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SKILLS4WATER

STANDARDIZED FRAMEWORK FOR INTEGRATING SOFT SKILLS INTO THE HIGHER EDUCATION CURRICULA FOR WATER MANAGEMENT

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Executive Summary

The water industry requires a highly skilled workforce capable of adapting to the evolving market and societal needs, which includes appropriate training in soft skills. To tackle future challenges, the European Commission aims to upskill the workforce to address skill shortages, prompting research projects like Skills4Water. This project focuses on integrating soft skills training into higher education curricula bridging the gap between the academic training and the water industry demands.

The project's Work Package 2 aims to align academic offerings with industry needs to enhance workforce competencies. This includes evaluating soft skills in the European water sector (Activity A2.1) by surveying stakeholders (education institutions, industry, regulatory bodies) and categorizing skills into personal, interpersonal, and situational. The findings, summarized in a comprehensive report (deliverable D2.1), outline the key soft skills needed in the sector and hence were used as the basis for developing a standardized framework for integrating soft skills into higher education curricula for water management (Activity A.2.). This aims to provide a strong educational base for the future development of water related soft skills and competences.

The framework development was carried out through two sub activities. First, existing curricula within the participating higher education institutions were evaluated to identify gaps in the coverage of the selected soft skills. Then, a common framework was developed for those soft skills based on the literature review of existing frameworks for integrating soft skills into curricula.

The evaluation report produced will be an important input for the practical guidance development (Activity A2.3). This framework will also serve as a basis for further activities of the Skills4water project, such as designing the learning activities to be included in the classroom (A3.1.) and innovative training programmes (Activity 4.1.).

By implementing this framework, the Skills4Water project aims to significantly enhance the readiness and adaptability of the future water sector workforce, ensuring they are well-equipped to meet the industry's evolving demands.

List of Abbreviations and Acronyms

Abbreviation/Acronym	Meaning
ACEEU	Accreditation Council for Entrepreneurial and Engaged Universities
CBHE	Capacity Building in Higher Education
EACEA	Education, Audiovisual and Culture Executive Agency
EU	European Union
H2O-People B.V.	Personal development organisation
HEIs	Higher Education Institutions
IPS	Interpersonal skills
LLL	Lifelong learning
MOOC	Massive online open courses
PES	Personal skills
SG	Serious games
SIS	Situational skills
SOS	Soft skills
UCA	University of Cádiz
UGAL	“Dunarea de Jos” University of Galati
UNI	University of Niš
VR	Virtual reality
WP	Work Package
WRM	Water Resources Management

1. Introduction

The water industry sector requires a highly skilled workforce able to learn and adapt to the continuously evolving needs of the market and society in general. Currently, the sector is experiencing a growing disparity between the labour market demand and the availability of adequately trained professionals. While the need for training in hard skills has been thoroughly addressed (e.g., SoftSkills4eu), the importance of soft skills is gaining increased attention and recognition.

To overcome future challenges, the European Commission has set an ambitious objective of upskilling the European workforce to address skill and occupation shortages. This has led to numerous research projects focusing on the development of frameworks to introduce soft skills training as part of the higher education curricula (e.g., SoftSkills4eu, CoSki21), as well as on finding the gaps between the higher education training and the demands of the non-academic sector. For example, one of the main objectives of the SEA-EU DOC project, involving the University of Cádiz, was to identify the labour market needs to boost career opportunities for doctoral alumni in marine and maritime sciences. According to this project, the most important soft skills identified were innovation and creativity, teamwork, complex problem resolution, leadership, and flexibility.

The main objective of the SkillsS4Water project is to equip students and young water professionals with essential soft skills, integrate them into higher education curricula, promote innovation and leadership in the European water industry, and disseminate related best practices across Europe. The project's work package 2 (WP2), ***Needs Assessment and Framework Development***, aims to bridge the gap between the water industry needs and the academic offerings, ultimately enhancing competencies and innovativeness of the workforce in the water sector.

To accomplish the specific objectives of WP2, three complementary activities were designed. Activity A2.1. *Evaluation of soft skills in the European water sector* was focused on identifying the most important soft skills within the European water sector. Four categories of stakeholders within the water sector were considered (higher education institutions, industry, water regulatory bodies and other sectors) to analyse their needs for soft skills. This was achieved through an online survey and various focus groups, classifying the soft skills into three groups, namely personal, interpersonal, and situational skills, following the literature review previously conducted.

A comprehensive *Evaluation report of soft skills in the European water sector*, including the results of the surveys and focus groups, was presented in Deliverable D2.1. The deliverable includes a description of all the soft skills considered. The most important skills identified per category are summarised in Table 1.

Table 1.Most important soft skills derived from the survey and focus groups conducted during A2.1.

PERSONAL	INTERPERSONAL	SITUATIONAL
Responsibility	Teamwork	Problem-solving
Motivation	Communication	Flexibility/Adaptability

Activity A2.2. *Framework development* aims to create a standardized framework for integrating soft skills into higher education curricula for water management. This framework will provide a robust

educational base for the future development of soft water related skills and competences. The framework development will be conducted through the following two sub activities:

- **A2.2.1.** *Reviewing existing curricula and identifying gaps in the coverage of soft skills*. Each of the three participating HEIs will review the curricula of at least two subjects taught at degrees related with water management. The goal is to identify gaps in the coverage of soft skills.

