

Output 4: Available aquaculture learning materials for salt and freshwater production in Scotland and Norway

Version: 21/3-2022

Output Leader: Trøndelag County

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Co-funded by the
Erasmus+ Programme
of the European Union

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

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Summary

An investigation into the availability of 'e learning' relating to salt and freshwater salmonid aquaculture was undertaken in Scotland and Norway. This revealed that any relevant 'e learning' courses are only accessible on a commercial basis, or as a registered learner if offered by a public sector tertiary education provider.

However, there are a range of digital resources available on the internet that could support aquaculture 'e learning' development. A start has been made towards creating a vetted' inventory. Some particularly useful information relating to the Salmon farming sector is available in Norway through digital and other media.

Investigations have revealed that many teachers are using textbooks to support their teaching. However, these texts are quickly out of date, particularly those on production methods or technology. Consequently, alternative digital and hard copy resources are used by teachers to overcome these limitations and provide a wider collection of reference sources.

As a result of this investigation, the development of a shared 'aquaculture open education resource' for VET teachers and learners is proposed as a long-term solution to the scarcity of aquaculture 'e learning'. This would be designed as an 'e book' to support education and training on Northern European aquaculture. It would cover hatchery and grow-out practices for salmon and other salmonids initially, but in time expand to include important new emerging aquaculture sectors.

1. Scotland

Currently Scotland has no public sector VET provider offering full time aquaculture VET. The education and training available at this level for school leavers is limited to the work based Modern Apprenticeship in Aquaculture, which is delivered by the UHI at the North Atlantic Fisheries College (NAFC) on Shetland, and Argyll College on the Scottish mainland.

Some of the larger companies have developed their own in-house provision and are moving forward with the development of their own company 'e learning' to ease training delivery across their dispersed farm sites.

1.1 Existing E Learning in aquaculture

Aquaculture courses are offered by two providers utilising 'e learning' to varying degrees. They own the courses and 'e learning' materials. Registered learners on their courses can access their provision presented using a Learning Management System (LMS).

They currently do not make their materials publicly available or collaborate other Scottish providers or third parties.

Scottish providers of aquaculture courses that apply 'e learning' are:

- UHI North Atlantic Fisheries College (NAFC) in Shetland

The Modern Apprenticeship in Aquaculture at levels 2, 3 and 4 and short courses for industry on specific high demand topics are offered.

The practical skills training for the Aquaculture MA is delivered by farm staff on the farm where trainees are employed. The underpinning knowledge required to complete the National Qualification

is delivered through 'e-learning' by the NAFC remotely. Some short courses in specialist subjects are offered through 'e learning' and are non-certificated.

Argyll College as the only UHI provider on the mainland, has a strong interest in developing and aquaculture 'e learning' collaboration. They have an LMS that their apprentices can access, but it is not well populated with aquaculture content.

- St Andrews University

'Sustainable Aquaculture' courses are offered at Higher VET Degree and post-graduate Degree level.

This provision is 100% e learning course supported by remote tutoring. Courses are often undertaken by those in work who already have practical experience and are seeking a St Andrews Degree to assist them in their career progression.

- Scottish Industry involvement in aquaculture E learning development

Mowi Scotland are developing an in-company e learning capability and are in conversation with Argyll College to develop linkage with the Scottish MA in Aquaculture. This may offer an opportunity for increased VET provider industry collaboration within Scotland and ultimately Europe. But in the short term, any 'e learning' resources developed are not available outside of the company in Scotland.

In summary, it is not possible to access the 'e learning' resources held by industry or the public tertiary education in Scotland to evaluate them.

1.2 Aquaculture digital resources available through the world wide web

There are materials available on the world wide web that can be sourced through search engines, reviewed, and used within e learning courses and blended learning.

PLI searches have revealed limited high-quality 'technically specific' resources available for saltwater and freshwater salmon production in a suitable format for VET learners.

Searches have included:

- Images from royalty free creative commons

A limited quantity of aquaculture images is available at no cost, but they hard to find. When used educationally within digital learning resources, the owner must be credited. There is a wider availability of images that can be purchased for educational use at a cost of approximately £10 per image.

- You tube videos

Some videos are available to support aquaculture subjects. Within a Learning Management System (LMS) it is possible to provide links to a video and start and stop anywhere in the timeline to present relevant sequences to learners.

