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Deliverable report for

GAIN

Green Aquaculture Intensification in Europe Grant Agreement Number 773330

Deliverable D5.1 On-line courses and supporting information

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Lead beneficiary: University of Stirling Authors: David Little; John Bostock, Richard Newton, Sonia Rey Planellas, Edouard Royer

WP 5 – Professional Development Task 5.1 – Free Online Courses

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1 Introduction

1.1 GAIN H2020 Project

Green Aquaculture Intensification in Europe (GAIN) (www.unive.it/gainh2020_eu) is a collaborative project funded by the European Union (EU) under the Horizon2020 framework. It is designed to support the ecological intensification of aquaculture in the EU and the European Economic Area (EEA), with the dual objectives of increasing production and competitiveness of the industry, while ensuring sustainability and compliance with EU regulations on food safety and environment.

Eco-intensification of European aquaculture is a challenge that requires the integration of scientific and technical innovations, new policies and economic instruments, as well as addressing social considerations, in order to promote the implementation of the principles of circular economy in aquaculture. In short GAIN aims to:

- Add value to cultivation through innovations in side-streams, ensuring improved secondary materials, increased profit and minimisation of the environmental footprint;
- Improve the management of aquaculture farms, in terms of resource efficiency, fish welfare and reduction of wastes;
- Support integrated policies and address current barriers to the implementation of the principles of circular economy in aquatic production.

Within this context, GAIN WP5 aimed at enhancing the capacity of aquaculture companies and individuals to use state-of-the-art smart technologies for eco-intensifying their activities, with a focus on GAIN innovative processes and products.

1.2 GAIN Online Courses

Within the frame of WP5, the objective of the GAIN Online Courses (Task 5.1) was to share with researchers, industry practitioners, regulators, students, and other interested persons the results and lesson learned from the GAIN project through the format of short self-study courses. These offer the opportunity for structured learning without requiring ongoing tutor input. As the materials are shared under a Creative Commons licence, they can also be reused and adapted by other teachers for use in college courses or other vocational training. It is anticipated that the materials will be available for up to five years, thereby providing an ongoing legacy for the project.

It was decided to develop a set of five courses to provide state-of-the art information concerning the pillars of ecological intensification investigated during GAIN i.e precision aquaculture, circular economy, sustainable feeds, and sustainability assessment, plus an introductory course to explain the project and define key concepts. These are structured in accordance with good course design, based on defined learning outcomes and using a mix of media to present the concepts and quizzes to help learners test and reinforce their learning.

2 Platform selection and course planning

2.1 Platform selection

A number of options were considered for hosting the online courses as summarised in the following table:

Host platform	Benefits	Barriers
University of Stirling Virtual Learning Environment (Canvas)	No hosting fees; staff familiarity with system; Good facilities for different media and quizzes	Closed system, only readily available for staff and registered students at the University of Stirling
Commercial learning management system provider (e.g. large number of providers listed at https://elearningindustry.com/direc tory/software-categories/learning- management-systems	Professional appearance; relatively easy to use; support for different access devices	Ongoing fees; potential loss of material if company goes out of business; potential lock- in to system.
Commercial host for Open-Source Moodle platform (such as Bluehost, TMD Hosting or InterServer)	Flexibility in implementation; ability to move host if problems arise	Steeper learning curve to design system; ongoing maintenance fees
Udemy (commercial course hosting platform) or similar.	Part of a well-known platform for self-learn courses which is widely promoted; Ease of use; potential to earn revenue from courses	Lock-in to the Udemy system; Significant limitations on length and materials for free courses; Copyright conditions
OpenLearn Create (Free Moodle Platform provided by the UK Open University for hosting courses free courses licenced under Creative Commons)	Well established platform with higher education credentials; no hosting fees; facilities for completion certificates and course badges; built on Creative Commons principles	Limited design options; less suitable for access via mobile devices

Table 1: Assessment of Hosting Platforms

After some review and discussion, it was agreed that OpenLearn Create offered the best solution, particularly for making the courses available well beyond the lifetime of the GAIN project itself and allowing materials to be utilised in a wider range of teaching and learning contexts.

2.2 Course design

The next step was to develop templates for course structure and content planning. These were based on the principle of working backwards from the desired outcomes to determine the required content.



Figure 2-1: Content design principles

Each course is split into several units (or modules), with learning activities (e.g. video, text with graphics or coding).



Figure 2-2: Suggested module structure

More detailed templates were developed to help plan the content of each unit and to document copyright and other metadata about each resource used in the course (Annex 1).