- **A2.2.2.** *Identifying best practices for integrating soft skills into curricula, drawing from existing frameworks and successful programs in other industries*. This sub-activity will involve drawing from existing frameworks and successful programs in other industries. A literature review will support the development of this activity.

These activities will be conducted based on the six specific soft skills shown in Table 1.

3. Methodology

3.1 Activity A2.2.1. Reviewing existing curricula and identifying gaps in the coverage of soft skills.

3.1.1 University of Cádiz

The University of Cádiz (UCA) has selected several subjects taught in various degrees within the water sector, covering the three levels of degrees indicated in Section 3.2 below, i.e., bachelor, master, and doctorate. Each subject's curriculum was evaluated to identify gaps in the coverage of the six soft skills selected. Specifically, missing or poorly covered skills were identified and recommendations for their implementation or improvement were made whenever the inherent characteristics of the subject (e.g., number of students, nature: theoretical, practical, etc.) allowed it, following the flowchart shown in Figure 1.

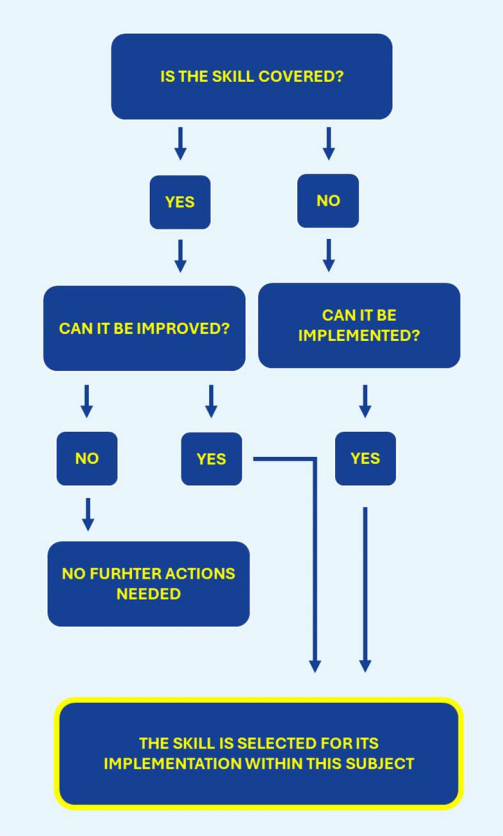

Figure 1. Schematic representation of the methodology used to select subjects for curricula evaluation.

The possibility of skills implementation in the subjects selected at UCA are summarized in Tables 2-4 below.

Subject 1: 42306006 - Physics
Degree: Bachelor's degree in environmental sciences
Faculty: Faculty of Marine and Environmental Sciences
Course: 1st year, second semester
Type: Basic training
ECTS: 6.00
Approximate number of enrolled students: 120
Type of face-to-face activities: Theory lessons, problem-solving seminars, laboratory practices
Number of lecturers: 2

Table 2. Review of the existing curricula in the subject 42306006 - Physics.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	No	Yes	Yes	Yes	No
Need of improvement	Yes	-	Yes	Yes	Yes	-
Possibility of implementation	Yes	Yes	Yes (in the laboratory and seminars)	Yes (in the laboratory)	Yes	No

Subject 2: 2370902 - Entrepreneurship and innovative projects
Degree: University master's degree in conservation and management of the natural environment
Faculty: Faculty of Marine and Environmental Sciences
Course: 1st year
Type: Compulsory
ECTS: 2.50
Approximate number of enrolled students: 10-20
Type of face-to-face activities: Theory lessons, problem-solving workshops
Number of lecturers: 3

Subject 3: 2371902 - Entrepreneurship and innovative projects
Degree: University master's degree in aquaculture and fisheries
Faculty: Faculty of Marine and Environmental Sciences
Course: 1st year
Type: Optional
ECTS: 5.00
Approximate number of enrolled students: 10-20
Type of face-to-face activities: Theory lessons, computer laboratory lessons
Number of lecturers: 8

Subject 4: 2373903 - Entrepreneurship and innovative projects
Degree: University master's degree in integrated management of coastal areas
Faculty: Faculty of Marine and Environmental Sciences
Course: 1st year
Type: Optional
ECTS: 2.00
Approximate number of enrolled students: 10-20
Type of face-to-face activities: Theory lessons, problem-solving workshops
Number of lecturers: 3

Due to the similarities in the structure of subjects 2-4, the analysis regarding the possibility of implementing the present framework is jointly summarized in Table 3.