Using Software such as H5P, over lay of information in text or interactivity such as multiple-choice questions become possible, making available video resources more educationally useful.

The Moodle open source LMS can host H5P, but most commercial LMS do not have this capability.

However, the owner of these YouTube videos can take them down at any time. The development of bespoke instructional videos is a much more secure solution longer term.

- Scientific Aquaculture papers

Many papers are published online and accessible. Most are unsuitable for Scottish VET level but may have occasional use for Higher VET in specific topics, especially when used to support investigative learning activities.

- Aquaculture information available online

There is a lot of general information in the public domain on aquaculture that could be accessed, but not copied without formal consent. For example, vendors show case their equipment and services, and the information is posted at a range of levels for various purposes. Some of this may be useful as a reference source within educational activities.

Any web-based aquaculture information can be sourced, vetted, and levelled for VET use.

2. Norway

Contrary to the situation in Scotland, Norway has 14 Secondary Schools actively delivering Aquaculture VET which articulates with an apprenticeship stage and colleges all maintain very close links with industry. It also has an emerging Higher VET provision. The aquaculture VET teachers meet annually, and Norway have led several EU funded Strategic partnerships funded under KA2 and KA 3 that have provided opportunities to develop more innovative approaches to VET delivery with their partners, and interest in the incorporation of E learning is growing, supported by industry.

2.1 The teacher's perspective

The Norwegian aquaculture industry has been characterized by a high rate of development since its inception in the early 1970. Core science subjects such as fish biology are relatively static and change very little. Conversely, other subjects such as production technology disease control, the development of fish welfare indicators, fish nutrition and feeding, sustainability indicators, aquaculture regulations and other aspects of aquaculture are rapidly evolving and quickly become dated when documented as hard copy text.

To try and keep their teaching 'up to date', Norwegian aquaculture VET practitioners complement their preferred textbooks with other learning resources to better support their teaching. There is no strong consensus as to which collection of textbooks and complementary resources represent the best package for teachers to work from. Each teacher develops their own learning materials, relatively independently and has their own preferences. As a VET teacher, dealing with a rapidly changing vocation, keeping teaching current to reflect industry best practice is a demanding occupation. In the past, the determined 'individualism' of some teachers has made it difficult for a more 'team based' approach to resource development and sharing to emerge, which may be more efficient and effective. However, ongoing EU funded innovative VET projects are providing the opportunity to overcome this hurdle.

2.2 Learning resource review

A pragmatic, broad' definition has been applied to the term "learning materials".

To reflect the aquaculture teachers' current reality, and to give some indication of what is available, a range of digital and some hard copy learning materials have been considered and evaluated that may be useful to aquaculture VET delivery.

Over the last decade, it has been essential in practice for all aquaculture VET teachers to complement outdated textbooks with other resources for the reasons given above.


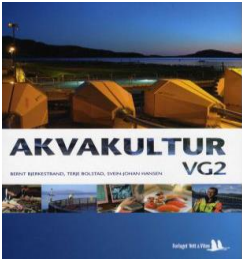
Aquaculture learning materials have been categorised in this evaluation as follows:

- a) Traditional textbooks.
- b) Learning platforms.
- c) Industry newspapers / professional journals.
- d) Public online resources.
- e) Relevant and updated information from research institutions.
- f) Relevant and updated information from supplier and service company websites.
- g) General web and student response tools.
- h) Instructional videos on YouTube and Vimeo.

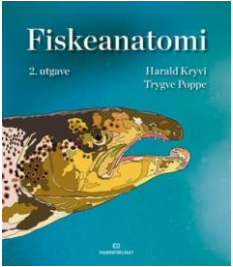
Traditional textbooks

A selection of aquaculture textbooks and other specialist books used in Norwegian aquaculture VET have been listed. Many books become outdated relatively quickly, particularly those addressing aquaculture technology and production methods. Biology and anatomy books have a longer shelf life, but even their knowledge and theories change from time to time.

In a normal situation within upper secondary education, a good 'up to date' textbook would form the foundation of the syllabus.