ion Date:	Completed By:	
Item Data		
Course – Overall objective /Main, Baout, (Brief descriptive text)	GAN	Dnline Course: Module Planning Template
Who should take this course? (suggest torget audience)		
Course Learning Outcomes	Version Date:	Complete
Summary of expected study time and learning activities	Item Data	
Module 1: Title	Module Title and Number	GATN
Module 1: Brief Description	This section is part of which course?	
Module 1: Learning Outcomes		Digital assets information templates
Module 1: Expected content	Summary of expected study time and learning	Digital assets mormation templates
Module 1: Expected student octivities	arevear	For every image, video, audio, document etc provided for use in the course, please complete a
Module 2: Existing resources and links	Modulo Loomino Outcomes (testable by	separate information template.
Module 1: People involved and	multiple-shole quity	
responsibilities	What are the knowledge	Image or illustration
Module 2: Title	module? Where can a learner find out more	Course/Module/Section (reference to where the image should be used)
Module 2: Brief Description	about <u>sheee 2</u>	Ref No. (give the image a reference
Module 2: Learning Outcomes	Madule Plan	number and use this in the text to identify where the image should be
Module 2: Expected content	Introductory text for this Module	placed)
Module 2: Expected student octivities		File Name
Module 2: Existing resources and links	Introductory video script	Title (image title or caption to use)
Module 2: People involved and	Introductory Activities	Author (full name and details for
responsibilities	Assessment/Self-Test (if	photographer or artist)
1	appropriate) for intra.	Source (include URL if available)
	Section 1: Title and Brief Description	Licence (Original image licence details)
	Section 1: Learning Outcomes	Identifiers (full names of people in the image, places, prganisations or
	Section 1: Expected content	other elements that might require identification)
	Section 1: Video Script	Alt Text (detailed description of the image to include for accessibility purposes)
		Other metadata (any other information about the image)

Figure 2-3: Course design and documentation templates

A lead author/organisation was agreed for each course as follows:

Course	Lead organisation	Lead author
Introduction to the GAIN Project and	Ca' Foscari University of Venice	Edouard Royer
courses		
Sustainable Aquafeeds (sustainable feeds	Sparos LDA	Tatiana Poletto
for aquaculture intensification)		
Valorisation of aquaculture wastes: An	Instituto de Investigacións	Xosé Antón Vázquez
approach to the circular economy	Mariñas, Consejo Superior de	Álvarez
(Aquaculture in the circular economy	Investigaciones Cientificas (IIM-	
	CSIC)	
Precision Aquaculture (the GAIN	IBM Research Europe	Fearghal O'Donncha
Information Management System)		
Sustainability of aquaculture products	Institute of Aquaculture,	Richard Newton
(Sustainability of	University of Stirling	
Aquaculture products)		

Note: The course title in brackets is the title given in the Amended Grant Agreement DoA

Day-to-day coordination of course development and implementation on the OpenLearn Create site was undertaken by John Bostock (University of Stirling). A schedule of activities was established, and regular (Zoom) meetings organised to discuss progress and ensure consistency in approach.

GAIN Task 5.1 - Onlin	ne Course	es				Legen	d:	_					_		_	_							-											
University of Stirling						On T	rack	Lo	w Risk		Me	d Risk	Hig	h Risk	k Un	assigne	d																	
Task Leader		Project	Start Date:	23/03/3	2021																													
		Scrolling	g increment:	0		March 23 24	h 25 26	27 28 2	ia 30 :	31 1	2 3	4 5	April	. 9	10 11 12	13 14 1	15 16	17 18	19 20	21 2	22 23 2	24 25	26 27	28 2	9 30	1 2	3 4	lay	5 7	8 9	10 11	12 11	3 14 1	15 16 17
						<													_															>
Milestone Description	Cotegory	Assigned To	Progress	Start	No. Days	т₩	TF	s s i	и т и	νт	FS	s M	т w т	F	s s m	τw	TF	\$ \$	мт	v	TF	s s	мт	w 1	F	s s	M 1	r v 1	F	s s	мт	νT	F	s s m
Overall coordination																																		
Start of work on task	Milestone	UoS	100%	23/03/2021	1	Þ																												
Preparatory work inc. templates	On Track	UoS	80%	23/03/2021	5																													
Task Kick-off meeting	Milestone	UNIVE	100%	09/04/2021	1									Þ																				
Progress meeting 1	Milestone	UNIVE	100%	23/04/2021	1																Þ													
Progress meeting 2	Milestone	UNIVE	0%	14/05/2021	1																												4	
Progress meeting 3	Milestone	UNIVE	0%	11/06/2021	1																													
Task reporting	Low Risk	UoS	0%	23/06/2021	4																													
All courses completed	Goal	UoS	0%	30/06/2021	1																													
Intro Course																																		
1. Develop course specifications	Med Risk	UNIVE	0%	17/05/2021	4																													
2. Course specification complete	Milestone	UNIVE	0%	22/05/2021	1																													
3. Prepare text and scripts	Med Risk	UNIVE	0%	24/05/2021	5																													
4. Prepare audio/visual materials	High Risk	UNIVE	0%	31/05/2021	5																													
5. Proparo Assossments	Med Risk	UNIVE	0%	07/06/2021	1																													
6. Basic course materials complete	Milestone	UNIVE	0%	08/06/2021	1																													
7. Set-up online course framework	Low Risk	Uo\$	0%	03/05/2021	2																													
8. Produce/edit video material	High Rick	UoS	0%	03/06/2021	8																													
3. Edit and upload course materials	Med Risk	Uo\$	0%	18/06/2021	4																													
10. Test, review and edit course	Low Risk	UoS	0%	24/06/2021	2																													
11. Course completed/published	Goal	Uo\$	0%	28/06/2021	1																													
Sustainable Feeds																																		
1. Develop course specifications	Med Risk	Sparos	0%	12/04/2021	7																													
2. Course specification complete	Milestone	Sparos	0%	19/04/2021	1														Þ															
3. Prepare text and scripts	Med Risk	Sparos	0%	19/04/2021	14																													
4. Prepare audio/visual materials	High Risk	Sparos	0%	03/05/2021	14																													
5. Prepare Assessments	Med Risk	Sparos	0%	10/05/2021	2																													
6. Basic course materials complete	Milestone	Sparos	0%	17/05/2021	1																													Þ
7. Set-up online course framework	Low Risk	UoS	0%	28/04/2021	2																													
8. Produce/edit video material	High Risk	UoS	0%	18/05/2021	14																													
3. Edit and upload course materials	Med Risk	UoS	0%	01/06/2021	6																													
10. Test, review and edit course	Low Risk	UoS	0%	07/06/2021	4																													
11. Course completed/published	Goal	UoS	0%	12/06/2021	1																													