Table 3.Review of the existing curricula in the subjects 2370902, 2371902, and 2373903 - Entrepreneurship and innovative projects.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes	Yes	Yes	Yes	Yes	Yes

Subject 5: How to captivate your audience: effective communication skills for scientists.
Degree: Doctoral degree program
Faculty: Faculty of marine and environmental sciences
Course: Any course
Type: Basic training
ECTS: 1.00
Approximate number of enrolled students: 20
Type of face-to-face activities: Theory lessons, workshops

Table 4.Review of the existing curricula in the doctorate course How to captivate your audience: effective communication skills for scientists.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	No	Yes	No	No
Need of improvement	-	-	Yes	-	-	-
Possibility of implementation	Yes	Yes	Yes (workshops)	Yes (in the laboratory)	No	Yes (workshops)

Apart from the selected subjects, the *Symposium of students of the Faculty of Marine and Environmental Sciences* (SACMA) has been chosen for the implementation of soft skills. SACMA is an annual symposium organized by faculty members since 2015. It is structured as a scientific workshop, where all the participants are students (final-year BSc students, MSc, or doctoral students) who present their research work as either a poster (including a 5-minute talk), an oral presentation or a short video clip. Sessions include a panel of professors who evaluate the students' abstracts, posters and/or oral presentations, ask questions and provide feedback. The purpose is to assess the student's communication skills (written and oral). Furthermore, we will integrate the current framework (Personal Skills: Responsibility & Motivation and Interpersonal Skills: Teamwork & Communication) into future editions of SACMA.

3.1.2 University of Niš

The University of Niš (UNI) has selected four subjects taught in various degrees within the water related sector, covering the two levels of degrees indicated in Section 3.2, i.e., bachelor and master. Each subject's syllabus was analysed to identify gaps in the coverage of the six soft skills selected. Specifically, missing or poorly covered skills were identified and recommendations for their implementation or improvement were made whenever the inherent characteristics of the subject (e.g., number of students, nature: theoretical, practical, etc.) allowed it, following the flowchart shown in Figure 1. The analysis of the syllabus of the courses was carried out based on the formally stated content of each course syllabus, but also on the elements of teaching realization that are inherent within the topics covered by specific units of theoretical and practical lessons. It is important to keep in mind that the organization of teaching classes at HEIs in the Republic of Serbia also implies the creation of a dynamic plan for the implementation of teaching classes for each school year, within which certain soft skills are directly or indirectly processed.

The possibilities of soft skills implementation in the subjects selected at UNI are summarized in Tables 5-8 below.

Subject 1: Water protection
Degree: Bachelor's degree in environmental engineering
Faculty: Faculty of Occupational Safety
Course: 3rd year, second semester
Type: Obligatory
ECTS: 6.00
Approximate number of enrolled students: 20 - 25
Type of face-to-face activities: Theoretical lessons, auditory, computational and laboratory exercises, problem-solving seminars, field trip.
Number of lecturers: 1

Table 5.Review of the existing curricula in the subject Water protection.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout seminar work)	Yes (Throughout seminar work)	Yes (in the laboratory work and seminar work)	Yes (in the laboratory work and seminar work)	Yes (Throughout problem-solving seminars)	Yes (Throughout case studies and field trip)

Subject 2: Public utilities
Degree: Bachelor's degree in environmental engineering
Faculty: Faculty of Occupational Safety
Course: 3rd year, second semester
Type: Elective
ECTS: 6.00
Approximate number of enrolled students: 10 - 15
Type of face-to-face activities: Theoretical lessons, auditory and computational exercises, case-study analysis, seminars, field trip.
Number of lecturers: 1

Table 6.Review of the existing curricula in the subject Public utilities.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout seminar work)	Yes (Throughout seminar work)	Yes (In the seminar work)	Yes (In the seminar work)	Yes (Throughout problem-solving seminars)	Yes (Throughout case studies and field trip)

Subject 3: Environmental management
Degree: Master's degree in environmental engineering/environmental management
Faculty: Faculty of Occupational Safety
Course: 1st year, first semester (environmental management), second semester (environmental engineering)
Type: Obligatory (environmental management), Elective (environmental engineering)
ECTS: 6.00
Approximate number of enrolled students: 15
Type of face-to-face activities: Theoretical lessons, auditory exercises, seminars.
Number of lecturers: 1

Table 7.Review of the existing curricula in the subject Environmental management.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	No	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (In the seminar work)	Yes (In the seminar work)	Yes (In the seminar work)	Yes (In the seminar work)	Yes (Throughout seminars)	Yes (Throughout seminars)

Subject 4: Hydroinformatics
Degree: Master's degree in civil engineering
Faculty: Faculty of Civil Engineering and Architecture
Course: 1st year, first semester
Type: Elective
ECTS: 5.00
Approximate number of enrolled students: 3-5
Type of face-to-face activities: Theoretical lessons, auditory exercises, computational examples, computer classroom, seminars.
Number of lecturers: 1

Table 8.Review of the existing curricula in the subject Hydroinformatics.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	No	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout theory lessons)	Yes (Throughout theory lessons)	Yes (in the seminar work)	Yes (in the seminar work)	Yes (Throughout workshops)	Yes (Throughout workshops)

3.1.3 University of `Dunarea de Jos` Galati - Romania

`Dunarea de Jos` University of Galati has selected four disciplines for both bachelor and master levels from two faculties with specializations in the water-related sector, as detailed in Section 3.2. The syllabi of these disciplines were examined in order to find gaps in learning of six specific soft skills. After gaps identification, recommendations for implementation or enhancement of these soft skills were made according to the flowchart shown in Figure 1. The research was based on the declared technically content of each course curriculum and teaching aspects.
The possibilities of soft skills implementation in the subjects selected at UGAL are summarized in Tables 9-12 presented below.