Original title	Translated title	Publisher / Author(s)	Published
Fiske og akvakultur VG1 	Fishing and aquaculture	Fagbokforlaget Terje Bolstad, Roy Dahle, Bjarte Haugland, Torunn Mikalsen, Ragnhild A. Solheim Nordenborg, Eli Skoglund, Tonny Storebø with others.	2021
Akvakultur: Havbruk i Norge VG2 	Aquaculture: Aquaculture in Norway	Forlaget Vett og Viten Bernt Bjerkestrand, Terje Bolstad, Svein Johan Hansen	1 st edition 2011 2 nd edition 2013 / 2018

<p>Fôringslære for akvakultur</p> 	<p>Feeding theory for aquaculture</p>	<p>Juul forlag / Landbruksforlaget</p> <p>Olai Einen, Turid Mørkøre</p>	<p>1997</p>
<p>Fiskeoppdrett</p> 	<p>Fish farming</p>	<p>Aschehoug</p> <p>Hans Tvenning</p>	<p>2007</p>
<p>Teknologi for akvakultur</p> 	<p>Technology for aquaculture</p>	<p>Juul forlag / Landbruksforlaget</p> <p>Odd-Ivar Lekang, Svein Olav Fjæra</p>	<p>1997</p>
<p>Økonomi og bedriftslære for akvakultur</p> 	<p>Economics and business teaching for aquaculture</p>	<p>Landbruksforlaget</p> <p>Arnhild Foseide Fagerholt, Frode Blakstad</p>	<p>2008</p>

<p>Fiskehelse og fiske sykdommer</p> 	<p>Fish health and fish diseases</p>	<p>Universitetsforlaget Trygve T. Poppe, Øivind Bergh</p>	<p>1999</p>
<p>Biologi for akvakultur</p> 	<p>Biology for Aquaculture</p>	<p>Landbruksforlaget Inger Oline Røsvik</p>	<p>1997</p>
<p>Oppdrett av laksesmolt</p> 	<p>Salmon smolt farming</p>	<p>Landbruksforlaget Tom Hansen</p>	<p>1998</p>
<p>Fiskeanatomi</p> 	<p>Fish anatomy</p>	<p>Fagbokforlaget Harald Kryvi, Trygve Poppe</p>	<p>2016</p>

<p>Kystnæringer 2 - Havbruk</p> 	<p>Coastal Industries 2 - Aquaculture</p>	<p>Landbruksforlaget Harald Sveier</p>	<p>1996</p>
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Learning platforms


In Norwegian education, several learning management systems (LMS) are used. These are systems that are not aimed at any specific curriculum. The systems are subject to regular replacements as their purchase is subject to competition under the Norwegian Public Procurement Act. This regular 'churn' can be a disincentive for some teachers less experienced in LMS applications

Examples of such learning management systems (LMS) are **Itslearning** and **Canvas**. However, all of them must be populated with learning resources by the teachers to be of any value to aquaculture VET.

Some commercial aquaculture trainers use more subject-specific learning management systems.

Blue Planet is a platform developed for commercial use and licenses for use must be purchased. Blue Planet offers both instructional videos and entire e-learning course packages. Sub-course packages are used, for example, within Aquaculture EQF 5 programs. Sortland college in northern Norway have purchased licenses to allow their learners to access the system.

NDLA is a public free platform developed in a collaboration between several county municipalities and published material is developed by and for teachers in the upper secondary school. NDLA does not offer course packages but is more of an online resource site where teachers can select teaching materials and instructional videos as needed from the range of resources available.

Platform	Comment
<p>www.blueplanetacademy.com</p> 	<p>Commercial / Private</p> <p>E-learning platform holding aquaculture resources. Hundreds of videos and a variety of online courses on related topics.</p> <p>Entire sub-course packages are used, for example within Aquaculture EQF 5 programs.</p>


<p>www.ndla.no</p> 	<p>The public National Digital Learning Arena (NDLA) is a collaboration between ten county municipalities that offer open digital learning resources for use in upper secondary and VET education. In addition to being a collection of freely available digital teaching tools, NDLA also offers several other online tools for online sharing and collaboration. Here you can find material for both fisheries and aquaculture. This material has been developed by teachers from different schools.</p>
	<p>itslearning is a digital learning support system developed by the Norwegian company itslearning AS.</p> <p>Itslearning is an online learning management system for general teaching in primary, upper secondary and higher education.</p>
	<p>Canvas is a digital learning management system currently used in Trøndelag County schools. Canvas is an online learning management system for supporting general teaching in primary, upper secondary and higher education.</p>

Industry newspapers / professional journals.

