T2.2 Report on the Alignment of AQUATECHinn 4.0 Programme with needs and opportunities of Vocational Training for European Certification in Aquaculture

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1. Executive Summary

This report presents the findings of a comprehensive survey conducted as part of the AQUATECHinn 4.0 project, aimed at aligning the programme with established requirements and European quality standards in aquaculture education and certification. The survey findings demonstrate strong satisfaction with the proposed course topics, with minor suggestions for improvement and considerations for enhancing adaptability and customization. These insights will inform strategic decisions to ensure that the AQUATECHinn 4.0 programme meets and exceeds global standards in aquaculture education and certification.

2. Detailed report on the deliverable

2.1 Background/Introduction

This report is the deliverable for Task 2.5. "Identify the needs and opportunities of Vocational Training, detect the meeting points with the Producers' Associations and transfer the possibilities of an official Curriculum at European level and a Certification valid in all EU countries." The task T2.5 is part of the work carried out in the WP2 of the Project "Approach to digitisation, collection of good practices and training programmes of the aquaculture sector to be digitized".

The main objectives of this WP2 are:

- To study the degree of implementation of the different technological areas that make up Aquaculture 4.0 in the European aquaculture production sector and the needs and demands of companies for the coming years in this technological field.
- To draw up a new structure for the training course, defining priorities and dissemination activities.
- To identify the topics where digitisation will be most appropriate.
- To evaluate the reinforcement of business opportunities using advanced digital tools
- To identify the needs and opportunities for Vocational Training, detecting meeting points with Producers' Associations and transferring possibilities for an official Curriculum at European level.

2.2. Description of work

Led by E-SCHOOL and in collaboration with UCH-CEU, CNC, and MARE, the consortium embarked on a comprehensive research endeavor aimed at analyzing the certification processes of Aquaculture Programmes across various countries. The primary objective was to align our programme with the established requirements, ensuring standardization and adherence to European quality standards.

Key components of the project included:

- **Preparation of a Specific Questionnaire:** A tailored questionnaire designed by the partners involved in this task to extract pertinent information regarding certification processes from each partner country. This instrument served as the foundation for data collection and subsequent analysis.

- **Data Collection and Analysis:** Through collaborative efforts, the consortium diligently collected and meticulously analyzed data obtained through the questionnaire. This phase entailed thorough scrutiny of certification procedures and requirements prevalent in diverse geographical contexts.

- **Preparation of a Comprehensive Report:** Building upon the insights gained from data analysis, partners compiled the findings into this report.

2.3 Aim of the survey

The survey aims to investigate the certification processes of Aquaculture Programmes in diverse international contexts. The primary objective is to enhance the standardization of our program by aligning it with established certification requirements. This comprehensive examination will inform strategic decisions to ensure that the AQUATECHinn 4.0 programme meets and exceeds global standards in aquaculture education and certification.

2.4 Survey Preparation

Following thorough deliberation and analysis of previous tasks, the working group carefully developed a comprehensive survey in English (Annex I) for distribution among project partners. The survey was structured into different blocks, each addressing specific aspects vital to the success and alignment of the AQUATECHinn 4.0 programme:

General Information: Gathering data about the involved organizations and countries.

Proposed Course Topics: Evaluating the relevance of each proposed course topic in relation to the overarching objectives of the AQUATECHinn 4.0 project.

Additional Topics and Potential Challenges: Soliciting feedback on additional topics deemed pertinent by partners, as well as identifying potential challenges that may impact programme implementation and alignment.

Competency Expectations: Assessing partner expectations regarding the competencies and skills to be acquired through the programme, ensuring alignment with industry standards and evolving needs.

Relevance to Standards: Examining the extent to which the programme aligns with established industry standards, regulatory requirements, and best practices.

Comprehensive Coverage: Evaluating the course topics to ensure comprehensive coverage of relevant topics and emerging trends in aquaculture.

Adaptability and Flexibility: Assessing the programme's adaptability and flexibility to accommodate evolving industry demands, technological advancements, and changing market dynamics.

Overall Assessment: Providing partners with the opportunity to offer feedback on their overall satisfaction with the proposed course topics.

2.5 Survey Distribution and Response Collection

The prepared survey was distributed to all project partners by email. Partners were given a deadline of two weeks to complete the survey, ensuring they had enough time to provide thoughtful responses. To maximize participation and address any issues or questions that arose during the survey period, follow-up reminders were sent periodically. These reminders aimed to encourage timely completion and ensure that any concerns or clarifications needed by the partners were promptly addressed.