Subject 1: Bioengineering
Degree: Bachelor's degree in system engineering
Faculty: Faculty of Automation, Computers, Electrical Engineering and Electronics
Specialization: Automation and Applied Informatics
Course: 4th year, first semester
Type: Optional
ECTS: 2.00
Approximate number of enrolled students: Min 20
Type of face-to-face activities: Theory lessons, problem-solving seminars, laboratory practices
Number of lecturers: 1

Table 9.Review of the existing curricula in the subject Bioengineering.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout theory lessons)	Yes (Throughout theory lessons)	Yes (in the laboratory practices)	Yes (in the laboratory practices)	Yes (Throughout seminars)	Yes (Throughout laboratory practices and seminars)

Subject 2: Informatic systems for the advanced control of biotechnological processes
Degree: University master's degree in system engineering
Faculty: Faculty of Automation, Computers, Electrical Engineering and Electronics
Specialization: Advanced Control Information Systems
Course: Second year, first semester
Type: Basic training
ECTS: 5.00
Approximate number of enrolled students: Min 10
Type of face-to-face activities: Theory lessons, problem-solving seminars, laboratory practices
Number of lecturers: 1

Table 10.Review of the existing curricula in the subject Informatic systems for the advanced control of biotechnological processes.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout theory lessons)	Yes (Throughout theory lessons)	Yes (in the laboratory practices)	Yes (in the laboratory practices)	Yes (Throughout seminars)	Yes (Throughout laboratory practices and seminars)

Subject 3: Recirculating aquaculture systems
Degree: Bachelor's degree in animal husbandry
Faculty: Faculty of Food Science and Engineering
Specialization: Fisheries and Aquaculture
Course: 4th year, first semester
Type: Basic training
ECTS: 4.00
Approximate number of enrolled students: Min 8
Type of face-to-face activities: Theory lessons, problem-solving seminars, laboratory practices
Number of lecturers: 1

Table 11.Review of the existing curricula in the Recirculating aquaculture systems .

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout theory lessons)	Yes (Throughout theory lessons)	Yes (in the laboratory practices)	Yes (in the laboratory practices)	Yes (Throughout seminars)	Yes (Throughout laboratory practices and seminars)

Subject 4: Recirculating aquaculture system engineering
Degree: University master's degree in animal husbandry
Faculty: Faculty of Food Science and Engineering
Specialization: Aquatic bioresources science and engineering
Course: Second year, first semester
Type: Basic training
ECTS: 8.00
Approximate number of enrolled students: Min 10
Type of face-to-face activities: Theory lessons, problem-solving seminars, laboratory practices
Number of lecturers: 1

Table 12.Review of the existing curricula in the Recirculating aquaculture system engineering.

	Personal skills		Interpersonal skills		Situational skills	
	Responsibility	Motivation	Teamwork	Communication	Problem-solving	Flexibility / Adaptability
Skill covered	Yes	Yes	Yes	Yes	Yes	Yes
Need of improvement	Yes	Yes	Yes	Yes	Yes	Yes
Possibility of implementation	Yes (Throughout theory lessons)	Yes (Throughout theory lessons)	Yes (in the laboratory practices)	Yes (in the laboratory practices)	Yes (Throughout seminars)	Yes (Throughout laboratory practices and seminars)

3.2 Framework development

The European Qualifications Framework (EQF) is an eight-level framework based on learning outcomes that was designed to serve as a translation tool between different national qualifications frameworks and that covers all types and levels of qualifications (https://europass.europa.eu/en/europass-digital-tools/european-qualifications-framework). This way, the EQF not only helps to improve transparency, but also eases the comparability and portability of qualifications, making it possible to compare people's qualifications from different countries and institutions. By encompassing all levels and types of qualifications and by using learning outcomes, the EQF clearly states what an individual knows, what they understand, and what they can do. Furthermore, the level of proficiency increases from the lowest (level 1) to the highest (level 8) value.

The EQF was first established in 2008 and revised in 2017, but Member States have committed to further develop it with the aim of making it more efficient by facilitating the understanding of qualifications by employers, workers, and learners at the national, international, and third-country levels.
Considering that levels 6-8 refer to the University, the current "Standardized framework for integrating soft skills into the higher education curricula for water management" has been developed based on those three levels:

- **Level 6**: Advanced knowledge in a field of work or study that requires a critical understanding of theories and principles. Equivalent to a bachelor's degree (BSc). In our case, we will refer to

this level of knowledge as Sufficient (A).

- **Level 7**: Highly specialised knowledge, some of it at the forefront of a specific field of work or study, laying the foundations for original thinking or research. Equivalent to a master's degree (MSc). This level of knowledge will be referred to as Good (B).
- **Level 8**: Knowledge at the most advanced frontier of a specific field of work or study and at the intersection point between various fields. Equivalent to a doctoral degree. This level will refer to an Excellent (C) level of knowledge.