This is an important teaching resource providing industry news, everything from technological innovations to biological challenges. Norwegian teachers choose to focus on Norwegian industry journals and newspapers.


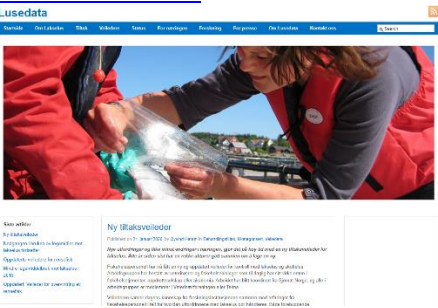
The articles published can be used to trigger the students' academic curiosity. They can be challenged to look for relevant cases and examples, nationally and internationally as relevant aquaculture issues from around the world are published.



Journal/Paper		Comment
<p>www.ilaks.no</p> 		<p>Free</p> <p>iLaks.no is an independent newspaper with a focus on salmon farming. The core of the editorial material will be business journalism throughout the salmon value chain. Despite the name, as well as writing about salmon, iLaks.no also report, analyse and comment on other farmed species, companies and activities that are relevant to the understanding of the dynamics in the salmon industry.</p>
<p>www.kyst.no</p> 		<p>Free, some pay articles</p> <p>Oceanspace Media owns several established brands in the trade press in Norway and internationally. For 50 years they have built up a solid knowledge base and can guide the reader through tens of thousands of articles published in Spanish, English and Norwegian.</p>
<p>www.intrafish.no</p> 		<p>Free, some pay articles</p> <p>IntraFish Media is a website for seafood news. Intrafish consists of a Norwegian site with a link to the English version under the same domain. Intrafish has reporters in the USA, England, Chile and Norway. In Norway, Intrafish has offices in the cities of Bergen and Bodø.</p>



<p>www.fiskerioghavbruk.no</p> 		<p>Free</p> <p>News from fisheries and aquaculture.</p>
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Public online resources

In Norway, there are several public online resources related to aquaculture. Most of these are both relevant and useful for teaching purposes. These are resource pages where students may find updated general guidelines and regulations relevant to the aquaculture industry. In general these pages are updated frequently, some are even updated daily.

Online resource	Comment
<p>www.barentswatch.no</p> 	<p>Fish health and sea lice</p> <p>Open information system with services for end users presented in the portal www.barentswatch.no. In addition, a shielded monitoring system is being developed that contributes to streamlining operational efforts. These services together make up the BarentsWatch department.</p> <p>The services create a basis for better collaboration, professional development, and information sharing, both for public agencies, industries and the general public. By collecting and sharing existing data, systems such as the Common Resource Register and services such as nationwide Wave Alerts are created.</p> <p>Ten Norwegian ministries and 29 administrative agencies and research institutes are partners but are subordinate to the Norwegian Ministry of Trade and Fisheries. The BarentsWatch department is headed by the Norwegian Coastal Administration.</p>
<p>www.lusedata.no</p> 	<p>Sea lice and cleaner fish</p> <p>“Lusedata” helps the Norwegian aquaculture industry in the fight against salmon lice by making statistics, knowledge and guidance easily accessible. Statistics are based on the Norwegian farmers' weekly reporting of salmon lice to the Norwegian Food Safety Authority. The website “Lusedata.no” is published by the</p>