2.6 Data Analysis and results

General Information:

A total of 17 responses to the questionnaire were received. Some responses encompassed multiple countries due to the participation of consortium partners operating in these regions. The diversity in responses highlighted the broad geographical representation and varied operational contexts of the partners. This underscored the importance of creating a flexible and adaptable curriculum. The distribution of responses is as follows:

Portugal: 7 responses

Italy: 4 responses

France: 1 response

Spain: 2 responses

Turkey: 2 responses

Greece: 1 response

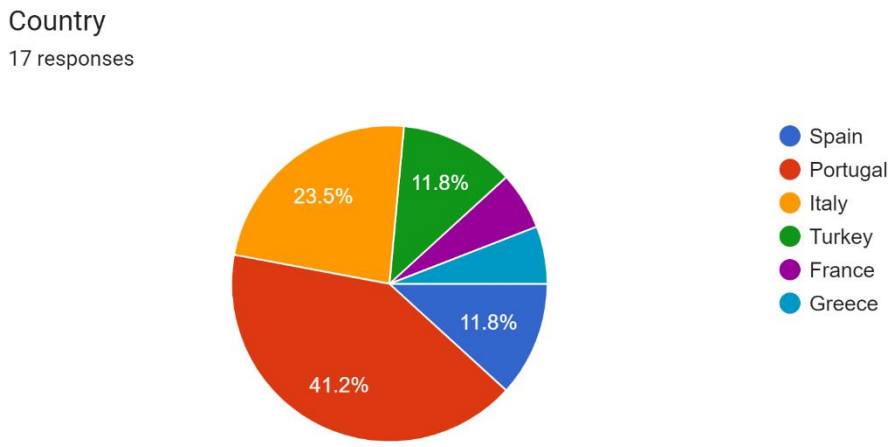

Figure 1: Distribution of responses by country.

Proposed Course Topics:

Partners evaluated each topic of the three modules of the courses using a Likert scale from 1 to 5. The results for each topic are presented below:

Survey results for Module 1: **New Technologies in Finfish and Shellfish Aquaculture**. The suggest topics evaluated as follows:

Table 1. Distribution of the answers to each question. Included the percentage for each question.

Module	Topic	1	2	3	4	5
1	1. Technologies applied to fish and shellfish farming in marine, freshwater and brackish water aquaculture	0 (0%)	0 (0%)	2 (13.3%)	3 (20%)	10 (66.7%)
1	2. Management of a Recirculating Aquaculture Systems RAS (Recirculating Aquaculture Systems) and Integrated partial recirculation systems (fresh water)	0 (0%)	0 (0%)	3 (17.6%)	5 (29.4%)	9 (52.9%)
1	3. New trends in the technological management of hatcheries	0 (0%)	0 (0%)	2 (11.8%)	7 (41.2%)	8 (47.1%)
1	4. Intelligent aquaculture farms. "Precision Fish Farming" (PFF). Remote control technologies: use of advanced sensor systems for monitoring culture parameters	0 (0%)	0 (0%)	1 (5.9%)	9 (52.9%)	7 (41.2%)
1	5. Digitalization, semi-automation and automation, use of drones/robots in farming and harvesting processes	0 (0%)	0 (0%)	5 (29.4%)	9 (52.9%)	3 (17.6%)
1	6. Improvement and development of new culture systems, methodologies, materials and engineering	0 (0%)	1 (5.9%)	4 (23.5%)	6 (35.3%)	6 (35.3%)
1	7. Data analysis and business/development planning (included the use of EU Grants: EMFAF and other R&D founding tools for SME	0 (0%)	0 (0%)	3 (17.6%)	6 (35.3%)	8 (47.1%)
1	8. VR RAS	0 (0%)	2 (11.8%)	4 (23.5%)	4 (23.5%)	7 (41.2%)

Summary of Ratings for Module 1

- **Technologies applied to fish and shellfish farming** received the highest rating with 66.7% of partners rating it a 5, and 20% rating it a 4.
- **Management of Recirculating Aquaculture Systems (RAS)** also received high ratings with 52.9% rating it a 5, and 29.4% rating it a 4.
- **New trends in the technological management of hatcheries** were rated highly useful by 47.1% of the partners.

- **Intelligent aquaculture farms (Precision Fish Farming)** had 41.2% of partners rating it a 5, and 52.9% rating it a 4.
- **Digitalization, semi-automation, and the use of drones/robots** in farming and harvesting processes saw mixed ratings, with the majority (52.9%) rating it a 4.
- **Improvement and development of new culture systems, methodologies, materials, and engineering** received balanced ratings across 3, 4, and 5.
- **Data analysis and business/development planning** was rated highly by 47.1% as a 5, with a further 35.3% rating it a 4.
- **VR RAS** had a more varied rating, with 41.2% of partners rating it a 5 and 23.5% rating it a 4.

These results indicate strong support for the relevance and importance of the proposed topics in Module 1, with a particular emphasis on practical applications and advancements in aquaculture technologies. The feedback highlights the partners' recognition of the need for technological innovation and enhanced management practices in the aquaculture industry.

Survey Results for Module 2: **Sustainability Management in Aquaculture**. The suggest topics evaluated as follows:

Table 2. Distribution of the answers to each question. Included the percentage for each question.

Module	Topic	1	2	3	4	5
2	1. Environmental, social and economic issues linked to shellfish and finfish farming	0 (0%)	1 (5.9%)	3 (17.6%)	4 (23.5%)	9 (52.9%)
2	2. Good practices for a sustainable management of shellfish and finfish farming	0 (0%)	0 (0%)	2 (11.8%)	4 (23.5%)	11 (64.7.9%)
2	3. Boosting the circular economy, farmed aquatic food bioeconomy and blue biotechnology	0 (0%)	0 (0%)	2 (11.8%)	7 (41.2%)	8 (47.1%)
2	4.a Integrated Multi-trophic Aquaculture technique in shellfish farming	0 (0%)	2 (11,8%)	5 (29,4%)	7 (41,2%)	3 (17,6%)
2	4.b Integrated Multi-trophic Aquaculture technique in fish farming	0 (0%)	0 (0%)	7 (41,2%)	6 (35,3%)	4 (23,5%)
2	5. Decarbonization and use of alternative sources of energy in aquaculture	0 (0%)	0 (0%)	4 (23,5%)	3 (17,6%)	10 (58,8%)