Figure 2-4: Part of GANT Planner for Course Development

Task coordination meetings were held via Zoom on the following dates:

09/04/2021	25/06/2021	23/07/2021	20/08/2021
27/04/2021	02/07/2021	30/07/2021	27/08/2021
14/05/2021	09/07/2021	06/08/2021	03/09/2021
18/06/2021	16/07/2021	13/08/2021	10/09/2021

3 Course content

3.1 Introduction

The courses were developed on the OpenLearn Create platform - <u>https://www.open.edu/openlearncreate/</u>. This is maintained by the UK Open University and



Figure 3-1: The GAIN Course Collection on OpenLearn Create

is a good fit for the GAIN online courses. The underlying software is the Open-Source course management system "Moodle". The Moodle system and particularly the OpenLearn implementation placed significant constraints on overall course design and functionality. However, we were able to work within these and the system provided the means of hosting different types of quiz and tracking individual student progress.

The GAIN courses are grouped into a "Collection" which provides the logical entry point for the project, and an opportunity for overall project branding. The courses are also available individually from the main course directory.

The courses can be classified into a few general subject areas (e.g. Science or Environment) and by study level. We selected level 3 as the content is generally oriented towards graduates and professionals.

A nominal indication of required study time is also given, with the introduction being the shortest and circular economy course the longest.

At the start of each course there are some introductory pages to provide information on the project and other courses in the collection, an introduction to the course tutors and some further guidance on navigating the materials. The main learning outcomes for each course are shown on the introductory page. The GAIN course collection can be found at https://www.open.edu/openlearncreate/course/index.php?categoryid=502.

GAIN H2020

Deliverable 5.1



Figure 3-2: Example of GAIN Courses showing in the main OpenLearn Create Directory

3.2 Introductory course

The introductory course was developed by Ca' Foscari University of Venice. Its aims are to introduce the GAIN project and particularly the concept of ecological intensification. The direct access link is: <u>https://www.open.edu/openlearncreate/course/view.php?id=7247</u>.

The key learning outcomes expected from the course are that the student should be able to demonstrate an understanding of ecological intensification in terms of:

- What it is
- How can it be applied to aquaculture and why it is crucial.
- Which are the main challenges it faces.
- How the GAIN project intends to promote its implementation.



The course is divided into two units. The first being introductory material and the second the main content, which is divided into three sections. The pages are as follows:

Introduction

- Welcome to the course (includes the introduction to GAIN video)
- Meet the tutors
- How to navigate this course

Exploring Ecological Intensification

- What does "ecological intensification" mean? (includes video presentation)
 Quiz 1
- How can ecological intensification be applied to aquaculture and why is it crucial for the future of the EU?
 - o Quiz 2
- How does GAIN intend to address the challenges of that paradigm shift? (includes video presentation)
 - o Quiz 3

Each quiz consists of five multiple choice or other format question which can be marked automatically. Learners are given the opportunity to revise their answers when incorrect. However, the marks are reduced for incorrect answers. Learners need to score at least 50% correct for the quiz to be marked as complete.

Learners who enrol on the course, read all the pages and complete the quizzes are able to receive a certificate of completion and digital badge.



Figure 3-3: Introductory course - Landing page

3.3 Sustainable Aquafeeds

The Sustainable Aquafeeds course was developed by Sparos LDA. It explores in detail the challenges of the aquafeed industry to become increasingly sustainable and, through innovation, meet the nutritional requirements of animals as well as the demands of its market. The direct access link is:

https://www.open.edu/openlearncreate/course/view.php?id=7409

The course consists of 4 units with each expected to take around 1 hour of study time. There is also an introductory section to provide context, guidance, and an introduction to the course tutors.

The overall learning outcomes for the course are that on completion, learners should be able to:

- Identify the main nutritional requirements of fish and how they change across species
- Recognize traditional and novel ingredients used/with potential for use in aquafeeds
- Demonstrate an understanding of the state of the art and future challenges in the formulation and production of new, sustainable and economical fish feed
- Demonstrate knowledge of formulation trends (plant-rich, alternative feedstuffs, functional additives) constrain feed production technology.
- Identify tools for assessing aquafeeds performance.