Therefore, each of the soft skills selected will include the three levels of proficiency mentioned above, following previous frameworks (i.e., SoftSkills4eu) and will refer to:

- The expected knowledge. In the context of EQF, knowledge is described as theoretical and/or factual.
- The elements needed to develop the skill, including other skills. In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive, and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).
- The competence, defined as the ability of the learner to apply knowledge and skills autonomously and with responsibility.

This information was included in tables like Table 3 below:

Table 13.Example of table.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level			
Good (B) Referring to MSc level			
Excellent (C) Referring to Doctorate level			

Experts meeting:

On the 26th of April, 2024, an experts meeting was held at the Faculty of Marine and Environmental Sciences (University of Cadiz, Spain) with the following agenda:

1. Presentation of the first draft of the "Standardized framework for integrating soft skills into the higher education curricula for water management"
2. Open debate among the experts to modify / improve the framework draft according to their experience and to agree on a final framework.

A total of 21 experts were invited to participate in the meeting, including faculty professors and headmasters, and representatives of research centres, private companies, and local authorities. However, only 4 people attended the meeting besides the project's team members, including: the Dean of the Faculty of Marine and Environmental Sciences (University of Cadiz), the Director of the Institute of Marine Sciences of Andalusia (ICMAN-CSIC), the head of the Department of Applied Research & Innovation at CTAQUA (a local, non-profit technological centre), and a full professor in Marine Biology (Biology Department, University of Cadiz). All the participants have a large experience in supervising BSc, MSc, and Doctoral students, hence being able to provide very useful feedback regarding the students' soft skills.

The framework agreed among all the participants is summarised in Tables 14-19 Section 4. Results).

Measures for continuous improvement:

The framework present in this document should be regularly reviewed based on the feedback obtained from stakeholders, changes in the industry needs within the water sector, and advances in educational research:

1- Feedback obtained from stakeholders: each participating HEI should regularly meet with local stakeholders that host students' internships to evaluate the outcomes of the framework implementation.
2- Universities like UCA organize regular workshops with the water sector industry in which researchers and lecturers are invited to participate. These workshops set the basis for future collaborations and the development of project proposals but can also serve as an open source of knowledge regarding changes in the industry needs that will be key for future improvements of the present framework.
3- Educational research projects are key to evaluate the degree of success in the implementation of soft skills, as well as to design the most up-to-date measures for their adaptation to the continuously changing industry needs. In this sense, universities like UCA participate actively in projects related with educational research, including Erasmus+ projects (e.g., Partnerships for Higher Education, Capacity building, etc.) or national projects. Furthermore, UCA has its own yearly call for funding for educational research projects, which can be used to review and improve the present framework beyond the Skills4water project timeline. Finally, UCA also provides a fully comprehensive list of training courses for lecturers that include the development of skills to improve the teaching methods (i.e. to motivate students, etc). Such courses can also assist in future evaluations of the present framework.

4. Results

Personal

Responsibility

Responsibility refers to an individual's ability to take ownership of their actions, decisions, and obligations. It involves **being responsible for one's own tasks, meeting deadlines and fulfilling commitments**. Responsible individuals demonstrate reliability, dependability, and a strong work ethic. This soft skill contributes to the success of teams and organisations by consistently delivering high-quality work and by actively seeking ways to improve processes and outcomes. Overall, responsibility is a fundamental aspect in both personal and professional contexts. A multidisciplinary examination, integrating insights from psychology, neuroscience, and social science, is pivotal in comprehensively grasping the development and manifestation of responsibility across diverse settings.

The soft skill responsibility can be seen from 3 different points of view: ethical, environmental, and professional (Skills-4U, 2017). Ethical responsibility entails guiding human behaviour based on rational considerations, particularly concerning the ethical implications of actions. Environmental responsibility involves the ability to assess the positive or negative ecological impacts of decisions, encompassing harm inflicted on other species, the environment, or future generations by an individual or group's actions or inactions. Professional responsibility is an integral component of moral responsibility and serves two main purposes, namely avoiding intentional wrongdoing and minimising inadvertent offences resulting from personal limitations, inherent weaknesses, or the negligence of others.

The corresponding syllabus has been summarized in Table 14.

Table 14.Syllabus of soft skill: Responsibility.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level	Comprehension of the concepts of responsibility.	· Prioritisation · Adaptability · Organisation · Punctuality · Self-criticism · Respect · Decision making	· Be able to know the implication of the actions, decision, and obligations. · Be able to recognise the responsibility for the activities in which they are involved. · Be able to meet deadlines and set objectives, demonstrating responsibility in assigned tasks.
Good (B) Referring to MSc level	Advance comprehension of the concepts of responsibility and implications of decision making.	· Self-management · Goal setting · Critical thinking	· Be able to do active decision making and be awareness of implications. · Be able to show initiative in perform activities.
Excellent (C) Referring to Doctorate level	Full comprehension of the concepts and implications of responsibility and know how to apply the concepts in the team framework.	· Leadership, Problem solving Teamwork	· Be able to do an active management of own and team responsibilities. · Be able to being proactive in decision making.

**Knowledge, skills, and competencies on subsequent levels include those from previous levels.*

Motivation

Assessing **motivation** as a soft skill is essential to understand the level of commitment, dedication, and willingness of individuals in a work or educational environment. This allows for identifying strengths and areas for improvement, as well as designing effective strategies to enhance the motivation and performance of individuals and teams. Moreover, Vera-Millalén (2016) describes motivation as one of the most important skills that employers look for professionals, and they conclude that this skill, among others, should be included in the curriculum of higher-education to prepare students to face challenges in a changing world.

In the SKILLS4WATER initiative, motivation plays a pivotal role in equipping individuals with the necessary drive to acquire and hone essential soft skills, such as communication, teamwork, problem-solving, and adaptability. By integrating motivation into higher education curricula, the project aims to inspire and empower future water professionals to embrace challenges, seek opportunities for growth, and strive for excellence in their endeavours. Furthermore, motivation serves as a catalyst for fostering innovation and driving positive change within the water sector. By nurturing a culture of motivation among students and young professionals, the initiative seeks to cultivate a skilled workforce capable of addressing complex water-related challenges and contributing to the development of sustainable and resilient water systems across Europe.

Within the framework of evaluating soft skills, motivation underscores a candidate's capacity to self-initiate, persevere, and adapt in dynamic environments characterised by diverse stakeholders, competing priorities, and evolving contexts. It reflects a proactive mindset that transcends mere compliance with tasks, demonstrating a genuine enthusiasm and dedication to making a positive impact in addressing water challenges at local, regional, and global scales.

The corresponding syllabus has been summarized in Table 15.

Table 15.Syllabus of soft skill: Motivation.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive, and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level	Understanding of theories and basic concepts of motivation, teamwork and proactiveness.	· Communication · Cooperation · Creative thinking · Holistic view · Willingness to learn · Self-confidence · Flexibility / Adaptability	· Be able to actively participate in group activities and projects, showing commitment and enthusiasm. · Be able to show initiative in tackling challenges and seeking creative solutions. · Being proactive in seeking opportunities for learning and personal growth.
Good (B) Referring to MSc level	Advanced knowledge of theories and models of motivation, implications of decisions, critical thinking and resilience.	· Problem-solving · Conflict management · Negotiation	· Be able to make informed and ethical decisions, considering the impact of their actions on the team and organisation. · Be able to critically evaluate their own performance and constantly seeking opportunities for improvement. · Be able to demonstrate resilience in the face of adversity and maintaining a high level of commitment and dedication.

Excellent (C) Referring to Doctorate level	Deep understanding of research and trends in motivation, leadership, and mentoring.	· Teamwork · Leadership · Mentoring · Responsibility	. Be able to lead teams, motivating and guiding members towards shared goals. · Be able to lead motivational research projects autonomously and responsibly, contributing to the advancement of knowledge in the field. · Be able to mentor other researchers and sharing knowledge and experiences for their professional development. · Be able to foster an inclusive and collaborative work environment, promoting the exchange of ideas and diversity of perspectives. · Be able to advocate for their ideas and perspectives constructively, based on evidence and solid arguments.

**Knowledge, skills, and competencies on subsequent levels include those from previous levels.*

Interpersonal

Teamwork

Teamwork is the collaborative effort of a group to achieve a common goal or to complete a task in an effective and efficient way. Teamwork is seen within the framework of a team, which is a group of interdependent individuals who work together towards a common goal. Teamwork is a cooperative skill that has an impact on interpersonal relations and ensures successful communication. Teamwork skills are very important because within work we face tasks that depend on a group of people rather than individuals. Since people are different, we have to take into account different work styles and be flexible and adaptable. In teams, we develop ideas and turn them into action, solving conflicts and facing up competition positively when necessary. Contacts with external partners are key for the development of companies and organisations, and thus, we have highlighted networking skills in this module.

The corresponding syllabus has been summarized in Table 16.

Table 16.Syllabus of soft skill: Teamwork.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level	What is the importance of teamwork. What are its key components and how to provide effective feedback.	·Emotional intelligence ·Flexibility ·Listen actively ·Motivation ·Communication	· Be able to work in a team to create value. · Be able to listen to other people's ideas. . Be able to contribute to simple activities. . Be able to establish new contacts and cooperation with others (individuals and groups). . Be able to express your own ideas.
Good (B) Referring to MSc level	Teamwork tools. Action plan elements. Techniques for managing relationships.	·Empathy ·Assertiveness ·Ability to delegate ·Planification	· Be able to work together with a wide range of individuals and groups to create value. · Be able to support diversity within their team. · Be able to give people the help and support they need to perform at their best within a team. · Be able to establish new relationships to get the support they need to turn ideas into action. · Be able to contact the right people to support their team activity. · Be able to express their ideas assertively. · Be able to show empathy towards others.

Excellent (C) Referring to Doctorate level	Techniques and tools to assess of team roles and performance. Team building techniques. Problem solving tools.	·Team building ·Content curator ·Problem solving ·Networking . Self-criticism	· Be able to build a team based on the individual knowledge, skills, and attitudes of each member. · Be able to manage conflicts effectively. · Be able to pull together information from a wide range of sources to understand their end users' needs. · Be able to design physical and virtual spaces that encourage team members to work together. · Be able to design working methods and incentives that enable team members to work well together. · Be able to assess the relative strengths and weaknesses of a team.

**Knowledge, skills, and competencies on subsequent levels include those from previous levels.*

Communication

Communication is the skill to effectively communicate ideas, information, and viewpoints with clarity and persuasion, both through spoken and written means, in an analogue or digital manner, while also actively listening and being open to the perspectives of others. For **communication** to be effective, it has to consider the social, cultural and physical context during which it occurs.

To transmit a message effectively, several key elements need to be identified and considered. First, there is the sender, who transmits the message, and the message itself, which is the content or subject of the communication that the sender needs to transmit. The receiver is the individual who receives and decodes the message. The context refers to the situation in which the message is sent, including the frame of reference that enables understanding, influenced by the receiver's level of knowledge. The code is the system of rules that allows the message to be formulated, such as the language chosen by the sender; for the message to be correctly interpreted, both the sender and receiver must understand this code. The channel is the medium that physically and psychologically connects the sender and receiver, enabling communication, with examples including written communication channels like email or text messaging or verbal like a talk or the radio or visual like images and posters. Finally, the feedback or response allows to evaluate whether the message came across as intended and was decoded effectively.

The corresponding syllabus has been summarized in Table 17.

Table 17.Syllabus of soft skill: Communication.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level	Importance of communication. Key components of effective communication. Communication tools How to select the appropriate message.	·Creativity ·Oral skills ·Identifying the message of the speech ·Interpersonal skills ·Wealth of language	·Be able to define the basic principles and importance of effective communication. ·Be able to construct and present simple messages by employing critical thinking. ·Identify the right tools and channels for transmitting a message.
Good (B) Referring to MSc level	Advanced techniques of effective communication. Theory behind designing effective communication. Use of different channels to transmit a message orally and written.	·Time-management skills ·Digital skills ·Teamwork ·Critical thinking ·Assertiveness ·Ability to accept criticism ·Accept feedback	·Be able to identify and analyse more complex and non-routine messages without guidance. ·Be able to transmit complex messages both verbally and in writing to the target audience. ·Be able to transmit persuasively messages of others (team). ·Apply the right tools and channels for transmitting a message.

Excellent (C) Referring to Doctorate level	Principles of psychology applied in communication. Listening to the audience and understanding messages transmitted.	·Listening skills ·Multicultural skills ·Emotional intelligence ·Motivation skills	·Be able to communicate both individually and within groups of different levels and cultures. ·Be able to tailor complex messages, ensuring that they are recalled in the future adequately. ·Be able to motivate and inspire the audience. ·Be able to listen actively and analyse the messages from the audience. ·Manage interactions with the audience under different contexts and situations, to overcome barriers or misunderstandings.

**Knowledge, skills, and competencies on subsequent levels include those from previous levels*

Situational

Problem-solving

Problem-solving has been identified as one of the most important soft skills from the employers' point of view when hiring new personnel (Cimatti, 2016; Skills-4U, 2017). Problems constitute new situations that require individuals to respond with innovative approaches. Thus, solving a problem implies carrying out tasks that often demand varying degrees of sophisticated reasoning, often surpassing mere routine actions. Problem-solving can hence be categorised as an intellectual soft skill closely linked to creativity, which involves utilising cognitive processes to address and resolve complex, interdisciplinary scenarios where the optimal solution is not readily apparent (Beltrán Sanz et al., 2021). This skill requires analysing situations, employing critical thinking, and making informed decisions to overcome challenges. By implementing solutions derived from structured problem-solving methods, individuals aim to overcome obstacles and constraints effectively. The goal of this competency is thus to enable students to accurately apply systematic problem-solving approaches, thereby enhancing their capacity to learn, comprehend, and independently apply knowledge. It must be pointed out that problem-solving skills are essential within the labour market, since they provide the know-how to solve internal problems, to deliver customer care, or to address issues with business associates (Beltrán Sanz et al., 2021). Within this context, multicultural skills are an asset to help problem-solving, since they can ensure establishing a better connection with colleagues and/or customers from different national or cultural backgrounds.

Within an educational context, teachers must be able to promote students' ability to solve problems on their own. The teacher can present a case study, i.e., a real problem, which the student must identify, analyse using qualitative or quantitative data, and provide the most appropriate solution. Therefore, assessing the learning outcomes linked to this skill may include problem examinations, writing a project or an essay, or through laboratory work (Beltrán Sanz et al., 2021). Many frameworks have been developed that include several identified soft skills, including problem-solving, such as the Digital Competence Framework for Citizens (Vuorikari et al., 2022).

The corresponding syllabus has been summarized in Table 18.