2	6.Environmental footprints of aquaculture activities and products through a Life Cycle Assessment (LCA)	0 (0%)	0 (0%)	6 (35,3%)	3 (17,6%)	8 (47,1%)
2	7. Sustainability App (Gaming)	0 (0%)	2 (11,8%)	0 (0%)	8 (47,1%)	7 (41,2%)

Summary of Ratings for Module 2

- **Environmental, social and economic issues linked to shellfish and finfish farming** received high ratings with 52.9% of partners rating it a 5, and 23.5% rating it a 4.
- **Good practices for sustainable management of shellfish and finfish farming** were rated very highly, with 64.7% rating it a 5 and 23.5% rating it a 4.
- **Boosting the circular economy, farmed aquatic food bioeconomy and blue biotechnology** received positive feedback, with 47.1% rating it a 5 and 41.2% rating it a 4.
- **Integrated Multi-trophic Aquaculture technique in shellfish farming** had mixed ratings, with 41.2% rating it a 4 and 29.4% rating it a 3.
- **Integrated Multi-trophic Aquaculture technique in fish farming** showed more varied ratings, with 41.2% rating it a 3 and 35.3% rating it a 4.
- **Decarbonization and use of alternative sources of energy in aquaculture** received strong support, with 58.8% rating it a 5.
- **Environmental footprints of aquaculture activities and products through a Life Cycle Assessment (LCA)** received balanced ratings with 47.1% rating it a 5 and 35.3% rating it a 3.
- **Sustainability App (Gaming)** had mixed ratings, with 47.1% rating it a 4 and 41.2% rating it a 5.

These findings provide a robust foundation for refining the curriculum to ensure it addresses the critical areas of sustainability and innovation in aquaculture, meeting the needs and expectations of industry partners.

Survey results for Module 3: **Animal Health management and biosecurity, welfare, nutrition, and reproduction**. The suggest topics evaluated as follows:

Table 3. Distribution of the answers to each question. Included the percentage for each question.

Module	Topic	1	2	3	4	5
3	1. Fish welfare (on farm, transport, stunning and slaughter)	0 (0%)	0 (0%)	2 (11.8%)	4 (23,5%)	11 (64.7%)

3	2. Disease prevention, biosecurity, therapeutics in aquaculture	0 (0%)	0 (0%)	1 (5.9%)	3 (17.6%)	13 (76.5%)
3	3. Microbiological and chemical contamination and toxins in Aquaculture	0 (0%)	0 (0%)	3 (17.6%)	5 (29.4%)	9 (52.9%)
3	4. Advances in fish and shellfish nutrition and reproduction	0 (0%)	1 (5,9%)	2 (11,8%)	6 (35,3%)	8 (47,1%)
3	5. Feeding strategies: Frequency and duration of feeding, ration and consumption calculation, loss control, Conversion Factor Optimization, new feeding techniques	0 (0%)	1 (5,9%)	2 (11,8%)	4 (23,5%)	10 (58,8%)
3	6. Production of New Species and domestication issues	0 (0%)	0 (0%)	5 (29,4%)	8 (47,1%)	4 (23,5%)
3	7. Omics technologies in aquaculture: Genomics, transcriptomics, proteomics to explore function, mechanisms, interactions between genes, transcripts, proteins, lipids, and other biomolecules	0 (0%)	2 (11,8%)	9 (52,9%)	4 (23,5%)	2 (11,8%)
3	8. VR Welfare	0 (0%)	1 (5,9%)	4 (23,5%)	2 (11,8%)	10 (58,8%)

Summary of Ratings for Module 3

- **Fish welfare (on farm, transport, stunning, and slaughter)** received high ratings with 64.7% of partners rating it a 5, and 23.5% rating it a 4.
- **Disease prevention, biosecurity, and therapeutics in aquaculture** received the highest rating, with 76.5% rating it a 5, and 17.6% rating it a 4.
- **Microbiological and chemical contamination and toxins in Aquaculture** were rated highly useful, with 52.9% rating it a 5 and 29.4% rating it a 4.
- **Advances in fish and shellfish nutrition and reproduction** received positive ratings, with 47.1% rating it a 5 and 35.3% rating it a 4.
- **Feeding strategies** had strong support, with 58.8% rating it a 5 and 23.5% rating it a 4.
- **Production of new species and domestication issues** received varied ratings, with 47.1% rating it a 4 and 29.4% rating it a 3.
- **Omics technologies in aquaculture** had a mixed reception, with 52.9% rating it a 3 and 23.5% rating it a 4.
- **VR Welfare** received high ratings, with 58.8% rating it a 5 and 23.5% rating it a 3.

These findings indicate a strong alignment with the critical areas of animal health management, biosecurity, welfare, nutrition, and reproduction, ensuring the curriculum meets industry standards and addresses the partners' priorities.