The full list of pages is as follows:

Before you start

- Welcome to the course (introduces the tutors)
- The GAIN Project and courses (includes GAIN video and links to other courses)
- How to navigate this course

1. Overview – what are sustainable aquafeeds?

- Importance of fish nutrition (includes video presentation)
- Overview of fish nutritional requirements (includes video presentation)
- Main ingredients and sources (includes video presentation)
- References and further reading
- Unit 1 quiz
- Credits and acknowledgements

2. Fish nutritional requirements and how they change across species

- Introduction
- Protein and Amino Acids
- Essential Amino Acids
- Energy
- Fatty Acids and other Lipids



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- Minterals
- Vitamins
- References and further reading
- Unit 2 quiz
- Credits and acknowledgements

3. Alternative fish feed formulations

- Introduction (includes video presentation)
- Sustainability challenges of aquaculture (includes video presentation)
- Manufacturing of aquafeeds (includes video presentation)
- Trends in alternative fish feed formulations (includes video presentation)
- Functional aquafeeds (includes video presentation)
- References and further reading
- Unit 3 quiz
- Credits and acknowledgements

4. Tools to evaluate aquafeeds

- Introduction
- Growth, nutrient retention and digestibility studies
- Health status: Histology, hematology and plasma metabolites
- Molecular and physiological biomarkers
- Microbiome analysis
- Simulation models
- References and further reading
- Unit 4 quiz
- Credits and acknowledgements

Each quiz consists of five multiple choice or other format question which can be marked automatically (other than quiz 4, which has 4 questions). Learners are given the opportunity to revise their answers when incorrect. However, the marks are reduced for incorrect answers. Learners need to score at least 50% correct for the quiz to be marked as complete.

Learners who enrol on the course, read all the pages and complete the quizzes are able to receive a certificate of completion and digital badge.







3.4 Valorisation of aquaculture wastes: An approach to the circular economy

The course "Valorisation of aquaculture wastes: An approach to the circular economy" was developed by several partners under the leadership of CSIC. It explores the different existing strategies to upgrade the waste and mortalities generated in the aquaculture activities beyond the conventional fish meal production and how they can contribute to a circular economy. The direct access link is:

https://www.open.edu/openlearncreate/course/view.php?id=7404

The learning outcomes for the course state that after studying the course, learners should be able to:

- Identify the potential alternatives existing for the valorisation of aquaculture wastes.
- Evaluate sustainable strategies of food byproducts processing/bioprocessing.
- Demonstrate an understanding of the selected waste water purification technologies in detail.
- Know the problems associated with shell valorisation: quantities and possibilities.
- Evaluate the use of shells as biofilters for nitrification and phosphorous adsorption in recirculation aquaculture systems (RAS).



The course consists of 4 units with each expected to take around 3 hours of study time. There is also an introductory section to provide context, guidance, and an introduction to the course tutors. The course pages are as follows:

Before you start

- Welcome to the course (introduces the tutors)
- The GAIN Project and courses (includes GAIN video and other course links)
- How to navigate this course

1. Overview – what is a circular economy

- Video Aquaculture waste generation and management
- What is a circular economy?
- Aquaculture waste generation and current management
- Marine biorefinery concept
- References and further reading
- Unit 1 quiz
- Credits and acknowledgements

2. Valorisation of aquaculture side streams

- Background to valorisation of aquaculture side streams (includes presentation video)
- Removal of particulate matter from wastewater (includes 2 videos)

- Treatment of dissolved matter in wastewater (includes presentation video)
- Valorisation of sludge (includes presentation video)
- Treatment and valorisation of mortalities (includes presentation video)
- Unit 2 quiz

3. Valorisation of secondary products of the aquaculture supply chain

3.1 Optimal production of fish protein hydrolysate

- Video: Production of fish protein hydrolysate from aquaculture by-products
- What is fish protein hydrolysate?
- What enzymes can be applied for proteolysis?
- What steps and variables must be evaluated for optimising the producction of FPH?
- Production of FPH from aquaculture waste
- Analytical determinations for FPH
- References and further reading
- Unit 3 Quiz A
- Credits and acknowledgements

3.2 Biotechnological conversion of aquaculture by-products

- Video: Application of marine peptones from aquaculture wastes
- What are peptones and marine peptones?
- Production of marine peptones
- Bacterial fermentation on marine peptones from aquaculture wastes
- Analytical determinations for marine peptones and bacterial bioproductions
- References and further reading
- Unit 3 Quiz B
- Credits and acknowledgements

3.3 Isolation of collagen and derivatives

• Introduction: Protein types and structures



Figure 3-5: Page from the Circular Economy Course

- 3.3.1 Collagen
- Collagen: a fibrous protein
- Video: Production of collagen from skin wastes of aquaculture species
- Sources of collagen

- Biochemical characterisation of collagen. Molecular weight: SDS-PAGE and GPC-LS
- Biochemical characterisation of collagen. Charge and hydrophobicity by HPLC
- Biochemical characterisation of collagen. Collagen structure by FT-IR and CD
- Collagen extraction process. By-products from aquaculture fish for collagen production
- Collagen applications
- References and further reading about collagen
- Unit 3 Quiz C

3.3.2 Gelatin

- What is fish gelatin?
- Video: Production of gelatin from aquaculture by-products
- Processes to produce gelatins from skin fish waste
- Gelatins from skin aquaculture by-products
- References and further reading about gelatin
- Unit 3 Quiz D
- Credits and acknowledgements (Section 3.3)

4. Valorisation of shellfish industry wastes

- Shellfish production and mineral by-products, especially calcium (video presentation)
- Historic examples of shellfish by-product valorisation (video presentation)
- Unit 4 Quiz A
- Current examples of shellfish by-product valorisation (video presentation)
- Innovative processes studies in the GAIN project (A) Shells as a substrate for the production of seaweed seedlings (video presentation)
- Unit 4 Quiz B
- Innovative processes studies in the GAIN project (B) The use of shells in recirculated aquaculture system biofilters (video presentation)
- GAIN experiments on the use of shells in recirculated aquaculture system biofilters (video presentation)
- Unit 4 Quiz C

Each quiz consists of four or five multiple choice or other format question which can be marked automatically. Learners are given the opportunity to revise their answers when incorrect. However, the marks are reduced for incorrect answers. Learners need to score at least 50% correct for the quiz to be marked as complete.

Learners who enrol on the course, read all the pages and complete the quizzes are able to receive a certificate of completion and digital badge.

3.5 Precision Aquaculture

The course "Precision Aquaculture" was developed by IBM Research, Ireland. It provides an introduction to how data analysis and machine learning can be used to improve environmental performance of fish farms. The direct access link is: https://www.open.edu/openlearncreate/course/view.php?id=7821

The essential learning outcomes for the course are expected to lead to learners having an awareness of:

- Precision aquaculture as a farm management • paradigm
- The types and role of data collected on farms and use in management
- The advantages of Julia programming language for data science
- The use of Julia for manipulating datasets
- The use of different machine learning models for farm data analysis
- Applying statistical and machine learning analysis to data from and aquaculture farm



The course consists of 5 units with each expected to take around 1-2 hours of study time. There is also an introductory section to provide context, guidance, and an introduction to the course tutors. The course pages are as follows:

Before you start

- The GAIN Project and courses (Includes video and link to other courses)
- Why should you take this course?
- Meet the tutors
- How to navigate this course

1. What is Precision Aquaculture?

- Introduction
- Data to inform farming decisions
- What is Precision Aquaculture
- Internet of Things for Aquaculture
- The role of models within Precision Aquaculture
- Precision Aquaculture: What we need.
- Unit 1 Quiz

2. Programming Tools

- Introduction to the Julia Programming language
- Julia Applied
- Part 1 Introductory Julia Live Tutorials (With external exercise)
- Unit 2 Quiz

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GAIN Online Courses
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- 3. Data Manipulation
 - Introduction to data wrangling
 - Part 2 Introduction to DataFrames in Julia Live Tutorials (With external exercise)
 - Unit 3 Quiz
- 4. Machine Learning
 - What is machine learning
 - Part 3-Julia with Python/R for Data Science. Live Tutorials (With external exercise)
 - Unit 4 Quiz
- 5. Data Driven Aquaculture
 - Machine learning analysis of caged salmon behaviour
 - Model Setup and Training
 - Machine Learning
 - Interrogating aquaculture data with Julia (With external exercise)
 - Results and analysis
 - Unit 5 Quiz

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	3. How to comme	nt ic math																
	4. Syntax for bas	il maur																
	Working wi	th env	ironn	nen	ts													
	Working in Julia scri	ints the de	fault sett	ing is t	to add at	ny packao	es we u	se to th	he default	project	tat~/	iulia/e	nviron	ments/v1	D			
	B is however easy	to create c	that indu	ngand	ant prok	ny puckuy	ter to cr			ot ore	ato a	direct	any for	it and the	o activate t	hat dire	ectory to my	ke it the
	"active project", wh project file which w	ich packag	e operat	ions n as f	nanipulat ollows:	e. Full det	ails on w	orking	with envi	ronmer	ate a nts an	e desc	cribed i	n the doci	imentation.	The m	ain requirer	nents are i
	' shell> mkdir MyPro	ect																
	shell> cd MyProject	/Users/kri	stoffer/M	vProje	ct													
	(v1.0) pkop activate																	
	(MyProject) pkop et	Statue D	COLOCT.	ton														
	(myrropoor) prig- ar	010103 2	ojeco.															
In (3):	using Pkg Pkg.activate(" Pkg.instantiat	// te())															
	How to prin	nt																
	In Julia we usually u	use prin	tln()	to prin	t													
In [1]:	println("I'm e	excited	to lea	irn 3	ulia!	")												
	I'm excited to	o learn	Julia															
	How to ass	ign va	riable	s														
	All we need is a var Julia will figure out t	riable nam types for u	e, value, s.	and a	n equals	sign!												
In [2]:	my_answer = 42 typeof(my_answ	2 wer)																
Out[2]:	Int64																	
	my_pi = 3.1418	59																
In [3]:	typeof(my_pi)																	

Wrapping up

- Final thoughts
- Credits and acknowledgements

Each quiz consists of four or five multiple choice or other format question which can be marked automatically. Learners are given the opportunity to revise their answers when incorrect. However, the marks are reduced for incorrect answers. Learners need to score at least 50% correct for the quiz to be marked as complete.

Learners who enrol on the course, read all the pages and complete the quizzes are able to receive a certificate of completion and digital badge.

3.6 Sustainability of aquaculture products

The "Sustainability of aquaculture products" course was developed by the Institute of Aquaculture, University of Stirling. It introduces to how data analysis and machine learning can be used to improve environmental performance of fish farms. The direct access link is: https://www.open.edu/openlearncreate/course/view.php?id=7822

The learning outcomes for the course are that learners should gain an awareness of:

- Different aspects and measures of • sustainability, and trade-offs between them relevant to aquaculture
- Sustainability issues relevant to ٠ aquaculture products
- What tools and indicators are used and basic knowledge of how they are calculated.
- Critical thinking about the tools and how they are applied in the context of aquaculture
- How change can be made through evidence-based policy



The course consists of 4 units with each expected to take around 1 hour of study time. There is also an introductory section to provide context, guidance, and an introduction to the course tutors. The course pages are as follows:

Before you start

- Welcome to the course (include tutor profiles) •
- The GAIN Project and courses (includes GAIN • video)
- How to navigate this course

1. Overview – what is sustainability?

- What is sustainability?
- How and why sustainability is reported
- The 4 pillars of sustainability
- Environmental impacts ٠
- Criticism over environmental impact mitigation • targets
- Unit 1 Quiz •
- Credits and acknowledgements

2. Common perceptions of sustainability issues in aquaculture

- Supply chain issues :resources,technology, • equity, knowledge
- Tradeoffs between marine ingredients and • alternatives
- Local v regional v global •
- Human and animal welfare •
- Unit 2 Ouiz •
- Credits and acknowledgements



Figure 3-7: Page from Sustainability of aquaculture products with embedded YouTube video

GAIN Online Courses The project has received funding from the European Union's Horizon 2020 Framework Research and Innovation Programme under GA n. 773330

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3. Measuring sustainability in aquaculture

- Introduction
- Building an LCA
- Unit 3 Quiz
- Credits and acknowledgements

4. Improving sustainability in aquaculture

- Value chain approach
- Institutions and governance
- Value chain assurance, standards and certification
- Education and human resource development
- Consumer issues
- Communication
- Unit 4 Quiz
- Credits and acknowledgement



Figure 3-8: Example drag and drop labels quiz

O	u	е	S	fi	0	n	2
-	•	-	-	•	~		_

Tries remaining: 3 | Marked out of 3.00

🔅 Edit question Flag question

Complete the following statements by matching the appropriate second part.

The EU has introduced the Product communicate sustainability credentials of production systems increase regulatory control of industry have a "Net Zero" carbon footprint develop broader assessments of sustainability harmonise how environmental footprints are measured and reported A common target for governments, companies, other organisations and even individuals is to Choose	Conceptual frameworks such as "The four pillars of sustainability" or "One Health" are used to	Choose Choose mainpulate consumer behaviour towards buying particular products	٠
A common target for governments, companies, other organisations and even individuals is to	The EU has introduced the Product Environmental Category Rules (PEFCR) in order to	communicate sustainability credentials of production systems increase regulatory control of industry have a "Net Zero" carbon footprint develop broader assessments of sustainability harmonise how environmental footprints are measured and reported	
	A common target for governments, companies, other organisations and even individuals is to	Choose	\$
Independent certification bodies such as the Aquaculture Stewardship Council and Global Aquaculture Alliance set performance standards that can help retailers to	Independent certification bodies such as the Aquaculture Stewardship Council and Global Aquaculture Alliance set performance standards that can help retailers to	Choose	٠

Figure 3-9: Example of matching answers and questions quiz





Question 5 Celit question V Flag question	ı
Select the missing words:	
Carbon trading is a system aimed at reducing gases that	
contribute to global , particularly emitted by burning	
fuels.	
methane inflation greenhouse nuclear market-based	
carbon dioxide inefficient warming fossil	
Check	

Figure 3-11: Example drop into sentence quiz

4 Course participation

The OpenLearn Create platform enables learners to enrol on courses and have their progress tracked. On successful completion (i.e. all material reviewed and quizzes completed with a grade above 50%), learners can be issued with a certificate of completion and digital badge for display on social media sites. The aim here is to enable learner's efforts to be recognised by employers or other interested parties.





Figure 4-1: Digital Badges for each GAIN course

Furthermore, the platform allows detailed monitoring of course enrolments, quiz performance and completion rates.

GAIN H2020

Status: Public Valorisatio Level 3: Ad	shed Last accessed: 04 November 2021 of aquaculture wastes: An approach to the circular economy vanced			
Role: Owner,	Collaborator, Course Manager			
Number of course views report	The number of users who have viewed your course since publication (including guest visits, enrolments, return visits).			
Enrolment questions report	If you have set up additional questions at enrolment, this report will show the responses.			
Downloads of ALT formats report	This report shows the number of times each alternative format of the course materials was downloaded by users. Users may download the same ALT format more than once and these are counted as separate downloads.			
Drop off points report	A report showing the point and date learners last visited in your course.			
Quiz Grader report	A report on quiz grades achieved by learners studying your course with filter to select which quiz.			
Activity completion report	Activity completion data for your course, showing all the activities for which completion is required.			
Course completion report	The completion data for your course showing all learners and what they have completed in the course, showing activities and course website completion.			
OpenLearn completion report	The completion data for your course showing all learners and what they have completed, including whether they have received a badge and/or Statement of Participation (if available).			
Badge report	A report showing the names of learners who have received the badge/badges for your course.			
Statement of Participation report	A report showing the names of learners who have received the Statement of Participation for your course.			
Enrolled users report	The enrolled users report with filters for enrolment methods, role, group and status of enrolled users on your course.			
Moodle report menu	Additional Moodle reports for your course, in the standard Moodle report menu layout.			

Figure 4-2: List of system reports available for each course



Figure 4-3: Example analysis of individual user progress during pilot testing



Figure 4-4: Example analysis of completion rate by activity during pilot testing

5 Dissemination

5.1 GAIN Collection

The GAIN online courses are disseminated directly via the GAIN website - <u>https://www.unive.it/pag/33897/</u> and social media. Our dissemination plan is being rolled out in real time with negotiations underway with FAO, Worldfish, Global Seafood Alliance and other national and international partners. Awareness of the free online availability is being spread through various platforms such as Facebook, Twitter, Linked in, SARNISSA etc.

The courses are also featured on the OpenLearn Create platform and a collection was created (<u>https://www.open.edu/openlearncreate/course/index.php?categoryid=502</u>) in order to give higher visibility and coherence to the project's efforts in supplying tools for a successful ecological transition of aquaculture.



Figure 5-1: Open Learn Create Collection Page showing link to GAIN courses

5.2 First review of courses' statistics

The courses were finalised and publicly released at the end of the GAIN project. It is then a bit early to report on participation rates. However, a first review of courses statistics can already be made at the collection level taking into account all the related activity until 11/01/2021:

- The total number of visits for the GAIN online courses is 2522. The course *Valorisation of aquaculture wastes* seems particularly attractive with 1058 visits.
- The enrolled learners (excluding enrollments fron GAIN staff) are 38 with a special mention to *Sustainable aquafeeds* which gather 14 of this enrollments.
- The badges awarded were 8 among which 4 badges were awarded for the *Introduction to the GAIN project and courses* completion.

6 Conclusion

The GAIN Online Courses, coordinated by the University of Stirling, successfully present the new ideas and emerging concepts for fostering the ecological intensification of aquaculture in the EU and the European Economic Area (EEA). This has been achieved in a format that can endure for up to five years post project, but specifically, is licensed under Creative Commons such that materials can be re-used within other courses by partners or other relevant organisations.

The materials present state of the art knowledge in several important areas relevant to the future of European aquaculture development. These include the issue of aquafeed formulation and management, the integration of aquaculture into circular economies, methods for assessing aquaculture product sustainability and methods for better controlling production through precision aquaculture. The latter course breaks new ground in presenting machine learning algorithms for precision aquaculture to interested learners.

Learners who engage with the courses and complete the content will receive a completion certificate and digital badge which can be used as evidence of their interest and knowledge when seeking employment. This will also help employers looking to employ well-informed active learners for their organisation.

7 Annex 1 – Course Design Guidelines and Templates



Section Concept Diagram Theory/ Explanations Problem definition Who is Why this is Solution affected by Key concept Benefits important this issue? Example Evidence? applications









Bloom's Taxonomy: Verbs for Writing Instructional Objectives

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	
arrange, define, duplicate, label, list, memorize, name, order, recognize, reproduce state	Comprehension classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate	Application apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.	Analysis analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.	Synthesis arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, acture	Evaluation appraise, argue, assess, attach, choose compare, defend estimate, judge, predict, rate, core, select, support, value, avaluate	https://www.slideshare.net/hala /multiple-choice-53832328

7

Blooms Taxonomy for Multiple-Choice Quiz

Analyzing

In this process, learners will have to break down the data that was provided in order to fully grasp the content (as it is now in more manageable parts). This usually requires learners to use comparative and/or deconstruction skills.

Applying

This asks learners to use information that they already have gained, in order to solve a problem that may be similar in nature. This involves implementation of prior knowledge and skills.

Understanding

Requires that the learners explain the situation or process in order to show that they have understood the materials. This usually involves summarizing, paraphrasing or detailed descriptions.

• Remembering

The learner's ability to retain and recall information. This usually comes in the form of recognition, retrieving, or listing.

https://elearningindustry.com/how-to-write-multiple-choice-questionsbased-on-revised-bloom-s-taxonomy

Tips for writing multiple-choice tests

1. Always use plausible incorrect answers in the questions

One of the biggest mistakes that elearning test creators make is not making the incorrect answers convincing enough. You have to make them plausible so that you are able to test their ability to **remember** the information and apply it to the problem. This is the only true way to gauge if a learner fully understands the concept.

2. Integrate charts into the exam

Include charts or graphs in your test, which will force the learner to use their **analyzing** skills. By having them interpret the data, they will be tested on whether or not they have really absorbed the information.

3. Transform the verb

If you want to include a divergent thinking question on your test, you can generally accomplish this by turning it into a noun. For example, if you are trying to test your learner's ability to describe a scientific process, have them choose the best description for it. This can be used to test both their *creating* and evaluating skills.

4. Create examples or stories to test their understanding abilities Write out detailed stories or examples that the learner must read before answering corresponding multiple-choice questions. This will not only test their *understanding* ability, but their *analyzing* skills as well. You can also make the learner tap into their remembering or applying abilities if you create a story or example that asks them to draw upon knowledge they've already acquired.

5. Use multilevel thinking These are the questions that include wording such as "the most appropriate" or "most important". Such questions serve to test the learners' judgment skills or understanding of an in-depth subject. For example, you could ask a learner a question about identifying a particular mental illness by first giving them a detailed explanation of a patient who exhibits a set of observed symptoms, then ask them to apply a particular psychological theory to come up with a diagnosis.

> https://elearningindustry.com/how-to-write-multiple-choice-questions based-on-revised-bloom-s-taxonomy



Online Course Planning Template

Version Date:	Completed By:	

Item	Data
Course Title	
Course - Overall objective (Main Focus	
(Brief descriptive text)	
Who should take this course? (suggest	
target audience)	
Course Learning Outcomes	
Summary of expected study time and	
learning activities	
Module 1: Title	
Module 1: Brief Description	
Module 1: Learning Outcomes	
-	
Module 1: Expected content	
Module 1: Expected student activities	
Module 1: Existing resources and links	
Module 1: People involved and	
, responsibilities	
Module 2: Title	
Module 2: Brief Description	
Module 2: Learning Outcomes	
Module 2: Expected content	
Module 2: Expected student activities	
Module 2: Existing resources and links	
Module 2: People involved and	
responsibilities	
	1

Module 3: Title	
Module 3: Brief Description	
Module 3: Learning Outcomes	
Module 3: Expected content	
Module 3: Expected student activities	
, Module 3: Existing resources and links	
Would S. Existing resources and mins	
Module 3: People involved and responsibilities	
Module 4: Title	
Module 4: Brief Description	
Module 4: Learning Outcomes	
Module 4: Expected content	
Modulo 4: Expected student activities	
Module 4. Expected student activities	
Module 4: Existing resources and links	
Module 4: People involved and responsibilities	



Online Course: Module Planning Template

Version Date:			Completed By:	
	ltem	Data		
Module Title a	nd Number			
This sectio wh	n is part of ich course?			
Summary o study time ai	of expected nd learning activities			
Modul Outcomes (multiple-c	e Learning testable by choice quiz)			
What are the pre-requis module? W learner fin ab	knowledge ites for this /here can a d out more out these ?			
Module Plan				
Introductory t	ext for this Module			
Introductory v	video script			
Introductor	ry Activities			
Assessment/. appropriate	Self-Test (if e) for Intro.			
Section 1: Titl	le and Brief Description			
Section .	1: Learning Outcomes			
Section	1: Expected content			
Section 1: Video Script				

Section 1: Expected student activities	
Section 1: Existing resources and links	
Section 1: Assessment	
Section 2: Title and Brief Description	
Section 2: Learning Outcomes	
Section 2: Expected content	
Section 2: Video Script	
Section 2: Expected student activities	
Section 2: Existing resources and links	
Section 2: Assessment	
Section 2: People involved and responsibilities	
Section 3: Title and Brief Description	
Section 3: Learning Outcomes	
Section 3: Expected content	
Section 3: Video Script	
Section 3: Expected student activities	
Section 3: Existing resources and links	
Section 3: Assessment	
Section 3: People involved and responsibilities	

Section 4: Title and Brief Description	
Section 4: Learning Outcomes	
Section 4: Expected	
content Section 4: Video Script	
Section 4: Expected student activities	
Section 4: Existing resources and links	
Section 4: Assessment	
Section 4: People involved and responsibilities	
Summary: Title and Brief Description	
Summary: Learning Outcomes	
Summary: Expected content	
Summary: Video Script (if any)	
Summary: Expected student activities	
Summary: Existing resources and links	
Summary: Assessment	
Summary: People involved and responsibilities	



Digital assets information templates

For every image, video, audio, document etc provided for use in the course, please complete a separate information template.

Image or illustration

Course/Module/Section (reference to where the image should be used)	
Ref No . (give the image a reference number and use this in the text to identify where the image should be placed)	
File Name	
Title (image title or caption to use)	
Author (full name and details for attribution – usually the photographer or artist)	
Source (include URL if available)	
Licence (Original image licence details)	
Identifiers (full names of people in the image, places, organisations or other elements that might require identification)	
Alt Text (detailed description of the image to include for accessibility purposes)	
Other metadata (any other information about the image)	

Audio or video

Course/Module/Section (reference to where the audio or video should be used)	
Ref No . (give the audio/video a reference number and use this in the text to identify where the resource should be introduced)	
File Name	
Title (image title or caption to use)	
Author (full name and details for attribution – usually the creator of the media file)	
Source (include URL if available)	
Licence (Original image licence details)	
Identifiers (full names of people featuring in the audio or video; places, organisations or other elements that might require identification)	
Alt Text (detailed description of the audio or video content to include for accessibility purposes)	
Other metadata (any other information about the audio or video)	
Script (if not provided elsewhere, please include a full script to enable closed captions to be created)	

Document

Course/Module/Section (reference to where the document link should be used)	
Ref No . (give the document a reference number and use this in the text to identify where the document (link) should be placed)	
File Name	
Title (document title or caption to use)	
Author (full name and details for attribution)	
Source (include URL if available)	
Licence (Original image licence details)	
Identifiers (further details of organisations, contributors or other identification that might be needed)	
Alt Text (description of the document to include with link for accessibility purposes)	
Other metadata (any other relevant information about the document)	

Acknowledgements

Please provide full details of people contributing to the course materials and any other text for the acknowledgement section: