may be additional challenges for some E-Learning content developers, such as catering for multiple languages and special learning needs. If a large proportion of the learners are likely to have difficulty with reading and comprehension, at the outset a decision may be made to include an audio overlay throughout the course.

- Plain language

Writing in 'plain Language' is usually best. Plain language (also called plain writing or plain English) is communication your audience can understand the first time they read or hear it. The USA Plain Writing Act of 2010 defines plain language as: "Writing that is clear, concise, well-organized, and follows other best practices appropriate to the subject or field and intended audience".

Others refer to the production of 'Plain English as being a craft based on "an understanding of the reader's needs, the translation of alienating jargon, and establishing an easy pace that readers can follow". In practice, from a writer's perspective, clarity of expression comes most of all from a clear understanding of the topic they are writing about. No writer can clarify for the reader what is not clear to the writer in the first place, which is why subject experts have a key role in the E Learning development process.

This means pitching the language at a level that suits the readers and using good structure and layout to help them navigate. It doesn't mean always using simple words at the expense of the most accurate wording or writing in childish language.

- Not lost in translation

Whenever the text is to be translated into multiple languages, the use of plain language by writers improves the accuracy of the translation process. When machine translation is used, as is becoming increasingly common, short simple sentences greatly improve the accuracy.

## Font and accessibility

It is possible to lose 75% of your readers by choosing the wrong type. Generally, it is best not to make learners read too much on screen text. If there is a lot of text, it is advisable to make use of PDFs that are available to open and print off.

It is not advisable to use italics on screen, as they are too 'jaggy' and make the text difficult to read. Line spacing is more important than typeface and must allow the text to be differentiated, line from line. The spacing should not be too wide though, as the brain switches off if there are more than four lines of double spacing.

It is worth noting that dyslexic readers can be assisted by using 5% yellow background and navy-blue text on screen in the text boxes.

Finally, never judge how long it is going to take someone to read a screen and do not use automatic move to next screen or automatic progression. The learner should be in control.

- Text on screen for the fluent reader

Typefaces such as 'Tahoma', 'Trebuchet' and 'Veranda' and 'Georgia', have been designed specifically for their legibility on screen. They are also sans-serif typefaces. The resolution of the computer screen makes the 'serifs' (or little flicks and tails on the letters) on fonts such as 'Times', difficult to read. Georgia is an exception as it is a serif typeface specifically designed for the screen. Veranda has often recommended for E Learning materials. Some programmes developed for course creators, such as Course Genie, default to Veranda and offer no alternative.

Reading on-screen text requires more effort and strains the eyes more than reading text on paper, and Georgia and Veranda have more space within letters and between letters as compared with Garamond and Times, for example. They are ideal fonts for web pages and online materials that are to be read directly from the screen.

- Printed text

Even for fluent readers, text on the computer screen is about 25% slower to read than on print, so using the most easily read typeface is important. When a lot of text is needed it is best to make use of PDFs, as the reader is more likely to read by printing it onto paper, if it is available to open and print off. This is much better than a screen full of dense text. The typeface in the PDF should be designed for reading the 'printed word' on paper. Research has shown that five times are likely to show good comprehension when a serif body type is used than sans serif. (Ref: Type and layout Colin Weildon 2005). Neil Lasher stated that when reading on paper, Gramond was the best type face for memorability. Georgia may be a good compromise for font that is to be read on screen and in the printed form.

## Text on screen for the non-fluent reader

The non-fluent reader includes those with lower literacy levels, dyslexia, and poor eyesight, who process text as 'immature readers '.

A mature or fluent readers' eye will bounce along a line of text, taking in about a dozen characters (letters) at a time. They match what they see with what they expect to be there and translate the code on the screen or page into language. Non fluent readers cannot scan this length of characters, have a narrower field of vision, and must work with one letter or one word at a time. As a result, they need a larger, simple typeface, space between the letters, and more space between the lines. A ragged right edge to the text helps them to move from one line to the next.

Veranda is therefore a good typeface for E Learning materials for non-fluent readers and serves them equally well when reading printed text.

# Images

A picture can say more than a thousand words, and most E-Learning courses make liberal use of digital images. Even when working within a tightly monitored, password-protected, closed online environment, there's no guarantee that your E-Learning products will always remain private. It is best to operate under the assumption that all digital products could eventually become public to comply with copyright legislation.

There are many ways to acquire suitable images to embed within E-Learning:

   (i)      Creative commons images
The Creative Commons is an organization that has made it much easier for people to share digital images. They have established a set of licenses that photographers can place on their work that automatically gives others permission to use that work in their own projects under specific terms and conditions.

Some photographers grant a Creative Commons license on their photographs, so that anyone who finds them online can easily check the chosen license and follow the restrictions of use specified in that license.

It is possible to enter the creative commons and look for images that have the two least restrictive licenses:

   a)   Creative Commons Zero (CCO)
This is the least restrictive level, and the one to look for first. Items marked as CC0 can be used by anyone, for any purpose, and without having to get permission or give credit to the artist. An image licensed with CC0 is the same copyright-wise as an image in the public domain.

   b)   Creative Commons by Attribution
Items with this license can be used for non-commercial or commercial purposes, so long as the user gives credit to the original artist.

There are several good photo sites, but thousands of photographers store their photography for public display in Flickr, and many of these photos have CC0 and CC BY licenses. To use such images a line of text should be added underneath the image providing four pieces of information (Creative Commons recommends using the acronym TASL to remember these):

T = the title of the image

A = the author (or artist)

S = the source (or where it is located online)

L = the license for the image

The attribution should be placed close to the image, so that those who view it connect the information to the picture.

> (ii)     Google Image Search

Although a Google search will pull up plenty of images there is no permission to use them. However, the search can be filtered so that the results only show images that are licensed for re-use. Tools need to be opened after the search and one of the options under "Usage rights" checked, to remove all the photos that have not been labelled for some form of reuse. Checking "Labelled for reuse with modification" should give you images that have the least number of restrictions.

> (iii)     Purchasing images

If you have the budget and lack the opportunity to take your own images, it is possible to purchase high-quality stock photography and illustrations. When making these purchases, the licensing agreements should be studied carefully. The general rule is, the more widely a user plans to distribute the product, the more the image will cost.

Be aware that when doing general searches for images, paid items will come up in the results. A paid image has a watermark: a translucent design that covers the image but doesn't prevent you from seeing the picture behind it. These watermarks are only removed after someone pays for the image, but it is possible to download a watermarked image, basically stealing the image and naively broadcasting that fact to the world!

> (iv)     Photography

Most of us can produce images of a high enough quality for practical use within E Learning. With some basic knowledge of photography and composition, this is very often the best approach. It can be the most cost-effective way to get images that precisely suit the learning purpose, especially when developing aquaculture technical subjects, and access to suitable aquaculture facilities.

Over time a large image stock and inventory can be built up. It is important to manage this inventory using meta data tagging, so as images can be easily held and retrieved for use as the stock of images grows. In a collaborative situation, image inventory management systems is even more important. If lacking, a lot of time wasting, and inefficiency can creep into the development process and worsen over time.

To achieve the highest image quality, professional photographers may need to be commissioned if the budget can accommodate them.

# Video

If a picture can say more than a thousand words, a video can say more than a hundred pictures, especially if it also has an audio and/or text overlay! With some author ware software such as H5P, multiple-choice questions can also overlay video, further enhancing the value of video within E Learning.

The main sources of video material are:

- You tube

One of the preliminary tasks undertaken by a good instructional designer is to find out what resources already exist that can be accessed and used. Depending on the subject area there can be useful resources freely available through You tube. However, videos cannot be simply downloaded and incorporated into learning resources, as that would be a breach of copyright. Access should be provided to suitable vetted You tube videos for E Learning, via hyperlinks.

When a relevant passage is contained within a much longer video, it is possible to start and stop the video at a specific place using 'Vibby' (see Vibby.com). The learner does not have to waste time looking at irrelevant content to access the sequence of interest. Using Vibby you can leverage the most relevant parts to focus your audience on the moments that matter, without any need for video editing experience.

However, generally, high-quality aquaculture videos are not commonly found through internet searches, and there is a higher reliance on video creation.

• Vendor supplied promotional videos
The suppliers of aquaculture equipment and resources often make high quality videos for promotional purposes that can be a very useful way to illustrate the operation of a particular piece of technology. Many vendors willingly give permission for the use of their video resources for educational purposes. It held increases exposure to their products and services, and can also help to train users, reducing the time spent with customer support.

• Informal video
It is possible to make useful unscripted videos of educational value. Attaching a 'Go Pro' camera to the helmet of a fish farm operative as they go about their daily work can provide some interesting raw footage that can be edited to provide insights to a wide range of aquaculture operations. A video of an informal interview with an experienced farm manager answering specific questions can enliven the learning experience. This kind of video required minimal preparation and can often be most effective when spontaneous and unrehearsed.

• Instructional video
Instructional videos require significant planning and production but are an invaluable asset when presenting online training to accurately portray a company's Standard Operating Procedures (SOPs) and emphasise good practice.

Storyboarding is essential to plan the creation of high-quality instructional video. The storyboard provides instruction to the camera person so as they know what sequences to shoot and whether to take a closeup or more panoramic shot, and when to cut to another sequence. The details of any audio and text overlay provided and notes on synchronisation of the audio and text with the video. This is important to the editor creating the final instructional video from the raw footage.

See Appendix 5 - Instructional video story board exemplar.

It is quite common to have a subsequent visual story board to demonstrate the visual design and layout of each sequence, which is signed off to authorise the final creative work. Instructional videos are a very effective resource and can be used to prepare learners prior to them receiving instruction, and/or to follow up the instruction they have received. They can also be used as a reference resource during a practical assessment. If feedback is provided to the learner that they are not yet fully competent and need to consider any aspect of the task, this can be demonstrated once more by the instructional video before undertaking the task again, helping to consolidate learning and remediate.

# Graphics

Graphical images can be a useful way of introducing a new concept or process and graphics are more effective than images or video for some topics. For example, whilst it is possible to photograph and/or video the gross anatomy of a salmon, it is not possible to show how osmosis impacts on a salmon with a photograph. A diagrammatic approach is the only way to visualise the topic and reduce the amount of descriptive text required.

In addition, infographics is a very good way of presenting data. Whether as chart or some other form of visual presentation, this is particularly useful approach when interpreting a science-based subject such as aquaculture to learners.

The production of simple graphics can be done in house. However, outsourcing to graphics specialists will provide the highest quality. Some of the most proficient graphics creators can work from exemplars or even sketches with annotation. If the graphics form part of a larger and more sophisticated learning object, then a storyboard specification will be required, with all the interactive elements described.

Many commercial creators deploy Adobe software, which as the market leader is relatively expensive. Adobe has a range of functionality:

➢ The Shaper tool allows freehand drawing of vector shapes, and the precision tool places shapes onto the artboard.
➢ Geometric shapes can be built up into intricate designs by dragging shapes and paths to move, reshape, and scale them.
➢ Colour and texture can be applied to shapes using fills and stroke and the properties of the shapes edited to refine the design.
➢ Designs can be saved a and shared as a PDF or as a JPEG, PNG, or TIFF at a set resolution for feedback.
➢ Images can be quickly adjusted using what is called 'Puppet Warp' by setting pins in the artwork, then moving and rotating it to create natural distortions and transform the design.
➢ Variable fonts are included and characteristics such as weight, slant, and width can be adjusted using sliders for a custom design.
➢ Professional templates are available, and by searching Adobe Stock one can be found to suit your project.

For organisations that lack the budget for the highest quality and most expensive graphics creation, there are cheaper alternatives such as Canva, offering based 'easy to use' graphic design software. By simply selecting one of the 8,000 templates you can modify text, fonts, images, symbols, colours, and most other component to meet your needs. There is a free version and a more expensive professional version which incurs a monthly licence fee.

# E Assessment

There are two main categories of assessment that can be supported by the application of appropriate digital tools: the assessment of skills and competences, and the assessment of underpinning knowledge and understanding.

## Knowledge and understanding

Most commercial LMS offer some degree of functionality for knowledge-based assessment, although the functionality is generally limited compared to developments within open-source software such as Moodle by a proficient IT technician.

Several approaches can be deployed for the assessment of underpinning knowledge and understanding, some of which suit E-assessment automation.

The VET Awarding body will normally issue guidance on E Assessment if summative and contributing towards the achievement of a quality assured National Qualification. Verification of the learner's identity and invigilation of the assessment process need to be addressed to safeguard the integrity of the qualification.

It is good practice within E Learning to make liberal use of various types of formative assessment at VET and Higher VET level. This is especially valuable when the learner does not have immediate tutor access for assistance. It helps to maintain their interest and motivation by not allowing them to passively absorb too much information for too long, before they think, or undertake an activity.

- Multiple Choice Questions (MCQs)

There is an art to developing good multiple-choice questions. When well designed, knowledge and understanding can be assessed effectively at the VET and Higher VET levels and the assessment process automated.

Prior knowledge can be established at the beginning of a new topic by starting with a selection of MCQs. This alerts the learner to those aspects of the subject they particularly need to concentrate on.  At the end of the topic, the knowledge they have gained from undertaking the learning episode can be assessed in a similar way, or in more depth. If the learner is asked to select multiple correct responses from a list of possible responses, the MCQ is much more challenging and requires a deeper knowledge to make the right selection. The results highlight any topics that the learner should revisit in preparation for summative assessment.

Feedback is a vital part of formative assessment and can be provided for each wrong response to explain why it was incorrect. This is more helpful that an uninterpreted result and partially compensates for not having immediate access to tutor support.

When presenting MCQS for summative assessment, it is common practice to develop assessment banks for each learning episode, form which the LMS can randomly select a certain number and present them to the learner. The precise selection will change each time, reducing the risk of learners getting too familiar with questions through overexposure. This is a particular danger if the MCQs used for formative assessment are also used in summative assessment.

- Visual and interactive assessment methods

Some LMS have a range of tools that support more visual and interactive forms of assessment that can be particularly useful at VET level.

The use of 'drag and drop' is a good method of assessing the learner's ability to make a correct identification.

For example:

- ➢ The organs of a salmon could be labelled by dragging a name from a list and dropping and assigning it to the correct organ.

> ➢ Words can be selected and dragged into gaps in a sentence to complete a summary point, helping to reenforce basic key points

- Longer assignments

Many commercial LMS have a facility for posting completed assignments for the tutor to assess. This helps assessment administration, but unlike the MCQs and visual interactive methods of assessment above, marking is not usually automated and requires a tutor's time and attention. There may be a need to include some of these types of assessment within Higher VET. However, the VET level can usually be assessed effectively without the use of longer assignments.

## Assessment of skills and competences

Skills and competences can be divided into practical skills which are generally observed during the completion of a practical task, and cognitive skills that are generally assessed by judging a completed piece of work.

A practical assessment involves an independent assessor observing a learner undertaking a set task or a series of set tasks in a real work environment or a simulated environment, for example at a school, college, or specialist centre. It allows the learner to demonstrate their procedural knowledge and skills of 'how to do something'.

For example, grading salmon parr can be observed and assessed in relation to given standards, which are often derived from company Standard Operating Procedures (SOPs). Feedback can be provided on any aspects of the learners work that do not meet the standard, and later reassessed after a period of practice. Alternatively, assessment can be undertaken through the gathering and recording of 'naturally occurring evidence' of competence, with constant feedback, until there is sufficient evidence of competence.

For comparison, a typical cognitive skill may be the development of a daily feed-schedule. To assess this skill the learner could be provided data on the fish stocks, water temperature and a feed manufactures feed table. They could then produce the feed schedule, all of which can be reliably assessed without the need for fish stocks or an actual aquaculture facility. The assessment of practical skills and competence is dependent on observations being made and recorded by a technically competent member of staff. Whether they are acting as the 'witness testimony provider or assessor, they need to gather and record assessment evidence, and an E portfolio is the best digital tool for this purpose.

- E portfolio

Any E -Portfolio assessment system needs several key actors to play a full and active part and all of them should receive comprehensive training in using the E portfolio to build their confidence:

> ➢ Learners should be encouraged to access the portfolio to post evidence contributing towards the achievement of specified PCs. This requires them to understand the structure and content of their qualification and to remain aware of opportunities arising for digital evidence gathering during their work. This can be in the form of documentation, audio, image, and video, and a range of evidence may be needed for some criteria.

The use of video can be particularly useful in recording a task being undertaken or the output from the task, especially now most learners carry a mobile phone with a reasonable camera. The more motivated and proactive the learners are, the more energy they will be able to put into the completion of their portfolio, taking some weight of others involved, downstream in the assessment process.

➢ Witness Testimony providers must be technically proficient and working with the work-based learner daily. They should be most familiar with their work and are often the supervisor or an experienced operative and work buddy. They can post witness testimonies by accessing the learner's portfolio, including any feedback provided. Guidance should be provided on any PCs not yet evidenced and what the learner needs to do next to practice, and/or gather more assessment evidence. Most of the assessment evidence from a witness arises during routine work, as opposed to managed assessment situations, and is termed 'naturally occurring'.

➢ Assessors must be technically qualified and ideally qualified to assess. They are responsible for judging the evidence that is presented in the portfolio to see whether it meets the standards in the PCs. They need to reassure themselves that the evidence is sufficient, robust, and reliable. They can enter the Portfolio at any time to judge the evidence presented and provide feedback to the learner.

➢ Internal Verifiers have an oversight and quality assurance role. They enter the portfolio system to sample the work of the assessors, to ensure they have been interpreting the standards correctly, fairly, and consistently. They apply a pre-determined sampling strategy, and once they have completed their work, the learner can be awarded their qualification. Wherever there is a team of assessors, as is common in larger organisations, the Internal Verifier is responsible for holding standard setting meetings with the team of assessors, to discuss any issues arising with the qualification and the assessment process. The overall aim is to ensure all assessors are interpreting and applying the standards in the same way.

# Learning technology evaluation

Learning needs should drive the selection and application of technology. This is an important underlying premise as there are a wide range of digital tools to support the development and delivery of E Learning to choose from.

Today, most tertiary education organisations and some companies deploy a Learning Management System (LMS) to hold and present learning resources and provide a range of communication tools for learners and VET practitioners. Additional software is sometimes used discretely or 'bolted on', to support E Learning and assessment.

Most LMS offer some basic tools to support E Learning content creation. However, if the ambition is to produce high quality interactive learning resources, the use of authoring software is essential.

3.9.1 Learning Management System (LMS)

There are two main ways to establish a Learning Management Systems (LMS).

One is to purchase a licence for a user-friendly high functionality LMS from a reliable vendor, and the other is to employ a skilled technician who can customise an open source LMS to provide the functionality required.

The importance of being able to support E Learning and E Assessment within a blended learning strategy has guided the LMS review process described below.

- Vendor supplied LMS

There are dozens of commercial LMS available to choose from, many of them serving a growing corporate market for compliance-based training. A long list of LMS and customised service providers have been examined in depth through the following process:

> Evaluation of LMS reviews available online.
> Demonstrations by Vendors.
> Conversations with existing users.
> Free LMS trial period.

The leading proprietary LMS have been subjected to scrutiny by a range of users, including teachers, trainers, and learners. For the purposes of this study, all aspects of VLE functionality and usability have been considered with reference to extensive published user reviews.

The 'Top twenty LMS' (based on user experience) is one of the most comprehensive and current reviews available on the internet and has been considered extensively:

https://elearningindustry.com/directory/software-categories/learning-management-systems/best/user-experience

The broad criteria used in these reviews are:

> System usability - the most widely used and validated metric for measuring ease of use
> Perceived Usefulness - the degree to which a user considers that the software maximizes their work performance

In layman's terms there are two main questions to address:

> Does the LMS have the features and functionality required?
> Is the LMS 'user friendly' and intuitive for the learners accessing the system, authors creating content, trainers leading the learning process, and LMS administrators?

Therefore, feedback from existing users is valuable, to make a balanced judgement and decipher the sales pitch accompanying LMS demonstrations.

The information available from the top twenty reviews above has been processed (Appendix 1- LMS review). Each of the 19 LMS functional components summarised in Table 1 below are further broken down, to enable a fully detailed comparison of alternative LMS based on the functions offered.

The Talent LMS comes out first, or first equal, in 14 of the 19 functional components. However, there are gaps in functionality revealed by detailed scrutiny of Appendix X that may be important to some organisations.

Feedback from reviews by users and guidance from those with first-hand experience were important in gauging the user friendliness of LMS offering adequate functionality, followed by free trials of those shortlisted.

| | LMS functional category | Loop | ADOBE (CP) | iSpring | Asentia | Talent LMS |
|---|---|---|---|---|---|---|
| A | Accounts | **100** | 83 | **100** | **100** | **100** |
| B | Activity grading | 0 | 33 | 33 | **100** | 33 |
| C | Authentication | 57 | 57 | **100** | **100** | **100** |
| D | Categories | 75 | 75 | 75 | 75 | **100** |
| E | Certificate Management | 0 | **100** | **100** | **100** | 80 |
| F | Compliance Management | 50 | **100** | 50 | **100** | **100** |
| G | Creation | 91 | 73 | 82 | **100** | **100** |
| H | Customization | 50 | 50 | 50 | 50 | 50 |
| I | Enrolment | 43 | 57 | 71 | **86** | 71 |
| J | Format | 50 | 12.5 | 37.5 | 50 | **62.5** |
| K | Gamification | 14 | 71 | **100** | 29 | **100** |
| L | Interface Options | 62.5 | 25 | 62.5 | **87.5** | **87.5** |
| M | Learning Types | 50 | **100** | 75 | **100** | **100** |
| N | Mobile Learning | 50 | **100** | **100** | 50 | **100** |
| O | Offline | 0 | **100** | **100** | 0 | **100** |
| P | Reports | 43 | 71 | 71 | **100** | 86 |
| Q | Roles | **100** | 75 | **100** | **100** | **100** |
| R | Security | 40 | **80** | 60 | 40 | 60 |
| S | Shopping Cart | 0 | 50 | 50 | 50 | **100** |
| T | System reports | 75 | 75 | 75 | **100** | **100** |

Table1: Summary of the % of LMS functions in each category for 6 LMS from the 'top twenty'

Based on the desk study analysis (Appendix 1), the Asentia LMS appeared to be most suited to supporting blended learning. This is consistent with its strap line *"Asentia LMS has been carefully designed to support blended learning".* When delivering qualifications through 'blended learning' which involves tutor led face to face training and skills instruction, the system is well worth considering.

However, it appears to have some weaknesses which include, security, the lack of offline access and relatively little 'gamification'. Not all LMS users apply gamification within their learning and assessment strategy, but security is important to all, and offline access can be a significant advantage for some learners.

Of the LMS reviewed, Loop appears to be the most poorly equipped for blended learning, due to a complete lack of activity grading and certificate management capability. It can be ruled out if any form of online assessment management capability is required.

Although 'Talent' and 'Ispring learn' have some strengths, they have one important weakness in comparison to 'Asentia' regarding the tracking of learner performance. Both lack an integrated gradebook which may limit LMS automation and the management of the assessment process.

The ADOBE LMS is relatively expensive and requires additional software to get the best from it. It is a sophisticated system, and the complementary ADOBE Captivate software is a creative tool that is

highly regarded by experienced instructional designers and could be teamed up with the ADOBE LMS to great effect, and for some, it may be worth investigating further.

Consequently, 'Asentia' and 'Talent' were shortlisted for demonstration by their vendors along with a system called 'Swift track'. This third system chosen for demonstration had a different history, as it was originally designed to be a user friendly an E portfolio for industry.

The three LMS demonstrations revealed useful additional information and observations and the specific strengths and weaknesses of each of these three LMS are summarised in turn:

**Asentia**

| Strengths | Weaknesses |
|---|---|
| A well-structured LMS Architecture | There appears to be lot of steps in the process of publishing course content |
| Comprehensive gradebook that can be configured and automated to suit needs (Report content and frequency) | The tracking function is not applied to course materials posted in the LMS |
| Has a SCORM wrapper, which enables a range of external software/tools to be used within the LMS as if they were integral to it, enabling extensive activity tracking functionality | Communication is supported through discussion boards, but the message centre is only part developed |
| Task assignments can be uploaded and graded | The quiz function is text only |
| A checklist can be launched by the LMS to support a practical assessment process (recording observations) | There is no offline access |

**Talent**

| Strengths | Weaknesses |
|---|---|
| Intuitive LMS for authors and simple to upload and check course content before publishing | No way of importing the results of practical assessment, other than by using the assignment function. On closer investigation, this was not a suitable tool for practical assessment. |
| Unlimited infrastructure through branches for different countries and/or departments | No gradebook, limiting the comprehensiveness of activity tracking |
| 99% of existing files are accepted for uploading | |
| External websites can be presented within LMS | |

| Relatively comprehensive quiz functions that include drag and drop | |
|---|---|

**Swift-track**

The 'Swift track' e portfolio available from RI Training was demonstrated and evaluated against the blended learning needs criteria.

| Strengths | Weaknesses |
|---|---|
| Designed originally as an e-portfolio to offer companies a comprehensive quality assured competence-based assessment process | Limited tracking of learning activity, but this could be added for a client on request. |
| A simple, minimalist system offering no more that a company needs that is easy to follow and learn | No Multilingual facility |
| Can be customised to add additional tracking and LMS functionality if needed and configured to represent company structures and roles | |
| Articulate specialists employed by the vendor can assist Articulate based content development | |

- Open-source solutions

The open-source Moodle platform has been developed by the academic community over a 10-year period, leading to the development of many advanced features and a growing 'self-supporting' Moodle community. Moodle is a world leading 'open source' platform, which has more recently been adopted by 9 registered 'Moodle Partner' companies.

These companies can provide complete customised solutions, at a price, that can include:

➢ The creation of a customised LMS with the functionality and features required
➢ The creation of interactive content (learning objects)
➢ Staff training, development, and support throughout the process from initiation to transfer
➢ Hosting services

Assisted more recently by the introduction of the 'Moodle Workplace' many companies are adopting the customised Moodle solution offered by Moodle partner companies.

The services of two recommended Moodle partner companies, Titus Learning and Synergy Learning were evaluated through initial demonstration and questioning.

This revealed the following:

➢ There are nine Moodle partners registered by Moodle who provide comprehensive customised services

- ➢ Moodle Workplace has been devised latterly to support the adoption of Moodle by companies.
- ➢ Moodle can support the easy development of 'home-grown resource' and host commissioned more ambitious 'interactive' learning objects.
- ➢ Home grown development can be supported by the HP5 software, allowing a relatively inexperienced but ICT savvy development team significant 'creative development opportunities'
- ➢ There is no 'long term lock in' to any Moodle partner or Moodle itself, as SCORM compliant resources can be migrated to an alternative LMS, if the company so chooses longer term.
- ➢ To work with a Moodle partner, the learner journey needs to be mapped and to inform a detailed specification for accurate costings and quotes by service providers.

**LMS evaluation conclusions**

Three commercial LMS supplied by vendors were selected and trialled:

- Talent is user friendly with relatively good course development functionality but limited assessment functionality and therefore cannot fully support blended learning as a stand-alone LMS.
- Asentia is a well-structured LMS administratively and well suited to blended learning with its wider assessment functionality including a practical assessment tool. However, the practical assessment functionality would not fully satisfy quality assured competence-based assessment in the workplace.
- Swift track offers sufficient functionality for the delivery and management of quality assured practical assessment and when teamed up with Articulate and Microsoft communication tools, may provide sufficient functionality as a minimalistic but user-friendly solution. Some smaller companies with limited IT support staff may favour the Swift track solution. However, it is not likely to offer VET providers delivering NQs the full level of functionality they require.
- Moodle is free open-source software with a very large community of users who help each other to resolve problems and complete bespoke customisation of the platform. Moodle workplace is a recent manifestation developed for the business world, as opposed to education. With the support of a Moodle technician or Moodle partner support services, Moodle can provide a bespoke LMS, once a specification has been agreed, and can continue to grow and evolve as organisational needs change.

## Authoring software

Authoring tools are used by content developers to create engaging interactive content for the LMS and are essential to the development of high quality 'on-line learning'. There are many commercially available products, and most are SCORM compliant, allowing 'trackable' course content produced and collaborative partners to utilise a different SCORM compliant LMS should they chose to.

**Review of SCORM compliant authoring tools:**
https://elearningindustry.com/directory/software-categories/elearning-authoring-tools/compliance/scorm-12

LMS selection should be undertaken alongside the selection of compatible authoring tools, taking account of the available 'online resource' authoring experience within the development team. Some tools require limited to no skills development as

exemplified by H5P, whereas others require significant development or are specialist tools best suited to qualified instructional designers, such as Articulate and Adobe Captivate, respectively.

- Articulate

This tools familiarity with Microsoft Power Point, shortens the initial learning curve for basic level users. It is relatively expensive software ($ 1,398 per author) and gaining full proficiency could be time consuming. It would be advantageous to have a qualified instructional designer in the team with Articulate experience, if reliant on this software.

Web site- https://articulate.com/

See reviews - https://uk.pcmag.com/cloud-services/85069/articulate-storyline-2
https://www.trustradius.com/products/articulate-storyline/reviews

- Adobe Captive

Arguably the leader for the creation of 'high end' interactive content, but not suited to non-specialist developers. This is a relatively expensive option as reliance on this software, would necessitate outsourcing of the development of interactive content, and/or the employment of a Captivate specialist.

It may have some merit for the development of the most ambitious content that is beyond the capability of the more user-friendly product, Articulate.

See reviews https://www.adobe.com/products/captivate.html

https://www.trustradius.com/products/adobe-captivate/reviews

- H5P

A free, open-source software that is relatively easy to use and offers 20 course architectures. However, there is no Power Point importing function, preview option or webcam recording. This software is a godsend for those with no budget to spend on training but limited compared with commercially available tools.

Web site- https://h5p.org/

See reviews- https://uk.pcmag.com/cloud-services/85073/h5p

It is worth noting that Articulate was rated 'hands down' the best on the market and the 'editor's choice' by a PC world reviewer and comes in at a cost of $1,398 per author and the more recent version Articulate 360 offers even more functionality. There are other high-quality authoring tools, including Camtasia, Lectora and Elucidat, but Articulate can address most needs and may be easier to apply more immediately, due to its Power Point similarity.


## E portfolio

The term e-portfolio is used to refer to a product created from "purposeful aggregation of digital items (related to learning) which present an assessor with evidence of the learners learning and/or ability".

Although an E portfolio can be used to present evidence of learning across a wide range of activities, including cognitive and practical tasks, in the context of Aquaculture VET, the E portfolio is a most valuable tool when applied to the assessment of practical skills.

However, this does require a 'framework of standards' typically presented as performance-criteria (PCs) and guidance on how each can be evidenced, including the nature and amount of evidence required to satisfy each PC. Unitised Aquaculture NQs that are unitised and composed of well-defined learning outcomes provide a solid foundation for E portfolio application. As the functionality for managing the assessment of skills (competence) was either lacking or weak in all the proprietary LMS (see above), this led to an exploration of E portfolios, designed specifically for the management of 'competence based' assessment. Whilst the Moodle Gradebook offers sufficient functionality to create an e portfolio, 'bolting' an e portfolio to a proprietary LMS using API may provide the functionality more readily and cost effectively.

Bespoke E portfolio tools can be developed by programmers, and solutions may be possible by developing the open-source Moodle LMS to provide this feature. However, the best E Portfolio systems are available from commercial vendors.

- Vendor provided E Portfolio

Although there are several E portfolios worth evaluating, Learning Assistant is a well proven system with a good track record that can be used to exemplify the functionality a commercial E Portfolio can offer.

How does Learning Assistant work?

Everything is online, and there are no paper portfolios to worry about. Learners and trainers can access the web-based E portfolio that contains all the relevant course material. Individual users can upload their evidence to the system, allowing each person involved in the process to plan, give feedback, assess, verify, and finally award the qualification within a well-managed and quality assured assessment process. The system allows vocational qualifications to be delivered anytime and anywhere.

In addition to the key roles described previously for learner, witness testimony provider, assessor, and internal verifier, an organisation would also need to establish a 'super user' to enrol learners, customise courses, set up reports and control every part of the system. When NQs are being awarded, the system is open to External Verifiers from the Awarding Body, so as they can sample selected portfolios. Finally, in a work-based training situation, it is common for the learner's manager to be able to review tailored progress reports.

There are secondary benefits to using such systems. When a learner or witness testimony provider uploads some evidence, the assessor is informed immediately, which speeds up the assessment process considerably. The use of E portfolios tends to increase the learner's digital competence and general confidence, which is motivating and enabling. There is a continuity of contact, and the learner can be provided regular guidance, at the time it is needed.

- Customised solution - Swift track

For comparison purposes a demonstration was provided by RI Training who offer the Swift track E-portfolio. This bespoke system been produced by programmers and designed for the management of skills-based assessment by employers as opposed to VET providers. It has sufficient functionality to support a quality assured work-based assessment process and is a viable alternative to larger vendor supplied E Portfolios for those who favour a streamlined system. Swift track has more recently added a modest 'no frills' basic LMS function, which has also been reviewed (Section 4.3.1).

# E Learning development

There were many mistakes made in Scotland and elsewhere regarding E Learning development in the 'early days. It was commonly assumed by institutional leaders that their experienced VET teachers could readily convert their courses to E Learning with the IT Managers assistance. Some went further and set ambitious targets regarding how much of their college curriculum would be 'online in 3 years' time, to impress their peers at conferences and events.

Some of these targets were achieved by staff by simply publishing screeds of notes or their PowerPoint presentations on the college LMS. This required minimal thought but was of very little real educational value. For E Learning to work well, as a significant component of a delivery system, it must be well designed, and many of the considerations have been detailed in Section 3.

The skill set required is therefore a very wide one, and over time the more genuinely progressive VET institutions moved towards a team-based approach towards E Learning development. Many examples of how this has been achieved are described in Section 2.

In this section, the skill set required and disciplines that that need to be instilled are described in more detail.

## Instructional design protocols

Instructional designers are architects, drawing up specifications and blueprints for an E Learning course before the actual construction begins. Sometimes they may build what they design, although this requires a much wider skill set. Often, they project manage a team of technical specialists (Learning Technologists) through the process of production and trialling.

When teachers are simply putting content into PowerPoint slides or PDFs, you don't really need an instructional designer. The subject matter experts can just write the content and the students will be recipients of that content, usually within a conventional classroom setting as a part of face-to-face delivery. Instructional designers understand how people learn and have ideas on how to engage learners and help them learn better, based on an understanding of learner profiles, and needs.

The basic instructional design process involves:

- Working with Subject Experts to identify what learners need to learn
- Developing objectives and ensuring content matches those objectives

- Developing assessments with the subject matter expert (note that this does not only mean 'tests')
- Revising and rewriting content to shape it for learning needs
- Structuring content and learning activities
- Creating or 'contracting' the creation of media to support learning
- Adapting instructional materials created for one format to another format (often adapting face-to-face materials to e-learning)

Teachers in the 'classroom' are 'instructional designers', through the lesson plan, and have the advantage of being able to interact there and then with learners in real time. The nature of the E Learning experience will determine how interaction, feedback and the consolidation of learning will be undertaken. Learning Management Systems (LMS) can offer communication tools to support 'synchronous delivery, whereby learners and their online tutor are communicating in 'real time' assisted by technology. At other times learning will be asynchronous and resource centred, whereby learners are engaging with learning resources and undertaking tasks independently. They can communicate with their peers and tutors asynchronously via message boards, emails, and similar types of technology. This communication can be shared with a group and/or private.

The intended learning experience including the balance between synchronous and asynchronous methods needs to be factored into the instructional design thinking at the outset, as it will influence the choice of resources and their application, all of which must be expressed within a design specification usually referred to as a 'storyboard'.

# E learning development team

It is possible, although unusual, for a group of teachers or in very exceptional circumstances, an individual member of teaching staff to produce E Learning. However, even when taking full advantage of the functionality and tools offered within a typical commercial LMS, the results will not be of a high quality. In addition, to incorporate some graphic and visual content, many VET practitioners will breach copyright laws. Whilst it is uncommon for legal action to be taken against teaching staff using visual resources 'grabbed' from the internet without permission within their own learning materials within a PowerPoint presentation delivered within the confines of the classroom, it is a different matter when presenting E Learning in an 'outward facing' LMS. In that scenario, a breach of copyright is much more likely to be challenged, and such practices should be discouraged by academic institutions and consortia

The development of high-quality E-Learning, whilst keeping on the right side of copyright regulations requires a team approach, with a specific role (or roles) for each member. The following team members working together as a team under the direction of a project manager and/or instructional designer can provide the skill set required to develop effective E Learning.

- Subject matter experts (SMEs)

The subject matter experts are usually experienced teaching staff who are full qualified in the technical aspects of the subject and able to interpret the subject at a specified EQF level. They can create raw text that the instructional designer is able to incorporate within storyboards, and therefore are an essential part of any development process. It is possible for subject matter experts with no previous teaching experience to join a development team and provide very useful input, especially when working with others who do have teaching experience.

- Instructional designer

The instructional designer is the interface between the subject matter expert and the technical developer/graphic designer. They translate the teaching and learning requirements and can speak in the language of the technical developer and graphic designer so that together, the optimal solution can be found.

The translation is vital to develop materials that,

> ➤ meet the needs of the learner
> ➤ do what the SME wants it to do in terms of delivering the learning outcomes
> ➤ engage learners and work.

It is also important to make the most effective use of time. Correct translation can save a lot of misunderstanding between various parties. The Learning Solutions Team (LST) can also see where similar material has been developed before or can be reworked to satisfy the learning outcomes.

If they are trained and competent to design for learning, the technical developer, graphic designer, or subject expert can also be an instructional designer.

- Technical developers

Technical developers use authoring tools, programming and LMS tools to create interactive on-line materials, integrate media elements and create animations. They are more than simply IT technicians and need to have a good understanding of the development process and be able to interpret the story board specifications accurately.

- Graphic designer

The graphic designer has a key input, advising on appropriate ways of illustrating complex concepts, the appropriate use of imagery, drawing diagrams and other visual elements and ensuring that the appropriate use of colour, fonts, layouts, navigation etc. meets accessibility and useability criteria.

Most are also very proficient with graphic design software and can produce the graphics specified in the story boards assisted by exemplars and supplementary notes to define the interactions required within the graphic created.

- LMS manager and IT technical support

Ultimately the LMS will be populated with learning materials and SCROM compliant courses developed using author ware. The LMS manager needs an in-depth technical knowledge of the LMS and the ability to advise the LMS users, VET practitioners and learners. They will also enrol learners and monitor activity, assist academic staff with the loading of courses and provide activity reports to academic teams and institutional managers.

# The E Learning Development process

Storyboarding is the central E-Learning development tool. It holds the specifications of 'learning objects' and enables those producing the text, visual, and multimedia resources to develop what is required to meet objectives and deliver the intended learning outcomes.

**Learning object definition**

*"A learning object is any digital resource that can be used to support learning. The term generally applies to educational materials designed and created in small chunks for the purpose of maximising the number of learning situations in which the resource can be utilised.*

*Commonly, learning objects are interactive, which can increase learner engagement and the effectiveness of learning."*

**What is meant by a storyboard and who is involved?**

The storyboard is the central communication tool within E-Learning development. It allows all of those involved in the development of learning objects to discuss design and develop materials that meet the needs of the learner, do what the subject matter experts want it to do in terms of the learning outcomes, and engaging learners.

The subject matter experts (SMEs), instructional designers, technical developers, and graphic designers can all have an input to story boarding at some stage of the process.

**How is the storyboarding process conducted?**

instructional designers are normally leading the E Learning development process, and most prefer to see SMEs chunk, structure, and sequence their content. This can be done outside of the story board within a word document. Alternatively, a power point presentation with notes can be an ideal starting point, but a series of bullet points alone may not be sufficient.

The SMEs do not need to design 'interactions' or necessarily create the course. This can be done by the instructional designer. But they should provide details on the target audience, the relevance of the training and the primary objectives. It is also very useful for the Instructional designer to hear from the SMEs, what has worked in the past during their previous experiences of teaching the subject. For example, the use of a specific graphic may have led to a learning breakthrough, an experience that can be used to help specify a learning object that incorporates that graphic and makes in interactive, to overcome the potential disadvantage of not being able to immediately ask the tutor questions following an illustrated explanation. Real case examples can be particularly valuable, especially if used to apply a concept to a simulation of the 'real world'.

Mind maps can also be very usefully deployed by SMEs to structure the course and can provide a 'macro-design' overview that the instructional designer can refine and work up into a story board format. They can help to stop learning being too linear and sequential. Whenever there are choices or judgements to make, each with different consequences, it helps to visualise the connections between topics and find all the lateral links. Mind mapping is a very good way of doing this and is also an excellent activity for the instructional designer to undertake with a group of SMEs, as it allows any differences in knowledge, experience, and opinion to be surfaced at the outset, before the job of creating the raw content is shared out amongst them. The SME team can start to see their

different individual strengths, ultimately helping them to become more effective collaborators, and easier to lead.

The story board itself can be presented in several different ways and two tried and tested examples have been provided in appendices 3 and 4.

- Appendix 3 - Internal anatomy of the salmon

This storyboard has three columns to capture the text input, a definition of the media to be used (graphics, video, diagrams, illustrations etc with the file format and resolution required defined) and a column with notes to describe any interactions needed.

- Appendix 4 – Egg receipt and incubation

This is a simplified story board that relies on two columns but using an agreed code that the technical developers and graphic designers can interpret, to describe the course architecture, links, and interactions and resources to be imported. The instructional videos referred to each have their own storyboards.

The application of collaborative tools such as google offer and share point, allow communication between members of the development team and the resolution of issues, up to the point of completion.

The instructional designer does not need a subject knowledge, but they do need to understand multimedia, how it works and appears on a PC screen. They must imagine in some detail how the learner will interact with the resource. It is this final point that is defined in the third column specifying the interactions. The more 'interactive' the learning content the more engaging the resources and learning experience are likely to be. However, the more ambitious the development team are, the greater the design requirement and cost of programming interactive multimedia resources.

The highest quality and most interactive learning objects are chosen very selectively to get greatest return on the investment, in terms of learning. If there is a simpler, cheaper way to achieve the same learning objective, it will normally be chosen to keep within budget.

Whichever template is used for story boarding, as well as providing a template within which the creative work is all recorded, leading to a specification, it also provides a vital role within project management and accountability. Once those commissioning the E-Learning development are satisfied, a budget can be allocated and the story board can be signed off, thereby approving the technical developers to start the creation of the course, or learning object specified.

**What are the practical benefits of a story board?**

Story boarding offers many practical benefits:

*A visual display and overview of information* – Because they are graphical by nature storyboards can give a simple means of seeing how the information will appear prior to going into the development phase.

*Stimulating discussion between the SME(s) and developer* – As your storyboard is laid out, you can begin to think holistically about your information presentation. New ideas can be stimulated concerning where learners may want to go for additional information on topics.

*Checking the pedagogy* –Decisions during an instructional design process often have to be made, such as what to include and where to include it. Whether an element makes pedagogical sense and

adds value to a course or helps the objectives to be achieved, beyond those that can be met by simpler (and less expensive) means, must be considered.

*Generating a plan of action* – Having a well laid out plan of action in course development helps the team to properly allocate time to various responsibilities during the development process. For example, someone can be sourcing images, taking photographs, or shooting video while other team members are building templates for online materials or creating quizzes etc.

*Showing navigation* – While certain navigation schemes are obvious within course design, by placing the design in a graphical context, you can begin to see how the graphical elements will work.

*Choosing a style* – In an environment where text and media elements are integrated, it is important to choose how this information will appear to the user. In addition, the institution, consortia, or company offering the E-Learning, may also have a house style and brand to reenforce. In some cases, this can influence the colours used as well as choice of fonts but should not take priority over important learner considerations within font selection.

*Gap analysis* – Once the entire storyboard has been laid out, you can take a step back and see whether something is missing. There may be an objective that has not been met by the content. It is better to notice these gaps before you get into full development to avoid extensive editing of content later.

*Peer evaluation of design* – When working by yourself, or in a group, it is a good idea to seek the opinion of others. They may confirm their approval of your ideas or have different ideas you have not considered. This is all part and parcel of fostering good teamwork.

*Building a consensus among a group of designers, subject matter experts, etc* – It can be a difficult process to develop a course in a group. For example, a designer may have different ideas about content placement and organisation than a content expert or multimedia creator. Storyboards provide a common element upon which all those involved can fall back on. They provide a means by which developers can achieve consensus prior to getting involved in the project. They also allow for simplification of the allocation of tasks to various individuals involved with the project.

*Graphical sizing* – When creating a graphic within a graphics program, it may look great. However, when you place this graphic within the context of other course materials you may discover that it is too big for your use, or that its colour clashes with other elements. Maintaining a similar look and feel to the images, helps learners create context and familiarity.

**What are the main considerations when creating story boards?**

*Clear learning objectives*

Once set, the rest of the design stage should be centred around how best to meet the objectives for the learner and their needs.

*Organise all information and media elements that have already been developed*

The first step is to figure out what you have, what you want and still need to meet your objectives. In addition, you may have ideas for media that you are able to find already produced online, some that you can link directly to without permission. There is however a potential risk to this approach. The content can be taken down at any stage leaving you stranded, so it is inadvisable when the resource is of a high priority to your course, but acceptable if it is a non-essential enhancement.

# Preparing for E Learning development

When considering embarking on an E Learning development project and determining how ambitious to be, it pays to take stock. You need to evaluate your capability as an organisation and if the development process is collaborative, your collective capability. The same approach could be followed when evaluating a potential new partner, to ensure they fit in with and complement the existing development team.

In general terms, the E Learning self-evaluation should include:

- The skill set, experience and time availability of staff considered for the development team
- The ICT infrastructure, and available software to support the development process
- The ICT technical support available to the development team and piloting process

Arguably, the formation of a well-balanced development team with the time, skills and commitment is the most mission critical aspect as the other resource requirements can be more easily purchased if lacking. It can be more challenging when trying to address a development skills gap.

The evaluation of the staff resource should enable the institution or development project leader to,

- Clearly and objectively identify their own strengths and weaknesses,
- assign roles to individual staff,
- identify any skill and/or capacity gaps, and
- plan to address any gaps identified through outsourcing and/or recruitment.

# Appendix 1    Vendor supplied LMS Evaluation of functionality

Note: The notation 1 denotes that the feature is included within the LMS. If all features are included the LMS receives a score of 100%.

| Feature | Loop | ADOBE (CP) | iSpring | Innform | Talent | Asentia |
|---|---|---|---|---|---|---|
| **Accounts %** | **100** | 83 | **100** | 83 | **100** | **100** |
| Add a new user | 1 | 1 | 1 | 1 | 1 | 1 |
| Archive users | 1 | | 1 | 1 | 1 | 1 |
| Browse list of users | 1 | 1 | 1 | 1 | 1 | 1 |
| Bulk User Actions | 1 | 1 | 1 | 1 | 1 | 1 |
| Custom/Mandatory User Profile fields | 1 | 1 | 1 | | 1 | 1 |
| Upload users | 1 | 1 | 1 | 1 | 1 | 1 |
| **Activity grading %** | 0 | 33 | 33 | 83 | 33 | **100** |
| Course History | | 1 | 1 | 1 | 1 | 1 |
| Gradebook | | 1 | | 1 | | 1 |
| Gradebook audit trail | | | | 1 | | 1 |
| Gradebook comments | | | | | | 1 |
| Manual Grading ("Marking") | | | 1 | 1 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Multiple grading scales | | | | 1 | | 1 |
| **Authentication %** | 57 | 57 | **100** | 86 | **100** | **100** |
| Active Directory/LDAP Integration | | 1 | 1 | 1 | 1 | 1 |
| Custom User login page | 1 | 1 | 1 | 1 | 1 | 1 |
| Manual Accounts | 1 | | 1 | 1 | 1 | 1 |
| Login | | | 1 | | 1 | 1 |
| SAML2/API Integration | 1 | 1 | 1 | 1 | 1 | 1 |
| Self-Registration | 1 | | 1 | 1 | 1 | 1 |
| Self-Registration w. Admin Confirmation | | 1 | 1 | 1 | 1 | 1 |
| **Categories %** | 75 | 75 | 75 | 75 | **100** | 75 |
| Assign Courses to categories | 1 | 1 | 1 | 1 | 1 | 1 |
| Create new Categories | 1 | 1 | 1 | 1 | 1 | 1 |
| Manage Categories | 1 | 1 | 1 | 1 | 1 | 1 |
| Priced Categories (Bundle) | | | | | 1 | |
| **Certificate management %** | 0 | **100** | **100** | **100** | 80 | **100** |
| Certification life-cycle | | 1 | 1 | 1 | 1 | 1 |
| Manage certification templates | | 1 | 1 | 1 | 1 | 1 |
| Predefined certification templates | | 1 | 1 | 1 | 1 | 1 |
| Unique Certificate by Course | | 1 | 1 | 1 | 1 | 1 |
| Unique Certification by Curriculum | | 1 | 1 | 1 | | 1 |
| **Compliance management** | 50 | **100** | 50 | 25 | **100** | **100** |
| Certificate expiration notifications | | 1 | | | 1 | 1 |
| Certification Expiration Management | | 1 | 1 | | 1 | 1 |
| Due Date notifications | 1 | 1 | 1 | 1 | 1 | 1 |
| Soft/Hard Stop Due Dates | 1 | 1 | | | 1 | 1 |
| **Creation %** | 91 | 73 | 82 | 73 | **100** | **100** |
| Assignments Engine | 1 | 1 | 1 | | 1 | 1 |
| Built-In Authoring Tool | 1 | | 1 | 1 | 1 | 1 |
| Can reuse PPTs, PDFs, Videos | 1 | 1 | 1 | 1 | 1 | 1 |
| Changing Course default settings | 1 | 1 | 1 | 1 | 1 | 1 |
| Consume online video content | 1 | 1 | 1 | 1 | 1 | 1 |
| Course backup Options | | | 1 | | 1 | 1 |
| Learning Paths (Curriculums) | 1 | 1 | 1 | 1 | 1 | 1 |
| Scheduling LIVE events | 1 | 1 | 1 | | 1 | 1 |
| Survey Engine | 1 | | | 1 | 1 | 1 |
| Tests Engine | 1 | 1 | | 1 | 1 | 1 |
| Upload courses | 1 | 1 | 1 | 1 | 1 | 1 |
| **Customization %** | 50 | 50 | 50 | 50 | 50 | 50 |
| Mobile Learning Support | | | | | | |
| Personalized views | 1 | 1 | 1 | 1 | 1 | 1 |
| **Enrolment %** | 43 | 57 | **71** | 43 | **71** | **86** |
| Attendance Tracking | 1 | 1 | 1 | 1 | 1 | 1 |
| Automated Enrolment (based on User data) | | 1 | 1 | | 1 | 1 |
| Guest Access Settings | | | 1 | | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Manual Enrolment | 1 | 1 | 1 | 1 | 1 | 1 |
| Self-enrolment | 1 | 1 | 1 | 1 | 1 | 1 |
| Self-enrolment (with a PIN #) | | | | | | 1 |
| Survey enrolment (based on a response) | | | | | | |
| **Format %** | 50 | 12.5 | 37.5 | 37.5 | **62.5** | **50** |
| Course Discussions | 1 | | 1 | | 1 | 1 |
| Gamification Format | | | | | | |
| Learner Upload | 1 | | 1 | | 1 | 1 |
| LIVE Chat Option | | | | | 1 | |
| LIVE Videoconferencing / Webinar | | | 1 | | 1 | 1 |
| Social Format | 1 | | | 1 | | 1 |
| Topics Format | 1 | 1 | | 1 | 1 | |
| Weekly Format | | | | 1 | | |
| **Gamification %** | 14 | 71 | **100** | **100** | **100** | 29 |
| Badge customization | | | 1 | 1 | 1 | |
| Badges | | 1 | 1 | 1 | 1 | |
| Customize Gamification mechanics | | 1 | 1 | 1 | 1 | |
| Leader boards | | 1 | 1 | 1 | 1 | 1 |
| Levels | | 1 | 1 | 1 | 1 | |
| Points | 1 | | 1 | 1 | 1 | 1 |
| Rewards | | 1 | 1 | 1 | 1 | |
| **Interface options %** | 62.5 | 25 | 62.5 | 62.5 | **87.5** | **87.5** |
| Additional external pages | 1 | | | 1 | 1 | 1 |
| Block Management | 1 | | | | | 1 |
| Calendar Settings | 1 | | 1 | | 1 | 1 |
| Language settings | | | 1 | 1 | 1 | 1 |
| Location Settings | 1 | 1 | 1 | | 1 | 1 |
| Media embedding settings | 1 | | 1 | 1 | 1 | |
| Multilanguage Support | | | 1 | 1 | 1 | 1 |
| Ready-made Themes | | 1 | | 1 | 1 | 1 |
| **Learning types %** | 50 | **100** | 75 | 75 | **100** | **100** |
| Asynchronous Instructor-led | | 1 | 1 | 1 | 1 | 1 |
| Asynchronous Self-paced | 1 | 1 | 1 | 1 | 1 | 1 |
| Blended Learning | 1 | 1 | 1 | 1 | 1 | 1 |
| Synchronous Virtual Classroom | | 1 | | | 1 | 1 |
| **Mobile learning %** | 50 | **100** | **100** | **100** | **100** | 50 |
| Offline (Disconnected Mobile App) | | 1 | 1 | 1 | 1 | |
| Online (Internet connected) | 1 | 1 | 1 | 1 | 1 | 1 |
| **Offline %** | 0 | **100** | **100** | **100** | **100** | 0 |
| Support for offline access to content | | 1 | 1 | 1 | 1 | |
| **Reports %** | 43 | 71 | 71 | 71 | 86 | **100** |
| Automated Report Scheduling | | 1 | | | 1 | 1 |
| Canned Reports | 1 | 1 | 1 | | 1 | 1 |
| Dashboards and Graphic Reports | 1 | 1 | 1 | 1 | 1 | 1 |
| Email delivery of Reports | | 1 | 1 | 1 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Exporting Reports in variety of formats | 1 | 1 | 1 | 1 | 1 | 1 |
| Grading Report Settings | | | 1 | 1 | | 1 |
| Training Record Maintenance | | | | 1 | 1 | 1 |
| **Roles %** | **100** | 75 | **100** | **100** | **100** | **100** |
| Define roles | 1 | 1 | 1 | 1 | 1 | 1 |
| Role Assignment | 1 | 1 | 1 | 1 | 1 | 1 |
| System Permissions per role | 1 | 1 | 1 | 1 | 1 | 1 |
| Teams and Team Hierarchies | 1 | | 1 | 1 | 1 | 1 |
| **Security %** | 40 | **80** | 60 | 40 | 60 | 40 |
| Anti-spam | | 1 | | 1 | 1 | |
| Anti-virus | | 1 | | | | |
| IP Blocker | | 1 | 1 | | | 1 |
| Restrict registration to specific domains | 1 | | 1 | | 1 | |
| Strong Passwords | 1 | 1 | 1 | 1 | 1 | 1 |
| **Shopping cart %** | 0 | 50 | 50 | 0 | **100** | 50 |
| Built-In Shopping Cart | | | 1 | | 1 | 1 |
| Shopping Cart as Plug-In | | 1 | | | 1 | |
| **System reports %** | 75 | 75 | 75 | 50 | **100** | **100** |
| Automatic email reports in predefined intervals | | | 1 | | 1 | 1 |
| Custom reports generator | 1 | 1 | | | 1 | 1 |
| Email notification settings | 1 | 1 | 1 | 1 | 1 | 1 |
| Live Logs | 1 | 1 | 1 | 1 | 1 | 1 |

## Appendix 2    Selection of 5 LMS from top twenty for comparative analysis of user review feedback

| Criteria | Loop | ADOBE Captivate | iSpring learn | Asentia | Talent LMS | SAP Litmos |
|---|---|---|---|---|---|---|
| Top twenty ranking | 1 | 2 | 3 | 6 | 9 | NA |
| Vendor Straplines | *'Introducing the opposite of clunky and expensive.*<br><br>*Solving engagement and productivity without 'bells and whistles. A frictionless learner experience'* | *'A fully featured LMS with a learner first approach'*<br><br>*An abundance of tools to take learning to the next level. Ideal if you are looking for responsive and personalized learning* | *'A fast LMS for your mission critical project'*<br><br>*You can launch your eLearning in one day with a minimum of fuss. Just upload your training materials, invite employees, and keep track of their results* | *'Asentia LMS has been carefully designed to support blended learning'*<br><br>*Seamlessly blends the most advanced eLearning technology with time-tested conventional training methods, within a rich learning ecosystem to foster collaboration and communication.* | *"For its price and feature set, Talent LMS is a gold mine"*<br><br>*With a highly intuitive interface, Talent LMS creates a distraction-free environment and makes learning a breeze. Your learners navigate through the platform easily, and access information in a snap* | *"Simple user interface and a mobile app"*<br><br>*This LMS is a good choice when you need to launch an onboarding course for your company's new employees. It helps that it is also quite simple for admin staff to begin using* |
| Multilingual | No Multilingual support | 10 languages | Multilingual support | Multilingual support | Multiple languages | |
| Pricing and support | Reasonably priced Up to 250 users $699/month<br><br>Up to 500 $1,199/month | Relatively high price $4/month/user (Discounts for 500+)<br><br>500 users costs $2,000/month | Reasonably priced Pay for active users per month at $2.84/user/month<br><br>500 active users cost $1,420/month | Moderate price 100 named users - $340/month<br><br>500 active users $ 1,700/month | Low cost (High VFM) $59/month at starter level on an annual plan | High cost 50-150 users/month is $15 per user 150-500 user/month is $6 per user 500 active users $3,000/month |
| Trials | Free trial | Free 30-day trial period | Free trial | Free trial | Free trial | Free trial |

| Key features | i) Work & performance focussed<br>ii) Can be customised (branded)<br>iii) Gimmick free simplicity<br>iv) Easy to navigate and administer<br>v) Very simple content creation (text, video, images, links) automatically formatted<br>vi) Individual learning paths and learner control (with tracking)<br>vii) Easy to engage learners through campaigns<br>viii) Accessible by mobile app<br>ix) Good back up service<br>x) Loop will soon integrate with HR system. | i) Skills focus<br>ii) Multi-lingual<br>iii) Downloadable content<br>iv) Gamification engagement<br>v) Badges and scoreboards<br>vi) Links with ADOBE captivate authoring tool<br>vii) Can publish SCORM compliant packages<br>viii) Countless e learning formats<br>ix) Can keep modules organised<br>x) Can customise user interface<br>xi) Accessible from mobile devices<br>xii) Wide functions with no plugins<br>XIII) Job aids can be linked to courses<br>XIV)Encourages peer learning | i) Industry leading integrated authoring tool<br>ii) Interactive quiz function<br>iii) Exam modules easy to set up<br>iv) The Learning Path allows to combine lessons into chapters and to set rules and permissions.<br>v) User portal can be localised<br>vi) Gamification features combined with course path is powerful<br>vii) Immediately integrates into the Power Point environment | i) Sophisticated rules system that will automatically enrol the right people in the right training at the right time<br>ii) Activity grading very strong: tracks successful completion while notifying progress and exceptions to supervisors<br>iii) Automates administrative tasks<br>iv) Combines videos, PowerPoints, sophisticated interactive multimedia, one-on-one mentoring, instructor-led training, off-line assignments, and social (peer) learning – Blended learning.<br>v) Fast and simple access to all the training in a centralized, searchable system<br>vi) Very responsive support team mentioned by reviewers<br>vii) Seamless appearance with company branding | i) Can create training quickly- great for authors Embedded Wix pages for content creation (easily)<br>ii) Training segmented by 'branches'<br>iii) Flexible, accessible & Customisable.<br>iv) Supports video conferencing & instructor led learning.<br>v) Good analytics / reporting<br>vi) Accessible by mobile devices<br>vii) Good gamification functions<br>viii) Very user friendly for novice learners<br>ix) Links with Go to Meeting<br>Can link to Zapier (750 tools)<br>x) Ease of administration<br>xi) Good range of test (assessment) options<br>xii) Technical support highly praised | i) Easy to begin, good onboarding courses<br>ii) Simple UX-driven design in both admin and learner roles<br>iii) Off-the-shelf content with Litmos Heroes subscription<br>iv) Many integrations and add-ons can expand functionality and provide a greater means for tailoring according to taste<br>v) After you complete a module as a learner, you can not only get a badge but also a custom certificate of completion, which admins can upload as a Microsoft Word document.<br>vi) You can create multiple Brands inside your portal that feature their own unique learner portal design |
|---|---|---|---|---|---|---|
| Downside | i) Limited functionality may lead to more external expertise | i) Not ideal for ecommerce driven learning | i) Basic reporting function<br>ii) Hard to find report options | i) A lot of steps to get course loaded (1 review)<br>ii) Replacing SCORM content with a new | i) Not a simple tool (but sophisticated)<br>ii) Lacks an integrated gradebook | i) Very limited customization capabilities for roles |

| | ii) Quizzing options and reporting on quizzes are limited. iii) Updating users is labour intensive | ii) Too basic for some? (ADOBE Captivate can overcome this but adds to cost) iii) May be complex for non-LD managers iv) Apps criticised by some | iii) Customized report generation needed for instructors to better understand learners experience graphically iv) Inconvenient when trying to create quizzes | version can be tricky (1 review) iii) Manuals light but great support service (1 review) | | ii) Some admin actions could be simplified iii) PRO plan without the Content Library is only available with 150+ learners iv) Some additional perks eg Automation Bundle that help manage platform are purchased separately v) Some clients complained about SAP Litmos support service vi) Pricing higher than the industry average |
| --- | --- | --- | --- | --- | --- | --- |

# Appendix 3  Storyboard – Internal anatomy of the salmon

| Title: Internal Anatomy of the Salmon | Completion Date: 15 August 2018 |
|---|---|
| Responsible person (teaching): Kare Romuld/Jon Ivar Theordorsen | Edited/Validated: |
| Instructional design: Christine Dudgeon/Martyn Haines | Tested: |
| Date: 29.5.2018 | Launched: |

**Introduction:** *This Powerpoint development is for people involved in aquaculture working towards a vocational qualification. (in Norway, this is the Journeyman Certificate in Aquaculture. In Scotland, this is the SVQ2 in Aquaculture.)  They are required to apply knowledge across a wide subject scope. This interactive activity is to be trialled in Norway where it supports classroom work, including practical salmon dissections and question &  answer sessions involving the One2Act  voting system.*

**Who is it for?**
The Journeyman Certificate in Aquaculture in the Upper Secondary School of Guri Kunna, Froya, Norway is undertaken by both young learners (16+) taking a vocational qualification in aquaculture, without necessarily any prior experience of the industry and mature learners already in the industry who need to gain this qualification. Both groups attend Guri Kunna but are in separate classes.

**Aim of the Powperpoint development:**
1.   To support the learner in learning to recognise the main features of the internal anatomy of the salmon
2.   To support the learner in learning the function of each of these internal features
3.   To be an interactive activity where learners can work at their own pace, separately or in groups
4.   To be an interactivity that can be used by the teacher on the whiteboard to teach/generate discussion
5.   The learning object should be 'stand alone' not requiring to be hosted on a VLE and be able to be easily uploaded on to each learner's laptop

**Internal anatomy features:**

- Liver
- Kidney
- Swim Bladder
- Intestine
- Spleen
- Stomach
- Pyloric caeca
- Heart
- Gills
- Ovaries
- Testes
- Brain

**Software: Microsoft Powerpoint, exported as a Powerpoint Show**

Powerpoint may also be converted to HTML5 by processing it through Captivate

Powerpoint set up:
Slide size: standard (4:3) to allow for general whiteboard size and ratios, tablets
Images: work to highest resolution during Master development and compress through Powperpoint prior to Powerpoint show export
Main slide: pale blue background
Custom shows: pale green background. Image to fill screen. Text to the right of or below the feature if at all possible.
(For Powerpoint settings, see end of Storyboard)

| Page | Text | Media – graphics, video, diagrams, illustrations etc – (define file format, resolution required  etc) | Notes and Interactions |
|---|---|---|---|
| Slide 1<br><br>Introductory page | **Internal anatomy of the Salmon**<br><br>Learn about the internal organs and what they do. | Photograph of salmon: salmon2_trans.png, width at least 1920 px | Image of whole fish is hyperlinked to slide 2, to fit approx. on the |

| | | | |
|---|---|---|---|
| | Click on the salmon to begin. | Cut -out to show fish only on transparent background | whole fish then fade again to final image of 20180507_103449.jpg At a larger size without whole fish as background. |
| Slide 2 Main page | Hover your mouse over each feature to show its name. Click on each feature to find out about its function. (Click again to return to this page.) | 20180507_103449.jpg Cut -out to show fish only on transparent background | Fade from slide 1 to slide 2 |
| Slide 3 Liver | The **liver** is the largest organ in the fish's body and is part of the digestive system. It is essential for maintaining chemical and blood sugar levels in the blood (just as it does in mammals). It stores, synthesises and secretes essential nutrients. Bile is produced by the liver then stored in the gall bladder and released for the break-down of fats. Finally, the liver is a cleansing organ. It removes metabolic wastes from the blood and aids the recycling of old blood cells. (Click anywhere to return to the whole fish) | Photograph: 201180507-103507 width at least 1920 px | Custom Show Liver |
| Slide 4 Kidneys | Salmon have two **kidneys** joined together positioned under the spinal column. The front kidney produces red blood cells and the back kidney cleans the blood. Urine is collected by ducts near the vent. The kidneys have a critical osmoregulation role to play within smoltification. They allow the young salmon to safely transfer from fresh to salt water. (Click anywhere to return to the whole fish) | Photograph: 201180507-103957 and 105854 width at least 1920 px | Custom Show Kidneys 103957 (Kidney cross section 105854 in situ |
| Slide 5 Swim Bladder | Salmon fill their **swim bladder** with air for the first time as swim-up fry. The air provides buoyancy, allowing them to hold their position in the water column without using so much energy. They can adjust the gasses in their swim bladder to allow them to alter their holding depth. | Photograph: 201180507-104339 width at least 1920 px | Custom Show Swim Bladder |

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| | (Click anywhere to return to the whole fish) | | |
| Slide 6<br><br>Intestine | The **intestine** extends from the pyloric caeca to the anal vent and is relatively short compared with mammals and herbivorous fish. As a carnivore, the natural diet of salmonids is high in protein and low in carbohydrates. Therefore most of the digestion occurs in the stomach.<br><br>(Click anywhere to return to the whole fish) | Photograph: 201180507-104732<br><br>width at least 1920 px | Custom show Intestine<br><br>Note this image is stomach pyloric caeca and then intestine |
| Slide 7<br><br>Spleen | The **spleen** is a storehouse for blood. It helps to control the amount of blood circulating through the body by creating a reserve pool that can be released during severe bleeding. This helps to improve circulation and oxygenation. The spleen also recycles worn-out red blood cells.<br><br>(Click anywhere to return to the whole fish) | Photograph: 201180507-103521 and 104159<br><br>width at least 1920 px | Custom Show Spleen<br><br>103521 spleen in situ<br><br>104159 close-up |
| Slide 8<br><br>Stomach | The **stomach** is a 'U shaped' sac-like digestive organ receiving food from the oesophagus. It contains enzyme secreting glands within a folded internal wall. The stomach is relatively muscular in salmonids.  It can compress the high protein food to aid digestion. The muscles can also relax, to allow more food to be brought in during periods of intensive feeding. The stomach's pH is 5. This pH is required by the protein digesting enzymes (proteases) such as pepsin that start the protein break down process.<br><br>(Click anywhere to return to the whole fish) | Photograph: 201180507-104647<br><br>width at least 1920 px | Custom Show Stomach<br><br>Top half of image near hands |
| Slide 9<br><br>Pyloric caeca | The **pyloric caeca's** function is not well understood, but it is thought to secrete digestive enzymes and have a nutrient absorption role. Since it takes the products of digestion into the blood stream for internal transportation round the body, it can be likened to the small intestine in mammals.<br><br>(Click anywhere to return to the whole fish) | Photograph: 201180507-103456 and 103515<br><br>width at least 1920 px | Custom show Pyloric caeca<br><br>103456 (mid view in situ)103515 (close up) |

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| Heart<br><br>Slide 10 | The heart is connected to gills by the ventral aorta and drives the blood round the body via a 'single circulatory system'. Once the blood has been pumped to the gills to absorb oxygen it then passes round the rest of the body. This is  not like mammals, where the blood returns to the heart before being pumped round the body within a 'double circulatory system'.<br><br>(Click anywhere to return to the whole fish) | Photograph: 201180507-104126 and 104138<br><br>width at least 1920 px | Custom Show Heart<br><br>104126 in situ<br><br>104138 close-up |
| Slide 11<br><br>Gills | Healthy gills are red because they are filled with oxygen rich blood. They take oxygen from the water by diffusion and expel carbon dioxide into the water. The gills contain lamellae which are fine, branched structures only two cells thick, to provide the greatest possible surface area. They perform the same function as alveoli in the mammalian lung but do so more efficiently.<br><br>(Click anywhere to return to the whole fish) | Photograph:<br><br>width at least 1920 px | Custom Show Gills<br><br>No image but they must have one, ideally a close up of lamellae |
| Slide 12<br><br>Ovaries | The female reproductive organ which produces eggs. | Photograph: 201180507-105829<br><br>width at least 1920 px | |
| Slide 13<br><br>Testes | The male reproductive organ which produces milt containing sperm. | Photograph:<br><br>width at least 1920 px | May be harder to source |
| Slide 14<br><br>Brain | The control centre of the nervous system. | Photograph:<br><br>width at least 1920 px | Need to ask. Must be available from dissections |

# Appendix 4 Story Board - Egg receipt and incubation

Code:

<title> Title of the slide

<body text> Text contained in the slide

Image to be inserted (with any notes about interactions)

<T/F> True False multiple-choice questions

<ans> Answer to multiple-choice questions

<feedback> Automated feedback to learner in response to their answer

<link> Link between keywords or titles and images

<link text> Text that is part of an interaction or linked to an image

<page link> Link to another page

<video link> Link to a video

<drag and drop> Interactive drag and drop exercise

| Section/ Screen | Content | Resources |
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| | | |

| 1. | <title>Introduction.<br><br><Body text> The production begins with the receipt of fertilised fish eggs of a known genetic strain, which are procured from a reliable disease-free supplier. The eggs are established and maintained in dedicated hatcheries so that they develop and hatch. Those working in a hatchery must understand the processes associated with egg receipt and incubation.<br><br>By the end of this section, you will be able to:<br><br>1. Describe the transportation and receipt of salmon eggs.<br>2. Describe the preparation of salmon eggs for incubation and associated biosecurity measures.<br>3. Describe the environmental conditions required to successfully incubate salmon eggs.<br>4. Conduct routine hatchery stockman's calculations and predict egg development. | **Background Image -** Eyed salmon egg<br><br>Close up of eyed salmon eggs |
| 2 | <title> Quiz<br><br><Body text>Your answers to the following 'true/false questions will show how much you already know about egg incubation. The results do not count towards your Diploma and feedback is provided to make you aware of any knowledge gaps revealed. | **Background image**<br><br>Ghosted image of incubating ova |
| 2.1 | <T/F>Salmon eggs should always be kept in the dark during incubation<br><br>True or false?<br><br><Ans>T<br><br><feedback> The answer is true, as light exposure can damage the developing embryos. | **Background image**<br><br>Ghosted image of incubating ova |

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| 2.2 | <T/F> The hatch date for salmon eggs in a hatchery can be accurately predicted if the water temperature is known and stable.<br><br><Ans>T<br><br><feedback> The answer is true, as hatch dates can be accurately predicted. | **Background image**<br><br>Ghosted image of incubating ova |
| 2.3 | <T/F> Different batches of eggs from different brood stock are always identical in size<br><br><Ans> F<br><br><feedback> The answer is false, as the size of salmon eggs can vary between batches | **Background image**<br><br>Ghosted image of incubating ova |
| 2.4 | <T/F> Salmon eggs are always exported by the egg suppliers at the eyed stage<br><br><Ans> T<br><br><feedback> The answer is true, as this is the stage when the eggs are most robust | **Background image**<br><br>Ghosted image of incubating ova |
| 2.5 | <title>Feed back<br><Body text> You have scored xx out of XX in this test. Hopefully this will help you to assess what you know and don't know about the incubation of salmon eggs.<br><br>Click next to enter the learning materials and take time to further extend your knowledge of incubation. | **Background image**<br><br>Ghosted image of incubating ova |

| 3 | <title>Wild egg production<br><br><Body text>In the wild, Atlantic salmon eggs are incubated within the gravel substrate of fast running nursery streams. Depressions in the substrate, called redds, are constructed by mature females, pre-spawning.<br><br>As the female salmon lays her eggs in the redd they are fertilised by the male and assisted by the female's vigorous tail movements settle into the substrate, absorbing water and hardening. Here a supply of clean, cool, well oxygenated water passes through the redd, as the eggs develop in darkness, undisturbed, until ready to hatch.<br><br>The conditions required for eggs to hatch are replicated in well-designed 'biosecure' hatcheries. The incubation facilities are carefully prepared and stocked with eggs of a known genetic strain, procured by a reliable disease-free supplier. | **Image**<br>Wild salmon on a redd<br><span style="color:red">Source from commons</span> |
| 4 | <title>Egg development<br><Body text> At the supplier hatchery, eggs stripped from the adult female salmon are mixed with the sperm from the male. Once fertilised they are held in clean, fresh well oxygenated so they can develop. After being subjected to<br><link> 360 degree days the eggs develop to an eyed stage<br><link text> 360 degree days is equal to holding the fish eggs in 10 degree water for 36 days or 45 days at 8 degrees).<br><br><fish feed link> The thermal exposure needed to reach each stage of egg development is well known for Atlantic salmon and are shown on the image. | **Image** Un-eyed eggs held in a tank<br><br>**Graphic** Salmon development cycle showing development stages and degree days.<br><br>Graphic showing Degree-days needed to move from fertilisation to eyed to hatch to yolk sac absorption and first feeding.<br><br>See sketch provided for details |
| 5 | <title>Egg transportation<br><Body text>Eggs are sourced from from overseas suppliers. Fertilised eggs are held by the supplier until they are at the eyed stage and robust, allowing them to be safely transported as air freight. | **Image** Eyed eggs<br><span style="color:red">PS image</span> Close up of eyed eggs showing eyes prominently and making clear they are sitting in a polystyrene egg tray |

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| | The egg boxes are made of polystyrene to provide insulation. They are relatively environmentally friendly, as minimal material is used in their construction. | |
| 5.1 | <title>Egg box design<br><Body text>The salmon egg boxes used by the supplier must comply with the following design standards to ensure that the eggs can be safely and efficiently transported.<br><br><link> Size<br>Airport transportation size requirements, so they can be easily loaded on a pallet.The image shows the size requirements.<br>       <Image> open box with dimensions shown (W, D and L)<br><br><link>stability<br><link text> Stable when stacked to reduce the need for handling in transit.<br>       <Image> close-up of stacked pallet.<br><br><link> Temperature controlled<br><link text> Fitted with two trays of ice overlying the egg trays to maintain an optimal environment of 4-6°C and keep the eggs moist.<br><Image>Fully stocked egg box with ice trays | Main page to have a pallet of fish boxes stacked on a pallet.<br><br>**Image X3**<br><br>Stack of egg boxes on a pallet<br>image<br><br>Close up of egg boxes to show several in the stack<br>image<br><br>Fully stocked egg box with ice trays<br>image The image should show the ice |
| 5.2 | <title> Egg box holding capacity<br><Body text> The egg boxes are compartmentalised and are typically composed of 4 trays, each with 6 chambers of 0.5 litres capacity. On average there are 6,000 eggs held per litre, depending on the size of the eggs, giving each box a 72,000 egg capacity.<br><br>The eggs are measured into the egg trays by volume, and their size (which can vary between batches) determines the precise number of eggs in each compartment. | **Image** Egg box with half a litre of eggs<br>Shoot Egg box<br><br>**Note:** The box should be shown empty with half a litre of eggs in a glass beaker being held, to show how many eggs are in each compartment |

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| | <Image> Egg box and half a litre of eggs | |
| 6 | <title>Egg receipt<br><Body text> Knowing the thermal exposure needed to reach each stage of egg development allows the hatchery manager to use 'Degree days' to calculate the date the eggs must arrive at the hatchery to support the production plan. The eggs must be collected from the airport and arrive back at the hatchery as soon as possible for initial inspection.<br><br>The following tasks are undertaken each time a batch of eggs is received at at the hatchery. Click on the links below to find out more.<br><br><Page Link>Hatchery biosecurity<br><Page Link>Preparing the hatchery<br><Page Link>Airport egg collection<br><Page Link>Hatchery arrival and goods inspection | **Image**<br>Salmon egg development<br>Shoot |
| 6.1 | <title>Hatchery biosecurity<br>On entry to the hatchery, staff must get changed for their work shift. They replace their outdoor footwear with designated colour coded hatchery boots and put on the protective clothing appropriate to their responsibilities.<br><Image> Hatchery staff dress<br><br>All commercial hatcheries have comprehensive biosecurity policies and procedures that are applied to all stages of their salmon production operation to reduce the risk of infectious diseases impacting fish health and welfare.<br><br><Video link> Hatchery Biosecurity | **Image -** Hatchery staff dress<br><br>Shoot staff putting on hatchery standard clothing boots and PPE<br><br>**Instructional video** Hatchery biosecurity SOP Ref<br>SB 1-5 |
| 6.2 | <title> Preparing the hatchery<br><Body text>Hatchery preparations are coordinated with egg collection from | **Image -** Hatchery staff checking floor drain screens |

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| | the airport. The incubation system must be ready by the time the eggs arrive at the hatchery door.<br><br>Staff check the hatchery containment barriers. This includes the floor drain screens and hatchery containment vault to make sure they are in working condition and securely in place.<br><br>The water flow is set at 3 Litres/Minute and the temperature at 6°C in the incubation systems receiving the eggs.<br><Video link>Egg incubation and hatch | PS to shoot<br><br><br><br>**Instructional video** Egg reception<br>SOP Ref<br>SB 4 |
| 7 | <Title> Egg incubation<br><Body text> Whether in a natural gravel redd or a hatchery, salmon eggs require a constant supply of clean, well oxygenated water. The water temperature determines the rate of embryo development. By controlling water temperature in the hatchery incubation system, egg development is manipulated to meet production plan requirements.<br><Image Link> Eggs in a redd and hatchery (split image)<br><br><Fish feed icon>In The ova are incubated at 8°C in accordance with the 'Thermal Regime'. The maximum daily temp variation cannot exceed 0.5°C to avoid stressing the eggs.<br><Link> Thermal Regime | **ImageX2**<br>Eggs in a redd<br>Creative commons or purchase<br><br>Eggs in a hatchery<br>Shoot |
| 7.1 | <title> Laying down eggs<br><Body text>There should be sufficient water flow to provide well oxygenated conditions for the eggs, but without agitating them.<br><br>When setting out the egg trays air entrapment must be avoided, as this can block areas of the screen, reducing dissolved oxygen levels or unnecessarily agitating the eggs when released.<br><br>No more than 22,500 eggs are gently and evenly distributed over the base | **Image** Laying down eggs<br>Shoot Close up of eggs being measured out into an egg tray<br><br><br>**Instructional Video**<br>Incubation and hatch<br>SOP Ref |

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| | of each egg incubation tray, avoiding physical trauma and disturbance. They are measured out volumetrically to achieve the required stock density in each tray.<br><Video Link> Incubation and hatch<br><Link> **Stockmans calculations -** Stocking egg incubation trays | SB 5 | |
| 7.2 | <title>Managing the incubation environment<br><Body text> There are a range of physical parameters to monitor and manage throughout the incubation period. Click on the links below for more information about how the incubation conditions are maintained.<br><br><link>Light<br><link text>Wild Atlantic salmon eggs in a spawning redd are buried within a matrix of gravel throughout the incubation of ova and alevins. These conditions are replicated in a salmon hatchery by keeping the eggs in darkness and only exposing them to red light for husbandry purposes.<br><br><link>Water flow rates<br><link text>Water flows are constantly monitored and recorded during day shifts by a flow meter fitted in the trays and recorded each shift. During incubation the flow is maintained at 3 Litres/Minute and the water level in the trays should not be beneath the level of their standpipes. If they are, this indicates that the tray's water inlet screen has been blocked by algae or suspended solids and needs to be cleaned.<br><Image> Flow metre<br><Image> Screen cleaning<br><br><link>Water temperature<br><link text>All staff must be aware of the current target incubation temperature and notify the manager of any incidence where the incubation temperature is +/- 0.5°C from the target.<br><br><link>Water quality | **Image-** Physical environment for incubation<br><br>Graphic to pull the three physical factors together **Light**, **water flow rates** and **temperature**) and present as a graphic with drop down text<br><br><br><br><br>**ImageX2**<br>Flow metre<br>Shoot. Technician checking flow metre in the incubation trays<br><br>Screen cleaning<br>Shoot. Technician cleaning screen<br><br><br><br>**Instructional Video**<br>Incubation and hatch<br>SOP Ref | |

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| | <link text>The pH, Dissolved Oxygen and Total Gas Pressure are monitored at the sump at the start of each day shift using a probe and at 2 hour intervals thereafter.<br><br>Click on the video below for a further insight into the monitoring process.<br><Video Link>Incubation and hatch | SB 1-5 |
| 7.3 | <Title> Degree days<br><Body text> Degree days is a widely accepted measure of 'thermal exposure' and can be used by salmon hatchery managers to accurately predict egg development. It is simply a function of time in days and temperature in°C. Degree hours is an alternative basis for calculating hatching times, and although more precise, it has not been widely adopted by industry.<br><br>Degree Days = Temperature (°C) x Days.<br><br>For example eggs in water at a constant 9°C for 15 days, have been exposed to135 Degree days.<br><br><Image>Degree days timeline<br><Link page> **Stockmans calculations** - Degree day exposure | **Image -** Degree days timeline<br><br>Graphic to show the Degree days timeline from fertilisation to first feeding |
| 7.3.1 | <Title> Stockman Calculation - Degree days exposure calculation<br><br>    1)  What is the Degree days exposure of salmon eggs that have been held for 30 days at 8°C following fertilisation?<br><br><Ans> 240 Degree days<br><br>    2)  What is the Degree days exposure of salmon eggs that have been subjected to 350 Degree days on arrival at the airport, after being | |

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| | laid out in incubators at 6°C for another 30 days?<br><br><Ans> 530 Degree days | |
| 7.4 | <Title> Predicting hatch dates<br><Body text> Typically, on arrival at the hatchery the eggs have been subjected to 350-360 Degree days from fertilisation. As the hatchery is maintained at a constant 6°C, the hatch date can be predicted precisely. Typically, the eggs are 41 days from hatching if the target temperature is maintained.<br><Image> Eyed egg<br><Fish feed icon>However, observations in hatcheries have shown that the biological development in Atlantic salmon eggs at temperatures lower than 5°C is quicker than Degree days would suggest. The biological Degree days at temperatures below 5°C relate to the actual temperature as shown in the Degree days graph.<br><image> Biological degree days<br><br><Page Link> **Stockmans calculations** - Hatch date predictions | **Image** Eyed egg<br>PA to shoot Maybe a closeup egg image?<br><br><br><br>**Image** – Biological degree days<br>Graphic to illustrate biological Degree days at low temperatures |
| 7.4.1 | <Title> Stockman Calculation - Hatch date prediction calculations<br><br>  1) If eggs on arrival have been subjected to 350 Degree days, how many days (to the nearest whole day) will it be before they hatch, if held at 8°C? Note, the requirement from fertilisation to hatch is 480 Degree days.<br><br><Ans> 31 days<br><br>  2) Consider this scenario: Eggs arrive at the hatchery on March 1st, having been subjected to 360 Degree days. They are incubated at 8°C for 10 days (including March 1st), followed by 5 days at an unintentional 10°C during a system failure. The failure was resolved | **Image**<br>Recently hatched alevin<br>Ps to shoot close up of recently hatched alevin with eggshell evident? |

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| | at the end of the 6th day and temperatures returned to 8°C.<br><br>In this scenario, on what date are the eggs expected to hatch?<br><br><Ans> March 29th | |
| 7.5 | <title> Modifying incubation temperature<br><Body text>A stable, controlled temperature of 8 is the normal default target. However, chiller malfunction can lead to deviations from target which impact on the Degree days exposure and hatch date, depending on the duration.<br><br>A water temperature target 'modification can ensure the target hatch date is still met. With reference to temperature records, the manager recalculates the incubation temperature to ensure the intended hatch date is still met.<br><br>The target temperature is 'reset' and entered on the hatchery office information board for staff to read on arrival each day<br><br><Fish feed icon> The embryonic development of eggs impacted should be carefully monitored. There may be yolk sac absorption issues or elongation due to stress.<br><br><Link page> **Stockmans calculation** - Resetting the temperature target | **Image** Operative taking water temperature<br>Shoot Operative water sampling<br><br><br>**Image** Hatchery information board temperature target<br>Shoot Staff looking at temperature target<br><br><br><br>**Image** Yolk sac elongation<br>Shoot Close up of elongated yolk sac |
| 7.5.1 | <Title> Stockman Calculation - Resetting the temperature target calculation<br><br><Body text> Scenario: There has been a RAS technical failure, and by the time it has been resolved by the end of day on March 15th, the eggs have been subjected to 490 Degree days exposure. The hatchery production plan has a hatch date of April 1st.<br><br>What temperature setting is required (to the nearest whole degree) for the | **Image** Hatchery information board temperature target<br><br>Shoot Manager completing the revision of the target on the office whiteboard |

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| | eggs to hatch on April 1st?<br><br>Ans: 7°C | |
| 8 | <title>Egg receipt and incubation essentials<br><Body text> To confirm your grasp of the essentials of egg receipt, match the words to complete the sentences.<br><br><drag and drop><br><br>Egg receipt:<br>The salmon eggs have been exposed to 360 **Degree-days** before transportation as **air freight** and are at the robust **eyed** stage**.**<br><br>Egg boxes are made of **polystyrene** and are stable and fitted with overlying **ice trays** to keep the eggs within 4-6°C<br><br>On arrival at the hatchery, egg boxes are unloaded **sequentially**, checked for **damage** which is **photographed** if found.<br><br>The eggs are quality checked for **colour**, which should be **orange**, **turgidity** and **size**.<br><br>If there is more than **2°C** difference in temperature between the egg box and **incubation** facility, the eggs must be acclimated by **trickling water** over them and checking the temperature every **5** minutes.<br><br>Eggs are disinfected using **buffodine** and the **pH** is monitored**,** keeping it within 6-8 by adding **Sodium Carbonate.** | |
| 9 | <title> Check what you now know.<br><Body text>You have now completed studying salmon egg receipt and | **Background image** |

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| | incubation.  It is time to see what you have learnt. The results of this test can be used to help you prepare for your final assessment at the end of the Salmon Ova to Nursery Transfer Unit. We advise that you spend a few minutes going over any subjects that need more attention, based on your results and feedback.<br><br>Click next to start the quiz. | Ghosted image of incubating ova |
| 9.1 | <M/C> What is the main environmental factor that determines the rate of egg development in a salmon hatchery?<br>Select the CORRECT ANSWER from the options below<br>a) Water flow rate<br>b) Dissolved oxygen level<br>c) Water temperature<br>d) The light regime<br><br><ans> c<br><br><Feedback>You should have selected answer c) as the correct answer as all other answers are incorrect. | **Background image**<br><br>Ghosted image of incubating ova |
| 9.2 | <MC>What is the incubation target temperature in most hatcheries?<br>Select the CORRECT ANSWER from the options below<br>a) 10°C with a maximum daily temperature variation of 0.5°C<br>b) 8°C with a maximum daily temperature variation of 0.5°C<br>c) 10°C with a maximum daily temperature variation of 1.5°C<br>d) 8°C with a maximum daily temperature variation of 1.5°C<br>e) 6°C with a maximum daily temperature variation of 0.5°C<br><br><ans> b<br><br><Feedback>You should have selected answer b as the correct answer as all other answers are incorrect. | **Background image**<br><br>Ghosted image of incubating ova |

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| 9.3 | <MC>For what reasons are salmon eggs sometimes sampled on receipt to assess the number of eggs per litre?<br>Select AS MANY of the following as you believe to be correct<br>a) To check the egg suppliers egg count is accurate<br>b) To check that the eggs have not shrunk during transport due to dehydration<br>c) To calculate the volume of eggs to lay out in the incubators to achieve the correct stock density<br>d) To check whether the eggs have swollen during transport due to water absorption<br><br><ans> a and c<br><br><br><Feedback>You should have selected answer a) and c) as the correct answers. The answers b) and d) are all incorrect, as they are not reasons for sampling. | **Background image**<br><br>Ghosted image of incubating ova |
| 9.4 | <MC>Why must hatchery staff ensure there is no air entrapment within the incoming water flow when setting up incubator egg trays?<br>Select AS MANY of the following as you believe to be correct<br>a) The incubation tray screens can become blocked, impeding water 'through flow' and reducing dissolved oxygen levels.<br>b) Metabolic wastes can collect in the incubation trays due to disrupted flows<br>c) The water level in the incubation trays will drop<br>d) The eggs can be unnecessarily agitated when entrapped air is released<br><br><ans> a and d<br><br><Feedback>You should have selected answer a) and d) as the correct answer. The answers b) and c) are all incorrect, as they are not reasons for stopping air entrapment. | **Background image**<br><br>Ghosted image of incubating ova |

| 9.5 | <MC> How is the 'Degree days exposure' calculated for a batch of developing eggs held at a constant temperature?<br>Select the CORRECT ANSWER from the options below<br>a) The number of days multiplied by the water temperature in degrees Fahrenheit<br>b) The number of days divided by the water temperature in Degrees Centigrade<br>c) The water temperature in Degrees Centigrade divided by the number of days<br>d) The number of days multiplied by the water temperature in Degrees Centigrade<br><br><ans> d<br><br><Feedback>You should have selected answer d) as the correct answer as all other answers are incorrect. | **Background image**<br><br>Ghosted image of incubating ova |

# Appendix 5 Instructional Video Story Board

| Unit | Learning Episode | Instruction | SOP Code | Learning objective(s) |
|------|------------------|-------------|----------|------------------------|
| **Salmon Ova to Nursery Transfer** | Egg husbandry | Egg incubation and hatch/post hatch husbandry routines | | To demonstrate egg incubation husbandry routines from setting up the incubator to hatch and post hatch |

| Sequence | Duration (Secs) | Instruction for media shoot and other resources | Audio | Text |
|----------|-----------------|--------------------------------------------------|-------|------|
| SB1 | 15 secs | Hatchery biosecurity<br>Footage: Operatives entering the changing room and getting dressed into hatchery clothing and boots and washing before entry to the work area | *All staff change into the clothing appropriate to their work and follow the company protocols for hand wash and boot disinfection before entry to the hatchery work area.* | **From before day 1**<br>All staff change into clothing appropriate to their work and follow company cleaning and disinfection protocols for hands and boots. |
| SB2 | 10 secs | Laying eggs down<br>Footage of closeup of eggs being measured and laid out in the incubation trays. Cut to closeup of incubating eggs | *The eggs are gently and evenly distributed over the base of the egg tray, avoiding any physical trauma and disturbance as they are laid down for incubation. To keep within company stocking density limits, there are no more than 22,500 eggs per tray.* | **Day 1**<br>Eggs are gently distributed over the egg tray base as an even layer (22,500 per tray maximum) |
| SB3 | 15 secs | Checking egg appearance<br>Footage: Operatives checking egg appearance..... Cut to discoloured eggs in the tray in closeup. | *The appearance of the eggs is checked every 2 hours for 8 hours after being laid down and any white surface discoloration recorded and reported.* | From Day 1<br>Egg appearance is checked every 2 hours for 8 hours, recording and reporting any white discolouration. |

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| SB4 | 8 secs | Checking egg tray flow rates<br>Footage: Operative checking flow meter set up on the in the egg trays... Cut to operative recording the flow | *The flow rate is checked every 2 hours by inspecting the flowmeter mounted on each incubator tray, to ensure it remains at 7 litres per minute and is recorded.* | Day 1<br>The flow rate is checked every 2 hours to ensure 7 Litres/ Minute, and recorded. |
| SB.5 | 6 secs | Check hatchery log and notice board<br>Footage: Operative entering the hatchery office and looking at the notice board. Cut to target temperature on the board. | *Notes left in the hatchery log are considered by the incoming shift, including any incomplete husbandry tasks and the water temperature target, which reflects the company's thermal regime.* | **From Day 2**<br>The incoming shift of technicians consult the hatchery log and note the water temperature target and incomplete tasks. |
| SB6 | | Checking egg trays<br>Footage: Operative checking the flow meter... Cut to the operative cleaning egg tray screens | *The incubation tray screens are checked twice per shift and cleaned, if necessary, whenever flow meter readings fall below 7 Litres per Minute.* | From Day 2<br>The incubation tray screens are checked twice per shift and cleaned, if necessary, whenever flow meter readings fall below 7 Litres/Minute. |
| SB.7 | 10 secs | Checking eggs<br>Footage: Operative checking eggs with a red-light headlamp without out sliding out tray...Cut to closeup of healthy eggs. then operative entering observations in the Hatchery Log | *Wearing a headlamp, technicians check the eggs at the start of each shift and every 4 hours thereafter, looking for abnormalities, particularly signs of white discolouration, which are recorded in a waterproof notebook.* | From Day 2<br>The eggs are observed every 4 hours to check for abnormalities, particularly white discolouration. |
| SB.8 | 8 secs | Hatchery log records<br>Footage: Operative referring to notebook before updating hatchery log | *At the end of each shift, the hatchery records are updated, including water quality monitoring data and any egg abnormalities observed.* | From Day 2<br>The hatchery records are updated at the end of each shift, recording important observations and any abnormalities. |

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| SB.9 | 8 secs | Day 3 arrival<br>Footage: Quick summary of dressing in changing room, and 2-3 second snippets of the routines established during days 1 and 2, namely, checking hatchery log, followed by water quality, flow rates and egg trays... 15 seconds in total to set the scene at start of day 3 | *The routines established during the first two days are completed at the start of day 3, before egg mortalities are dealt with for the first time.* | **From Day 3**<br>Routine husbandry tasks are completed before attending to mortalities |
| SB.10 | 30 secs | Dead and moribund egg removal<br>Footage: Operative displaying the range of equipment that can be used, This can be shot in good strong light before entering the hatchery.... Cut to operative removing eggs with:<br><br>a) Tweezers<br>b) Bulb pipette<br>c) Syphon and bucket<br><br>Cut to moribund eggs being anaesthetised. | *The egg trays are checked every 4 hours., and dead and moribund eggs removed daily. A range of disinfected utensils are used to remove dead and moribund eggs, including:*<br><br>• *tweezers,*<br>• *bulb & pipette,*<br>• *syphon and small receptacle.*<br><br>*Any moribund eggs are euthanised with a double strength anaesthetic.*<br><br>*The numbers removed are recorded. When the previous days mortality rate is below 0.16%, the frequency of subsequent checks can be reduced.* | From Day 3<br>Dead and moribund eggs are removed with a range of utensils:<br><br>• Tweezers<br>• Bulb and pipette<br>• Syphoning into a small vessel<br><br>Moribund eggs are euthanised with a double strength anaesthetic. |
| SB 11 | 10 secs | Egg mortality classification, removal, and recording<br>Footage: Eggs being viewed, and their condition related to the mortality classification, providing an example of | *Dead and moribund eggs are classified using the company's mortality classification system and recorded in the hatchery log. There are three applicable classifications: Embryonic, Environmental or Mycosis (fungal disease)* | From Day 3<br>Dead and moribund eggs are classified using the company classification system to define the cause of mortality. |

| | | each category in turn, with closeups of dead eggs. | | |
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| SB.12 | 10 secs | Removing dead eggs from previous shift<br><br>Footage of an operative checking hatchery logbook and reading it ...Cut to operative approaching dead eggs from previous shift... Cut to a closeup of the eggs.... Then show operative lifting and taking them to the 'mortality collection zone'. Include any meaningful hatchery signage in the shoot...<br><br>Cut to continuation of routine husbandry tasks | *If the hatchery logbook shows that there are dead eggs left by the previous shift, they are immediately taken to the mortality collection zone before the hatchery routines begin.* | **From Day 4**<br>Any dead eggs left by the previous shift are taken to the 'mortality collection zone' |
| SB.13 | 10 secs | Checking for hatch and removing eggshells<br>Footage: Operative checking the trays. Cut to closeup of eggs starting to hatch and zoom in to individual alevin breaking free of eggshell. | *As the anticipated hatch day approaches at 420-480 Degree days exposure, egg trays are checked once per shift for signs of hatching.* | **Day 14-17**<br>As the anticipated hatch day approaches (420-480 Degree days) the egg trays are checked once per shift for signs of hatching. |
| SB.14 | 10 secs | Cleaning screens of eggshells<br>Footage: Operative cleaning screens ..... Cut to closeup of eggshells... Cut to alevins | *Once the hatch has started, eggshells are removed as soon as possible from the screens once per day for 2 or 3 days, depending on the hatch intensity, to reduce the release of ammonia. Care must be taken to avoid the disturbance of alevins.* | Day 14-17<br>The eggshells are removed from screens to reduce ammonia release, whilst avoiding disturbance of the alevins. |
| SB.15 | 15 secs | Measure Ammonia<br>Footage: Manager looking at water data on the PC screen... Cut to manager | *As the ammonia levels can rise rapidly due to eggshell fragments breaking down, the water quality data is carefully scrutinised. In the event* | Day 14-17<br>Ammonia levels in the egg trays are monitored carefully during |

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| | | speaking to operative who then undertakes a water make up | of an 'ammonia spike', the make-up water is increased to dilute the ammonia to safe levels, whilst maintaining a stable water temperature. | the hatch and make up water added in the event of an 'ammonia spike'. |
| SB.16 | 15 secs | Removing un-hatched eggs<br>Footage: Show closeup of tray and zoom in to a small number of unhatched eggs...Cut to operative removing small number of un-hatched eggs... Cut to an operative looking in at a tray with a lot of unhatched eggs... Cut to operative speaking to the manager... Cut to eggs being removed | *Unhatched eggs are removed on the fourth day after the egg hatch started, without disturbing the alevins. If there are a lot of unhatched eggs, the manager is informed so as they can authorise their removal or take an alternative course of action.* | **Day 18**<br>Unhatched eggs are removed on the fourth day after the hatch started, without disturbing the alevins. |
| SB 17 | 10 secs | Alevin welfare<br>Footage: Scan base of the egg tray.... Cut to a closeup of alevins... Cut to manager checking water quality data Cut to flow rate being checked... | *During the post hatch transition the water temperature and quality should not deviate from company standards, as small variations in environmental conditions can stress the alevins.*<br><br>*The water flow rate in the trays is checked to ensure it conforms with the suppliers' recommendations, which depends on the incubator flow pattern, but is typically 3 Litres per Minute per Litre of eggs.* | Day 18<br>The water temperature and quality must remain stable during the post hatch transition to avoid stressing the alevins. The flow rate should be adjusted to ensure 3 Litres per minute per Litre of eggs, depending on the flow pattern. |
| SB 18 | 20 secs | Alevin check and mortality removal<br>Footage: Operative checking trays without removal Cut to Alevin close up, including some dead alevins.....Cut to alevin removal with tweezers, bulb pipette and syphon in series (a few seconds of each method)... Cut to moribund alevins being removed and | *Alevins are checked every 4 hours without removing the trays. Any dead or moribund alevins are routinely removed once a day, using a permitted method, which includes tweezers, bulb pipette and syphon. Moribund alevins are euthanised with double strength anaesthetic and all equipment cleansed after use. The* | **Day 19**<br>The alevins are checked every 4 hours without removing the tray. Mortalities and moribund alevins are removed daily using either tweezers, bulb pipette or syphon. All equipment is |

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| | | euthanized.. Cut to cleansing of equipment... Cut to updating hatchery records. | *mortalities are recorded in the hatchery records at the end of the shift.* | cleansed, and mortalities recorded. |
| SB 19 | | Alevin development<br>Footage: Close up of alevins in the bottom of the trays. Cut to operative catching a sample, placing in a glass beaker, and checking the yolk sac. Cut to alevins being health checked | *For some time after hatch the alevins are too sensitive to sample. The development of the population is monitored for the first time at 650 Degree days, including the rate of yolk sac absorption and alevin health, and the regime repeated weekly.* | **From Day 38**<br>The alevins are sampled weekly from 650 Degree days to check yolk sac absorption rates and health |
| SB 20 | | Readiness for transfer a week before<br>Footage: Operative yolk sac absorption sampling... Close up of alevins at this stage | *Typically, 1 week before the alevins are ready for transfer to the fry unit, their yolk sac absorption rate should be 85-87%.* | **Day 52-53**<br>Yolk sac absorption rates should be 85-87% one week before transfer. |
| SB 21 | | Ready for transfer<br>Footage: Operative yolk sac absorption sampling... Close up of alevins at the 90-95% stage. | *The alevins are ready for transfer to the fry unit once the yolk sac absorption rate is 90-95%. Under the 'thermal regime', this should occur 60 days after the eggs were first laid down for incubation.* | **Day 60**<br>Yolk sac absorption rate should be 90-95% when alevins are ready for transfer to the fry unit, 60 days after being laid down. |