Additional Topics and Potential Challenges

Responses Regarding Additional Topics

Out of the 11 responses received on the additional topics to be included in the course curriculum, the following insights were gathered:

1. No Additional Topics Required:
   6 responses explicitly stated "no" or indicated no need for additional topics.

2. Specific Additional Topics Suggested:
   - Ecosystem Services of Bivalve Molluscs Farming:
     One response suggested including ecosystem services offered by bivalve molluscs farming.
   - Basic Knowledge of Weather Forecast, Oceanography, and Hydrodynamics:
     One response highlighted the importance of understanding weather forecasts, basic oceanography, and hydrodynamics, along with practical concepts such as knots and daily management operations, given that many aquaculture activities occur in natural environments.
   - Fish Nutrition and Feed Formulation:
     One response recommended including fish nutrition and feed formulation.

3. General Positive Feedback:
   One response indicated that the course curriculum is well-designed and balanced, suggesting no additional topics were necessary.

Summary of Additional Topics Suggested

I. Ecosystem Services of Bivalve Molluscs Farming:

Highlighting the ecological benefits provided by bivalve farming could add depth to the curriculum, emphasizing sustainability and environmental impact.

II. Weather Forecast, Oceanography, and Hydrodynamics:

Adding basic knowledge about interpreting weather forecasts, understanding oceanography, and hydrodynamics can prepare learners for real-world aquaculture operations, particularly those conducted in natural settings.
Including practical concepts such as knot tying, and daily management operations can enhance the hands-on skills needed for effective farm management.

Fish Nutrition and Feed Formulation:
Integrating detailed information on fish nutrition and feed formulation can provide a comprehensive understanding of dietary needs, feed efficiency, and formulation techniques, contributing to better health and growth rates in aquaculture species.

Conclusion
Most responses indicate satisfaction with the current curriculum, with a few specific suggestions for additional topics to enhance the comprehensiveness and practical relevance of the course.

Potential Challenges in Covering Topics Within the Allocated Timeframe

Responses Regarding Challenges
Out of the 12 responses received on the potential challenges in covering the proposed topics within the allocated timeframe, the following insights were gathered:

1. **No Foreseen Challenges:**
   5 responses explicitly stated "no" or "not yet," indicating no anticipated challenges in covering the topics within the allocated timeframe.

2. **Specific Challenges Highlighted:**
   - **Splitting Point 4 of Module 3:**
     One response suggested that Point 4 of Module 3 could be more effective if split into two parts: one for shellfish and one for finfish.
   - **Expertise and Bias in Ratings:**
     One response noted that their ratings should not prejudice the results as they are not domain experts. They also mentioned that the time allocated for digital VR/gamification apps seemed appropriate for introductions, with additional practice to be conducted independently by students.
   - **Balance of Module 3:**
     Multiple responses highlighted concerns about the balance of Module 3:

- **Nutrition and Reproduction (4 hours):** Several respondents felt that 4 hours is insufficient to cover both nutrition and reproduction comprehensively, suggesting that these topics are complex and need more time.
- **Feeding Regime:** It was suggested that the feeding regime could be merged with nutrition and possibly use less time than currently allocated.
- **Omics Technologies (4 hours):** One respondent believed that 4 hours for omics technologies might be excessive and suggested a restructuring to allocate time more effectively.

3. **Adjusting for Different Skill Levels:**
   - One response noted that the course duration should be adaptable depending on the skill level of the participants, ranging from unskilled workers to those with PhDs. They suggested creating different groups based on skill level to ensure the content is appropriately challenging and relevant.

Summary of Potential Challenges

1. **Splitting Comprehensive Topics:**
   - Splitting complex topics like advances in fish and shellfish nutrition and reproduction could ensure more focused and thorough coverage, addressing the specific needs of each category.

2. **Effective Use of Digital Tools:**
   - Ensuring that the introduction of digital VR and gamification apps is comprehensive yet concise, with additional independent practice opportunities, can help manage time constraints during formal instruction.

3. **Balance and Allocation of Time:**
   - Reassessing the time allocation for various topics in Module 3:
     - **Nutrition and Reproduction:** These topics may require more than 4 hours for thorough coverage.
     - **Feeding Regime:** Consider merging this with nutrition and adjusting the allocated time accordingly.
     - **Omics Technologies:** Reducing the time allocated for omics technologies might be beneficial, redistributing it to more critical areas.

4. **Adapting to Different Skill Levels:**

- Offering adjustable course durations or creating different groups based on participant skill levels can help ensure that the training is effective and relevant for all participants, from unskilled workers to those with advanced degrees.

Conclusion

While most respondents do not foresee significant challenges, several specific concerns were raised about the balance and time allocation within the curriculum, such as:

- Splitting complex topics for more detailed coverage,
- Ensuring effective use of time for digital tools,
- Rebalancing time allocations within Module 3,
- Adapting to the course for different skill levels.