Table 18.Syllabus of soft skill: Problem solving.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility*
Sufficient (A) Referring to BSc level	Knowing techniques to identify simple problems. Knowing basic problem-solving techniques.	·Logical thinking skills ·Critical thinking ·Time-management skills · Open mind · Respect and tolerance with others' ideas ·Creativity	·Be able to identify and analyse simple routine problems with guidance. ·Be able to propose solutions to the problem by employing critical thinking, with guidance. ·Be able to make an informed decision to the problem with guidance.
Good (B) Referring to MSc level	Knowing techniques to identify complex problems. Knowing techniques to solve complex problems. Knowing advanced digital tools to solve complex problems.	·Self-criticism ·Efficiency ·Self-sufficiency	·Be able to identify and analyse more complex and non-routine problems without guidance. ·Be able to search for information and to propose solutions to the problem by employing critical thinking, without guidance.
Excellent (C) Referring to Doctorate level	Knowing teamworking techniques. Knowing team-management techniques.	·Interpersonal skills ·Listening skills ·Communication skills ·Multicultural skills	·Be able to help others to solve complex problems. ·Be able to integrate knowledge to contribute to professional practice by proposing new ideas. ·Be able to make an informed decision to the problem without guidance, working individually or collectively.

**Knowledge, skills, and competencies on subsequent levels include those from previous levels.*

Flexibility / adaptability

Flexibility/adaptability is a critical soft skill that can significantly enhance personal and professional effectiveness. This skill refers to the ability to adjust to new conditions and handle unexpected challenges with ease. Flexibility and adaptability as personal soft skills are essential qualities that can greatly improve one's ability to navigate various aspects of life, from daily interactions to significant life changes. These skills enable individuals to respond effectively to different situations and environments, making them more resilient and proactive. According to Forbes ´ *Adaptability is a willingness to confront or change your own ideas and preconceptions. Flexibility is more a willingness to "meet others halfway" procedurally*. ´ In the workspace flexibility and adaptability are important for other soft skills such as problem solving, innovation, team working and management (related with change management). Flexibility and adaptability are not only about responding to changes but also about proactively seeking improvements and being comfortable with the inherent uncertainty of most situations. Cultivating these skills can lead to more opportunities and greater success in all areas of life.

The corresponding syllabus has been summarized in Table 19.

Table 19.Syllabus of soft skill: Flexibility/Adaptability.

LEVEL	KNOWLEDGE	RELATED SKILLS & OTHER ELEMENTS	COMPETENCE
Levels are based on:	*In the context of EQF, knowledge is described as theoretical and/or factual.*	*In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).*	*In the context of the EQF, competence refers to responsibility and autonomy is described as the ability of the learner to apply knowledge and skills autonomously and with responsibility.*
Sufficient (A) Referring to BSc level	Understanding the concept of Flexibility and adaptability. Knowing different techniques to highlight flexibility and setting simple goals. Know-how to accept new ideas.	· Improving personal reliability qualities · Scenario planning and role-playing · Active listening · Holistic view · Self-criticism · Organizational capabilities · Willingness to learn	· Be able to set simple goals. · Be able to identify strengths and areas for improvement.

Good (B) Referring to MSc level	Understanding the elements of Flexibility and adaptability. Know different methods of setting complex goals. Identifying areas for improvement.	· Recognising features of a flexible person · Mental Agility · Problem solving resourcefulness · Team working · Critical Thinking · Role flexibility · Empathy · Accept criticism · Problem solving	· Be able to set complex goal. · Be able to learn actively. · Be able to improve flexibility and adaptability.
Excellent (C) Referring to Doctorate level	· Knowing different techniques to promote flexibility and adaptability to others. · Knowing different Leadership techniques.	· Overcoming obstacles to effective teamwork. · Conflict resolution · Emotional intelligence · Emotional Resilience · Empathy	· Strengthening respect in the team. · Fostering flexibility and adaptability among workers. · Be able to gain external perspectives on adaptability. · Leadership.

**Knowledge, skills, and competencies on subsequent levels include those from previous level.*

5. Conclusions

The water industry sector requires a highly skilled workforce capable of learning and adapting to the continuously evolving needs of the market and society. This requires adequate training in specific soft skills which are harder to learn within a traditional classroom than hard skills and are also more difficult to measure and evaluate.

Within this context, the Skills4water project has identified six essential soft skills for the water industry: responsibility, motivation, teamwork capacity, communication, problem-solving and flexibility and adaptability (Activity A2.1). The project has developed a framework to serve as a basis for implementing these soft skills in the higher education system. This framework encompasses the three EQF levels related to university education, i.e., bachelor, master, and doctorate, ensuring the continuous and progressive acquisition of the skills selected.

This framework is intended to be useful for future soft skills training, guidelines (activity A2.3 of this project), and potential pre-employment testing. Furthermore, the framework is flexible enough to allow for its revision and improvement as market and societal needs evolve with time.

The successful integration of these soft skills into higher education curricula will help bridge the gap between academic training and industry demands, fostering a more competent and adaptable workforce. The ongoing assessment and refinement of this framework will ensure that it remains relevant and effective in meeting the dynamic needs of the water industry.

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