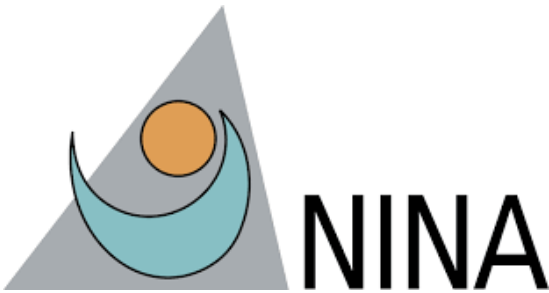

	Norwegian farmers member organization, Sjømat Norge (Seafood Norway).
<p>www.hi.no</p>  <p>HAVFORSKNINGSINSTITUTTET</p>	<p>Environment and fish health</p> <p>The Institute of Marine Research (Havforskningsinstituttet - HI) is one of the largest marine research institutes in Europe with approx. 1100 employees. The main activities are research, consulting and monitoring. HI aims to be a leading knowledge provider for the sustainable management of resources in the marine ecosystems, and for the entire chain from sea to food.</p> <p>In addition, HI have a separate shipping company that is responsible for several research vessels. These ships are important for collecting marine data. HI also has several laboratories that analyze the samples from the monitoring and research programs.</p> <p>Research and advice from HI will help to lay the foundation for society to be able to utilize the great values in the sea in a sustainable way. HI says, <i>“We are a neutral knowledge provider that will make the results of our research known both nationally and internationally. All our work must be based on integrity, creative joy, interaction and respect.”</i></p> <p>HI is subordinate to the Norwegian Ministry of Trade and Fisheries, and around half of the activities are financed by the ministry. The rest is funded by external research funds.</p>
<p>www.vetinst.no</p>  <p>Veterinærinstituttet Norwegian Veterinary Institute</p>	<p>Fish health</p> <p>The most important function of the Veterinary Institute is contingency planning and competence development aimed at preventing threats to the health of fish, animals, and human beings. Today the core activities comprise diagnostics, research, innovation, monitoring, risk assessment, consulting, and communication. Furthermore, the Veterinary Institute is a national and an international reference laboratory and is involved in a wide range of international collaborative activities.</p> <p>The Veterinary Institute is a public-sector institution, under the ownership of the Norwegian</p>

	<p>Ministry of Agriculture and Food. The Institute also carries out tasks for the Norwegian Ministry of Trade and Fisheries. The Veterinary Institute obtains its basic financial support from the two above-mentioned ministries and the Research Council of Norway.</p>
<p>www.fiskeridir.no</p> 	<p>Regulations</p> <p>The Norwegian Directorate of Fisheries is the central advisory and executive administrative body for the fisheries and aquaculture industry and is subordinate to the Norwegian Ministry of Trade and Fisheries. We provide knowledge-based advice that contributes to developing and implementing the government's policy in aquaculture, fisheries and marine land management.</p>
<p>www.lovdato.no</p> 	<p>Laws and regulations</p> <p>The Lovdata Foundation is a non-profit foundation whose purpose is to create, maintain and operate systems for legal information. Lovdata was established in 1981 by the Norwegian Ministry of Justice and the Faculty of Law at the University of Oslo.</p> <p>Lovdata offers on its website several important and central legal sources for free. The information includes all applicable laws and regulations - as well as new decisions from the Supreme Court, the Courts of Appeal and the District Courts.</p> <p>Lovdata has a central role in the administration of the regulations by publishing Norsk Lovtidend (Norwegian Law Magazine) on behalf of the Norwegian Ministry of Justice.</p>

Relevant and updated information from research institutions.

There are several independent organizations engaged in research, including aquaculture. On their website you will find recent research reports. These are many reports that deal with challenges and their solutions in relation to the industry's environmental and fish health issues.

In an industry that is developing as fast as the aquaculture industry, it is important that students have access to the latest available research knowledge and the opportunity to immerse themselves.

Research institution	Comment
<p>www.akvaplan.niva.no</p> 	<p>Akvaplan-niva is a subsidiary of the Norwegian Institute for Water Research (NIVA). Akvaplan-niva has around 130 employees. Several of our employees have assistantships at Norwegian and foreign universities.</p> <p>Akvaplan-niva has, in addition to the head office in Tromsø, offices in the Norwegian cities of Alta, Bodø, Trondheim, Bergen, Oslo, Ski and in Reykjavik, Iceland.</p>
<p>www.nina.no</p> 	<p>The Norwegian Institute for Natural Research (NINA) is an independent foundation that researches nature and the interaction between nature and society. NINA was established in 1988. The head office is in Trondheim, with branch offices in Tromsø, Lillehammer, Bergen and Oslo. In addition, NINA Sæterfjellet operates a breeding station for mountain foxes in Oppdal, and the research station for wild salmonids at Ims in Rogaland County.</p> <p>NINA's activities include both research and assessment, environmental monitoring, consulting and evaluation. NINA has great breadth in competence and experience with both natural scientists and social scientists in the staff. We have knowledge of the species, the types of nature, society's use of nature and the connections with the great driving forces in nature.</p> <p>The overall goal is that NINA will contribute to sustainable societal development by delivering research-based and current knowledge about biodiversity, climate and society.</p> <p>We use NINA mostly to show students studies of environmental impact from aquaculture on nature and wild fish.</p>
<p>www.nofima.no</p> 	<p>Nofima is a leading food research institute that conducts research and development for the aquaculture industry, the fishing industry and the food industry. Nofima is owned by, among others, the Norwegian Ministry of Trade and Fisheries (56.8%).</p>

Relevant and updated information from supplier and service company websites.

There are rapid developments in aquaculture technology and the most useful and up-to-date information is often found on the technology suppliers' website. There are many suppliers to choose from and a small selection of the largest Norwegian suppliers to the aquaculture industry are referred to below.

In Norwegian legislation, the suppliers' written instructions and user manuals must be followed in relation to construction of facilities, operation, and production. Therefore, this is a valuable source of up-to-date knowledge for education and students.

Supplier and service company	Comments
<p>www.scaleaq.no</p> 	<p>Total supplier of floating fish cages, nets, frame moorings, rafts and feeding systems, among others.</p>
<p>www.akvagroup.com</p> 	<p>Total suppliers of floating fish cages, nets, frame moorings, rafts and feeding systems, among others.</p>
<p>www.fiizk.no</p> 	<p>Supplier of Lice skirts, cleaning, sorting and digital solutions.</p>
<p>www.egersundnet.no</p> 	<p>Supplier of nets for fish cages. The company is a part of AKVA GROUP.</p>
<p>www.skretting.no</p> 	<p>Skretting is a world-leading supplier of innovative and sustainable nutrition solutions to the aquaculture industry. Skretting has production facilities in 20 countries on five continents and has three factories in Norway distributed along the coast. Skretting supply feed for various fish species from hatching to slaughter.</p>

www.ewos.com



Cargill established its operations in Norway in 2015 with the acquisition of EWOS, a global leader in salmon feed. Cargill employs about 366 people in eight locations in Norway. The locations include three feed mills and a state-of-the-art research and development centre.

www.biomar.no



BioMar is a world leader in high-performance diets for over 45 different fish and shrimp species in more than 80 countries. The main focus is to help customers deliver healthy and tasty seafood. This with the goal of developing efficient, safe and nutritious feed products with the least possible environmental footprint.

www.froygruppen.no



Service company with the following services: Wellboat services, Sea freight, De-liceing and treatment, Moorings, Cage washing and Cage service, Net washing and repairing, Inspections and certification, Seabed mapping and documentation, Towing, Diving and ROV, Control systems.

www.aqs.no



AQS AS is one of Norway's largest marine contractors. AQS are specialists in aquaculture but perform all types of service and diving assignments. With 19 service vessels and about 160 employees working along the Norwegian coast, AQS has great capacity and competence to meet different needs.

AQS currently has a modern fleet of specialized service vessels, both high-speed diving boats, catamarans and single-hull vessels up to 49 meters. The vessels are equipped with modern equipment for a wide range of missions. As many as 65 of AQS's employees are working divers, making AQS Norway's largest diving company. AQS dives from both service vessels, high-speed vessels and land based on a mobile diving station mounted on a car trailer.

www.akerbla.no



Fish health and the environment

Services:

Project management, Application aquaculture site, Environmental monitoring, Feed strategy, Fish health and fish welfare, Salmon lice control, Study and development, Hygiene inspection, Construction certificate, Mooring analysis, Main component certificate, Product certification, Service station and nets certification, Environmental studies, Current measurement, Seabed mapping, Waves and Sea current measurements, 3D modelling, Site survey and MetOcean report, Area cooperation, Biosafety, Prevention of salmon lice

www.aquagen.no



Research-oriented breeding company that develops, produces and delivers genetic material and fertilized roe to the global aquaculture industry. With science, health, sustainability and a future as its driving force, AquaGen manages and owns the world's most processed breeding material for Atlantic salmon, rainbow trout, Pacific salmon and Lumpfish.

Since the 1970s, when the collection of these fish species began, there has been continuous research and development in collaboration with industry and research institutions. Based on long-term systematic breeding work, combined with the use of modern breeding technologies, solutions are currently offered to many challenges in the aquaculture industry.

www.optoscale.no



OptoScale provides real-time monitoring of changes in weight, welfare and sealice. OptoScale has developed advanced sensors and software that enable real-time analyzes of biomass, welfare and sealice. The company has won a number of awards and has gone from being a Norwegian supplier to becoming an internationally recognized supplier with customers in Scotland, Shetland, the Orkney Islands and Canada in addition to Norway.

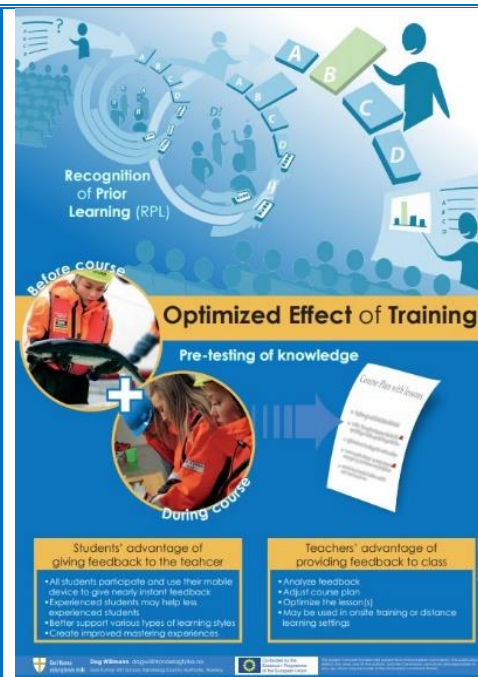
General web and student response tools.

Trøndelag County Municipality and Guri Kunna VET School have, developed teaching methodology used in the aquaculture training for adults as an output from several Strategic Partnership projects (*see below*). One of the focus areas has been on promoting learning through interaction and discussions in the student group (*Peer learning*). Another focus area has been to streamline training by recognising weak and strong areas of knowledge in relation to the training to give priority to the weak areas.

In the development of this teaching methodology, the use of interactive student response systems has been central. There are several different systems that CAN be used, but we have listed systems that have been used in our method development.

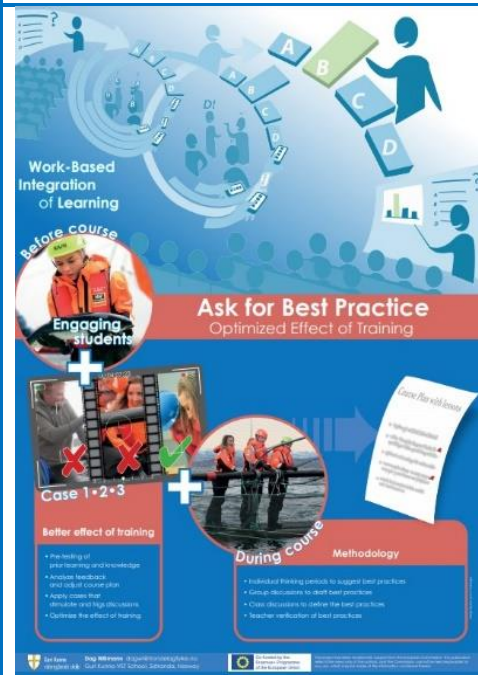
“Optimal” project (2016-2019):
Pre-testing / Post-testing methodology

Developing methods for the establishment of prior knowledge to help organize aquaculture classes delivered face to face and via video conferencing to mature learners in employment



“ASK for BEST PRACTICE” project (2018-2022):
Word cloud methodology

Sharing best practice between partners in support of conventional face to face VET and work based delivery



<p>Kahoot</p> 	<p>Quiz tool.</p> <p>A tool for the creation and presentation of quizzes.</p>
<p>www.mentimeter.com</p> 	<p>Word cloud / Testing / Quiz tool</p> <p>This is a pedagogical tool we use in the classroom.</p>
<p>www.one2act.no</p> 	<p>Word cloud / Testing / Quiz tool</p> <p>Rapid response Technology that has supported the development of innovative VET delivery to aquaculture class and work- based learners. It has been used in a range of ways to stimulate greater learner engagement and interaction with peers and the teacher.</p>

Instructional videos on YouTube and Vimeo.

There are some video materials, both self-developed and external developed, relating to aquaculture VET training on YouTube and Vimeo. They can be used within teaching. The teacher is at the mercy of what is available at the time and if they become dependent on a good resource they get taken down, this can cause problems if an alternative cannot be found and substituted.

These videos are not necessarily instructional videos but can be used to set the tone for an specific learning topic.

2.3 Open educational resource for teachers

Sourcing suitable aquaculture textbooks is problematic for reasons previously described, and those hard copy texts addressing technical matters are quickly out of date. Although there is a lot of material available online, as the report shows, it is not available within an organised and coherent framework.

An online 'open educational resource' for aquaculture would be a major step forward for teachers and learners. This would ensure 'aquaculture industry best practice' could be held within a well-structured E book format written at the appropriate level for the VET learner. This could serve as an aquaculture technical information hub, complemented by, and linked to the other useful learning resources documented in 2.2 above, some of which are constantly updated.

The resource would take the form of a structured e-book, with chapters and topics and be promoted to both teachers and students. It could also provide the core resource within a future blended learning delivery that relied more heavily on well-designed E Learning.

An open educational resource could

- be made widely available,
- updated and translated more easily than a textbook,
- incorporate other digital media and e-tools, such as animations and video

There would need to be

- a sustainable process for aquaculture intelligence gathering,
- a development team to keep the resource up to date,
- an external committee with full stakeholder representation to quality assure the resource and approve annual updates.

Future EU VET innovation funds could be bid for and secured to part fund the initiation and development of the open educational resource for aquaculture and fill the current void. Key stakeholders and beneficiaries could form a sustainable partnership and business model to support the essential ongoing updating and development beyond the grant aided period.

An initial outline of key topics to include is provided in Appendix 1

Appendix 1 - Topics for an open educational resource in aquaculture

1. Land based aquaculture
 - a. Breeding
 - I. Life cycle
 - II. Salmon ova
 - III. Characteristics
 - b. Hatchery
 - I. Water treatment, water chemistry, environment
 - II. Operations
 - III. Equipment
 - IV. Vaccination
 - V. Smoltification
 - c. Laws and regulations
2. Sea based aquaculture
 - a. Facilities
 - i. Locality and licenses
 - ii. Facilities certification
 - iii. Cages and nets
 - iv. Feed systems
 - v. Monitoring
 - b. Daily routines
 - i. Daily fish care
 - ii. Equipment control
 - iii. Monitoring
 - iv. Knots and stitches
 - c. Production planning
 - i. Smolt plan
 - ii. Biological budget
 - iii. Economical budget
 - iv. Harvesting plan
 - d. Growth and feeding
 - i. Density
 - ii. Biomass
 - iii. Feed factor
 - iv. Growth
 - v. Feed and feeding
 - vi. The craft of feeding
 - e. Sea lice
 - i. Sea lice anatomy
 - ii. Laws and regulations

- iii. Treatment
- f. Fish health and fish diseases
 - i. Fish welfare
 - ii. Anatomy
 - iii. Bacteria and virus diseases
 - iv. Parasites
 - v. Prevention and treatment
- g. Cleaning fish
 - i. Fishery of cleaning fish
 - ii. Production of cleaning fish
 - iii. Use of cleaning fish
 - iv. Fish health and diseases
- h. Other operations
 - i. Harvesting
 - ii. Sorting
- i. Laws and regulations.
 - i. National laws regarding aquaculture
 - ii. Animal laws
 - iii. Workers law
- j. HSE
 - i. Safe work environment
 - ii. Deviation work
 - iii. documentation
- k. Environment
 - i. B and C surveys
 - ii. Impact on other species
 - iii. Impact on nature
 - iv. Conflict with other interest
- 3. Boats and work vessels
 - a. Well boat
 - b. Service vessels
 - i. Big operations
 - ii. Crane and winch
 - iii. Dangerous work
 - iv. Building a locality
 - v. Certificates
- 4. New production methods
 - a. Landbased RAS
 - b. Offshore
 - c. Closed and semi-closed cages

5. Other aquaculture species

- a. Cod
- b. Trout
- c. Char
- d. Shellfish
- e. seaweed