Competency Expectations

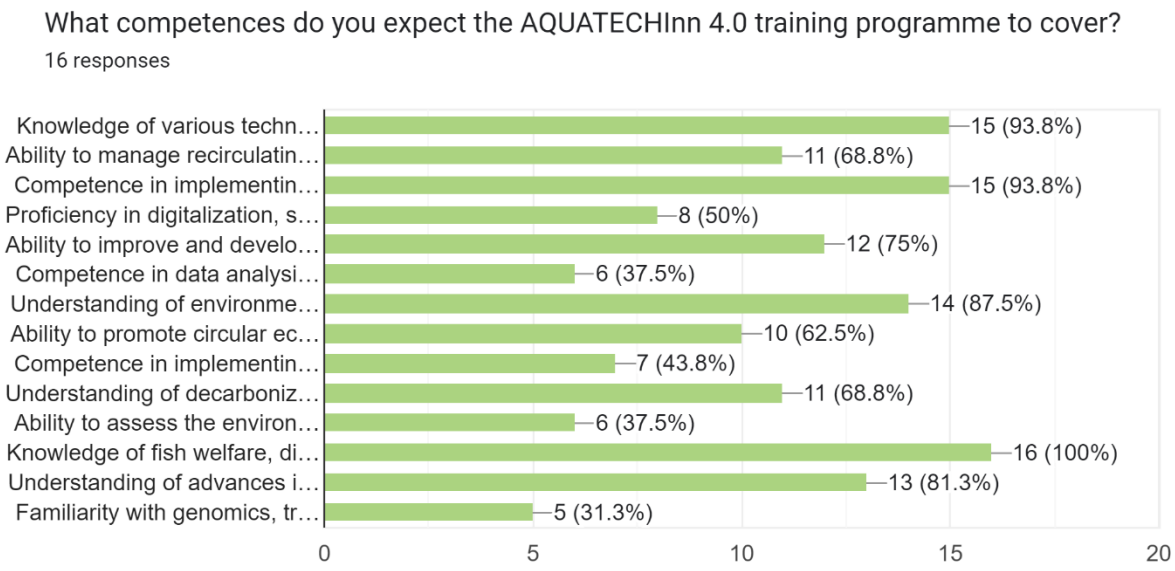

Figure 2. Distribution of the answers to each question. Included the percentage for each question.

Based on the 16 responses provided, the expected competences for the AQUATECHInn 4.0 training programme can be summarized as follows:

Knowledge of Various Aquaculture Technologies: (93.8%)

Understanding the application of technologies in marine, freshwater, and brackish water environments. The high percentage of responses underscores the critical importance of technological proficiency in diverse aquaculture settings.

Management of Recirculating Aquaculture Systems (RAS) and Hatchery Trends: (68.8%)

Ability to manage RAS and stay updated on hatchery trends. While a significant proportion of respondents recognize the importance of this competence, further emphasis may be warranted to ensure comprehensive coverage.

Implementation of Intelligent Aquaculture Practices: (93.8%)

Proficiency in utilizing advanced sensor systems and intelligent aquaculture practices. The overwhelmingly positive response highlights the critical role of technology in enhancing efficiency and productivity within aquaculture operations.

Digitalization and Automation Skills: (50%)

Competence in digitalization, automation, and drone/robot usage. While this competence is recognized by half of the respondents, efforts may be needed to emphasize its significance in driving innovation and competitiveness in aquaculture.

Innovation and Development of Culture Systems: (75%)

Ability to innovate and develop new culture systems. The substantial agreement on the importance of this competence underscores its pivotal role in driving sustainability and adaptation to evolving industry needs.

Data Analysis and Development Planning: (37.5%)

Competence in data analysis and development planning. While fewer respondents highlighted this competence, its importance in informed decision-making and strategic planning cannot be overstated, warranting attention on the training programme.

Understanding of Environmental and Sustainability Issues: (87.5%)

Knowledge of environmental, social, and economic issues and sustainable practices. The overwhelming consensus on the importance of sustainability reflects the industry's increasing focus on responsible practices and resource conservation.

Promotion of Circular Economy Principles: (62.5%)

Ability to promote circular economy principles and bioeconomy. While a majority recognize the importance of circularity, further emphasis may be needed to ensure widespread adoption and integration into aquaculture practices.

Implementation of Integrated Multi-Trophic Aquaculture (IMTA) Techniques: (43.8%)

Competence in implementing IMTA techniques for sustainability. While fewer respondents highlighted this competence, its potential to enhance resource efficiency and mitigate environmental impacts merits attention in the training curriculum.

Decarbonization Strategies and Alternative Energy Sources: (68.8%)

Understanding of decarbonization and alternative energy sources. The significant agreement on the importance of sustainability and energy transition underscores the industry's commitment to reducing carbon footprint and dependence on fossil fuels.

Assessment of Environmental Footprints: (37.5%)

Ability to assess environmental footprints through LCA. While fewer respondents emphasized this competence, its role in guiding sustainable practices and informing decision-making warrants consideration in the training programme.

Understanding of Animal Health and Welfare: (100%)

Knowledge of fish welfare, disease prevention, and biosecurity. The unanimous agreement on the importance of animal health underscores its fundamental role in ensuring ethical practices and safeguarding industry reputation.

Advances in Nutrition and Reproduction Techniques: (81.3%)

Understanding of nutrition, feeding strategies, and reproduction techniques. The majority recognition of this competence reflects its significance in optimizing production efficiency and ensuring animal welfare.

Familiarity with Omics Technologies: (31.3%)

Basic familiarity with omics technologies. While fewer respondents highlighted this competence, its potential to drive innovation and deepen understanding of biological processes may warrant further exploration in the training programme.

Perspectives on the Adequacy of Course Content for Achieving Competences

Based on the responses provided, there is a mix of opinions regarding the sufficiency and adequacy of the current course content to achieve the expected competences. While some respondents express confidence in the existing content, others highlight potential limitations in coverage or suggest a need for specialization and depth in certain topics. Below is a summary of the responses:

1. **Positive Responses:**
   "Yes"
   "Exactly yes"
   "Completely."
   "I do"

2. **Concerns about Coverage:**
   "To cover all the topics, the time is not enough. It is best to specialize and go more in depth of three/four topics."

These responses suggest that while some respondents believe the current course content is sufficient and adequate, others express reservations about the depth and coverage of certain topics within the given timeframe. This feedback indicates a potential need for further evaluation and adjustment of the course content to ensure comprehensive coverage and effective attainment of the expected competences.

Feedback on Course Content Alignment

Based on the responses provided, most respondents did not offer additional comments or suggestions regarding the alignment of the course content with the expected competences. One respondent explicitly mentioned deferring to domain experts for opinions on alignment, while another expressed satisfaction with the existing content and deemed additional additions unnecessary. These responses suggest a general acceptance of the current course content and alignment with the expected competences among the respondents.

Relevance to Standards

Assessment of Course Relevance to Industry Standards

Based on the responses provided, there is a strong consensus among respondents that the proposed topics adequately address industry standards and requirements in different countries. Most respondents affirm the alignment of the course content with industry standards, expressing confidence in its ability to meet the needs of the aquaculture sector. Some respondents even believe that the course exceeds national standards, indicating its comprehensive coverage and relevance.

However, one respondent from Türkiye raises a specific concern regarding the applicability of certain topics to their country's aquaculture practices. They highlight that shellfish culture is not common in Türkiye, and the use of high technology is limited in the sector. This suggests a potential challenge in effectively transferring complex information to sectors with varying technological capacities and practices.

Overall, respondents perceive the course as valuable and impactful, providing added value to the aquaculture sector. This feedback underscores the importance of tailoring course content to accommodate diverse industry standards and practices while ensuring relevance and applicability across different countries and contexts.

Suggestions for Addressing Specific Standards and Regulations in Course Content

Based on the responses provided, there is a range of opinions regarding the inclusion of specific standards or regulations within the course content. While some respondents express no explicit need for additional standards, others offer suggestions for consideration. These suggestions include:

- Sustainability and Welfare Certifications: Emphasizing certifications related to sustainability and animal welfare, reflecting the industry's increasing focus on ethical and responsible practices.
- Existing Regulations: Addressing existing regulations such as Real Decreto 1585/2011 and Orden ECD/306/2012 in Spain, which establish the minimum teachings for technical training in aquaculture.
- Efficiency in Farm Operations: Incorporating lectures and practices to explain efficiency in farm operations, reflecting practical aspects of aquaculture management.
- Local Legislation: Including information on local legislation pertaining to aquaculture operations in each country, such as licensing requirements and governmental agencies to consult.

Comprehensive Coverage

Consensus on the Comprehensive Coverage of Proposed Topics

Based on the responses provided, there is unanimous agreement among respondents that the combination of proposed topics offers a comprehensive overview of the subject matter. The respondent's express confidence in the breadth and depth of the topics covered, affirming that they collectively provide a well-rounded understanding of aquaculture-related concepts and practices. While some respondents acknowledge previous suggestions for consideration, the overall sentiment is overwhelmingly positive regarding the comprehensiveness of the proposed topics. This consensus underscores the effectiveness of the course content in addressing key aspects of aquaculture education and training.

Consensus on Adequacy of Topic Coverage

Based on the responses provided, most respondents perceive no significant gaps in the coverage of topics within the course content. While some suggest that the current coverage is sufficient for an initial step, others express contentment with the breadth of topics addressed. However, a few respondents offer minor suggestions for enhancement, such as considering additional topics raised previously or providing more specific focus within certain areas, such as circular economy or fish nutrition and feed formulation. Overall, the responses indicate general satisfaction with the comprehensiveness of the course content, with minimal gaps in topic coverage.

Adaptability and Flexibility

Perceptions on the Adaptability of Course Topics

The responses regarding the adaptability of course topics to accommodate diverse learner backgrounds and needs vary. While some respondents express confidence in the breadth and depth of the topics covered, believing they adequately address the diverse needs of learners, others find it challenging or suggest the need for more flexibility and modularity.

Some respondents emphasize the importance of flexibility in adjusting the course to meet the varying backgrounds and skill levels of learners. Some suggest modifying the duration of topics based on learners' prior knowledge or experience. Others stress the need for the lecturer's expertise to match the diverse needs of learners, highlighting the significance of instructor quality in facilitating adaptability.

Overall, this feedback underscores the importance of considering diverse learner needs and employing flexible approaches to ensure effective education and training in aquaculture.

Perspectives on Customization and Specialization Options within Course Topics

The responses regarding the implementation of customization or specialization options within certain topics vary among respondents. While some express strong support for such options to cater to individual interests and needs, others are more reserved or skeptical about the feasibility and effectiveness of customization.

Proponents of customization emphasize the importance of offering flexibility and additional resources for learners to delve deeper into specific areas of interest. They believe that customization can enhance the learning experience and provide opportunities for further exploration.

However, some respondents express concerns about the practicality of customization within the course structure. They suggest that customization may be challenging to implement effectively or may lead to potential boredom or unproductivity, particularly for instructors.

Overall, this feedback underscores the need for careful consideration and planning to ensure that customization options align with the goals and constraints of the course.

Overall Assessment

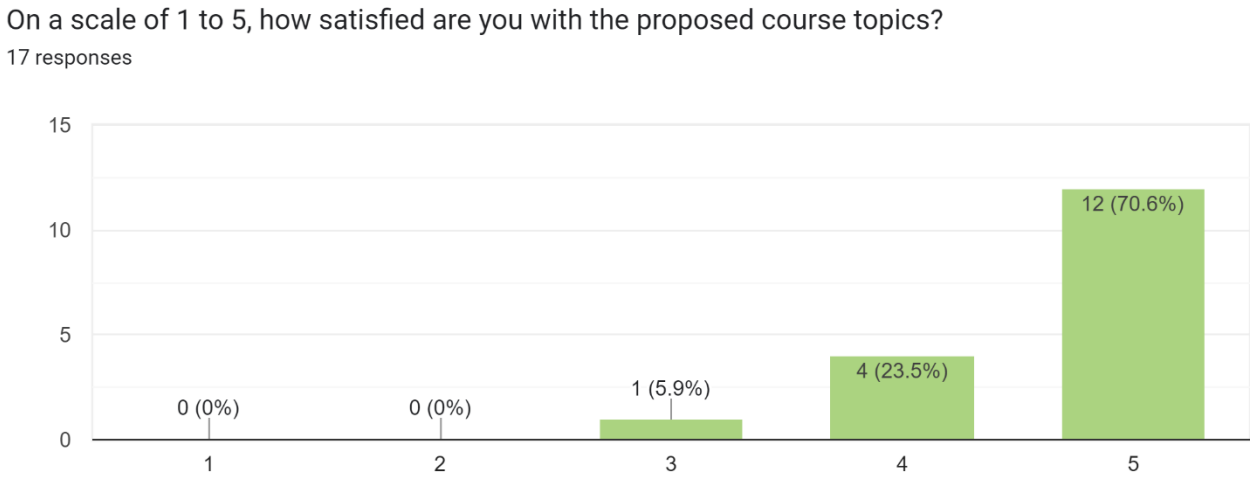

Figure 3. Distribution of the answers to overall satisfaction with the proposed course topics.

Based on the responses provided, most respondents express high levels of satisfaction with the proposed course topics. Out of 17 responses, 12 respondents (70.6%) rated their satisfaction with a

score of 5, indicating a high degree of contentment. Additionally, 4 respondents (23.5%) rated their satisfaction with a score of 4, signifying a positive assessment of the topics.

Only 1 respondent (5.9%) rated their satisfaction with a score of 3, suggesting a moderate level of satisfaction.

Overall, the positive responses indicate a strong endorsement of the proposed course topics, highlighting their relevance, comprehensiveness, and alignment with the needs of learners in the aquaculture sector.

2.7 Conclusions

The survey indicates strong satisfaction with the proposed course topics, with minor suggestions for improvement and considerations for enhancing adaptability and customization. More specifically:

- **High Satisfaction:** Most respondents (82.4%) expressed high levels of satisfaction (rated 4 or 5 out of 5) with the proposed course topics. This indicates strong endorsement and approval of the content.
- **Comprehensive Coverage:** Respondents generally perceive the course topics as comprehensive, covering a wide range of relevant areas in aquaculture education and training.
- **Adaptability:** While some respondents suggested the need for customization or specialization options within certain topics, overall, there is a perception that the course topics are adaptable to accommodate diverse learner backgrounds and needs.
- **Minimal Gaps:** Most respondents did not identify significant gaps in the coverage of topics, indicating that the proposed content is perceived as adequate for achieving the intended learning objectives.
- **Customization:** While opinions varied, there is some support for the inclusion of customization or specialization options within certain topics to cater to individual interests and needs.
- **Suggestions for Enhancement:** A few respondents offered suggestions for enhancement, such as providing more specific focus within certain areas.
- **Challenges Identified:** Some respondents highlighted challenges, such as the difficulty of addressing diverse learner backgrounds.

Annex I

The survey which was prepared in English is shown below:

Aquaculture Programme Certification Analysis and Alignment Questionnaire (T2.5)

Dear AQUATECHinn 4.0 partners,

This questionnaire is a component of the AQUATHECHInn 4.0 project, designed to elevate the European aquaculture sector by enhancing skills and quality in line with market demands. Through digital diagnostics and innovative education, it modernizes traditional processes, optimizing growth, health, and welfare factors. It fosters technological advancements and sustainability to improve industry performance, create jobs, and enhance economic contributions. Moreover, it aims to connect education, training, and businesses to further professionalize the sector and improve labor market access.

We are initiating this survey endeavor to examine certification processes of Aquaculture Programmes across various countries. The goal of this survey is to effectively standardize our program by aligning it with established requirements.

We kindly request your participation in this endeavor by responding to the questionnaire below. Please adhere to the provided instructions and assign a vote to each question using the following scale:
1 = Strongly Agree, 2 = Agree, 3 = Undecided, 4 = Disagree, 5 = Strongly Disagree.

Your valuable contributions will greatly assist in adapting the Aquaculture Programme to meet diverse country-specific standards. Thank you for your participation.

General Information:

Name of the institution/organization

.....

Country

- ◯ Spain
- ◯ Portugal
- ◯ Italy

- ◯ Turkey
- ◯ France
- ◯ Greece

Proposed Course Topics:

Module 1: New Technologies in Finfish and Shellfish Aquaculture

Please rate the relevance of each of the proposed course topics to the overall objectives of the AQUATECHinn 4.0 project.

1. Technologies applied to fish and shellfish farming in marine, freshwater and brackish water aquaculture (9 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

2. Management of a Recirculating Aquaculture Systems RAS (Recirculating Aquaculture Systems) and Integrated partial recirculation systems (fresh water) (8 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

3. New trends in the technological management of hatcheries (6 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. Intelligent aquaculture farms. "Precision Fish Farming" (PFF). Remote control technologies: use of advanced sensor systems for monitoring culture parameters (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. Digitalization, semi-automation and automation, use of drones/robots in farming and harvesting processes (5 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. Improvement and development of new culture systems, methodologies, materials and engineering (3 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Data analysis and business/development planning (included the use of EU Grants: EMFAF and other R&D founding tools for SME) (3 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. VR RAS (2 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Module 2: Sustainability Management in Aquaculture

Please rate the relevance of each of the proposed course topics to the overall objectives of the training course.

1. Environmental, social and economic issues linked to shellfish and finfish farming (5 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

2. Good practices for a sustainable management of shellfish and finfish farming (10 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

3. Boosting the circular economy, farmed aquatic food bioeconomy and blue biotechnology (10 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4.a Integrated Multi-trophic Aquaculture technique in shellfish farming (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4.b Integrated Multi-trophic Aquaculture technique in fish farming (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. Decarbonization and use of alternative sources of energy in aquaculture (2 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6.Environmental footprints of aquaculture activities and products through a Life Cycle Assessment (LCA) (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Sustainability App (Gaming) (1 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Module 3: Animal Health management and biosecurity, welfare, nutrition, and reproduction

Please rate the relevance of each of the proposed course topics to the overall objectives of the training course.

1. Fish welfare (on farm, transport, stunning and slaughter) (7 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

2. Disease prevention, biosecurity, therapeutics in aquaculture (8 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

3. Microbiological and chemical contamination and toxins in Aquaculture (8 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. Advances in fish and shellfish nutrition and reproduction (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. Feeding strategies: Frequency and duration of feeding, ration and consumption calculation, loss control, Conversion Factor Optimization, new feeding techniques (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. Production of New Species and domestication issues (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. Omics technologies in aquaculture: Genomics, transcriptomics, proteomics to explore function, mechanisms, interactions between genes, transcripts, proteins, lipids, and other biomolecules (4 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. VR Welfare (2 hours)

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Additional Topics and Potential Challenges

Are there any additional topics you believe should be included in the course curriculum?

……

Do you foresee any challenges in covering these topics within the allocated timeframe?

.....

Competency Expectations

- [ ] Knowledge of various technologies used in finfish and shellfish aquaculture, including those applied in marine, freshwater, and brackish water environments.
- [ ] Ability to manage recirculating aquaculture systems (RAS) and integrated partial recirculation systems, as well as familiarity with new trends in hatchery management.
- [ ] Competence in implementing intelligent aquaculture practices, including the use of advanced sensor systems for monitoring culture parameters.
- [ ] Proficiency in digitalization, semi-automation, and automation techniques, including the use of drones and robots in farming and harvesting processes.
- [ ] Ability to improve and develop new culture systems, methodologies, materials, and engineering techniques in aquaculture.
- [ ] Competence in data analysis and development planning, including the utilization of EU grants and other research and development funding tools for small and medium-sized enterprises (SMEs).
- [ ] Understanding of environmental, social, and economic issues related to aquaculture, as well as knowledge of good practices for sustainable management.
- [ ] Ability to promote circular economy principles, farmed aquatic food bioeconomy, and blue biotechnology in aquaculture.
- [ ] Competence in implementing IMTA techniques in both shellfish and finfish farming for sustainable aquaculture practices.
- [ ] Understanding of decarbonization strategies and the utilization of alternative sources of energy in aquaculture operations.
- [ ] Ability to assess the environmental footprints of aquaculture activities and products through Life Cycle Assessment (LCA).
- [ ] Knowledge of fish welfare, disease prevention, biosecurity measures, and therapeutic interventions in aquaculture.
- [ ] Understanding of advances in fish and shellfish nutrition, feeding strategies, and reproduction techniques.
- [ ] Familiarity with genomics, transcriptomics, proteomics, and other omics technologies for exploring biological functions and interactions in aquaculture.

Do you consider that the current course content is sufficient and adequate to achieve these competences?

……

Please share any additional comments or suggestions regarding the alignment of the course content with the expected competences.

……

Relevance to Standards

Do you believe the proposed topics adequately address industry standards and requirements in different countries?

……

Are there any specific standards or regulations that you think should be explicitly addressed within the course content?

……

Comprehensive Coverage

Do you think the combination of proposed topics provides a comprehensive overview of the subject matter?

……

Are there any gaps in the coverage of topics that you think need to be addressed?

……

Adaptability and Flexibility

How adaptable do you think the course topics are to accommodate the diverse backgrounds and needs of learners?

……

Do you think there should be options for customization or specialization within certain topics?

……

Overall Assessment

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree