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EU-CONEXUS Skills Survey Report

MS3
T3.1 DEVELOPMENT OF SIGNATURE JOINT MASTERS ON SMUCS
WORK PACKAGE THREE (WP3) JOINT SMUCS MASTER PROGRAMME DEVELOPMENT AND MICRO-CREDENTIAL DEVELOPMENT

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Executive summary/Abstract

A significant undertaking of Work Package Three, within the EU-CONEXUS+ project focuses on the development of a Signature Joint Masters on Smart Urban Coastal Sustainability (SmUCS) and 20 micro-credentials. The deliverables of the work package will be achieved through the development of new joint, flexible and innovative curricula based on inter-disciplinarity, and cross-sectoral approaches while focusing on student-centered learning and innovative pedagogies. This report seeks to identify the challenges and learning needs of the industries within our communities across the alliance. It aims to create an alignment between our education offerings and the skills required to deliver on the just green transition, as outlined by the European Green Deal (European Union, 2023).

To ensure that the specific focus areas of the new signature Joint Masters and micro-credentials are aligned with the needs of our communities and industry and the labour market across Europe, a skills survey was planned, designed, developed and rolled out across all nine EU-CONEXUS+ partner countries (Ireland, Croatia, Cyprus, Greece, France, Lithuania, Spain, Romania and Germany) in the period of February 2023 – December 2023. This survey, together with other analysis techniques including interviews and student focus groups and evaluation of national and European skills policy documents, was designed to capture labour market needs and inform the most in-demand topics for the SmUCS Masters and micro-credentials as well as other future educational offerings of EU-CONEXUS. Work Package Three Milestone three, as presented in this document starts with a brief overview of EU-CONEXUS, followed by information on the skills survey design, statistics and results following analysis of the responses from the skills survey.

Recognising the imperative of a fair and just green transition for employment and social progress, we further commit to exploring opportunities and embracing lifelong education approaches through integrating insights from the latest Green Competency Framework (Bianchi *et al*., 2022).

Introduction

1.1 Introduction

Milestone 3, which is featured in this document, is a report from the skills survey conducted across the EU-CONEXUS alliance from June 2023 to January 2024. While an initial skills survey was previously undertaken within the EU-CONEXUS alliance in 2020, it only featured the six countries constituting the initial members of EU-CONEXUS.

Consequently, to provide up to date and relevant skills needs assessment within EU-CONEXUS, the responsibility of Work Package Three was to implement a renewed and expanded European skills survey.

The survey was a crucial tool to align the specific focus area of the EU-CONEXUS joint Master programme and micro-credentials with the needs of society and industry across Europe. It consisted of fourteen scales that aimed to understand the perceived rate of importance for a range of sector-specific, sustainability and transversal knowledge and skills. One scale was dedicated to investigating the importance of pertinent aspects of sustainability knowledge, another evaluated the importance of transversal skill needs, and twelve distinct sector scales examined the specific needs of each sector included in the survey. Once respondents completed the two general knowledge and skills scales (i.e. transversal skills and sustainability skills needs), they then self-selected a sector and completed one more scale and one open-ended question. This empowered industries to select the sector most relevant to them, a modification designed to heighten the specificity and accuracy of gathered data.

It was evident throughout the process of collecting data for the current study, that various types of sustainability and general skills are frequently interchangeably used terms. We see reference to green skills, green competencies, green digital skills, digital skills, transversal skills, and soft and hard skills. It may be useful to outline the main skills referred to in the current study, notably green skills, green competencies, digital skills and transversal skills. However, first, it is essential to clarify some general terms: These terms are: "competence", "skills", "knowledge", and "attitude" (European Commission, 2019). Competence is the demonstrated ability to apply knowledge, skills, and attitudes to achieve observable results, while a skill is the ability to carry out processes and use existing knowledge to achieve results. Knowledge is composed of the concepts, facts and figures, ideas and theories which are already established, and support the understanding of a certain area or subject and attitudes describe the disposition and mindset to act or react to ideas, persons, or situations.

These general terms are further contextualised to our sustainability focus and so more specifically, green competencies (Bianchi, *et al.* 2022) refer to a framework that comprises four interrelated competence areas: ‘embodying sustainability values’, ‘embracing complexity in sustainability’, ‘envisioning sustainable futures’ and ‘acting for sustainability’ to improve and develop the knowledge, skills and attitudes to live, work and act sustainably. Green competencies can be understood as a prerequisite to effectively shape systemic and critical thinkers who care about our planet’s present and future. Examples of green competencies include: valuing sustainability, supporting fairness, systems thinking and futures literacy.

Cedefop (2012) maintains green skills can be defined as “the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society.” OECD and Cedefop (2014) define green skills as “the skills needed by the workforce, in all sectors and at all levels, to help the adaptation of products, services and processes to the transformations due to climate change and to environmental requirements and regulations”. Examples of green skills include: how to conduct energy audits, measure the sustainability of tourism activities, as well as training staff on recycling programmes. Digital skills are defined as a range of abilities to use digital devices, communication applications, and networks to access and manage information. They enable people to create and share digital content, communicate, collaborate, and solve problems for effective and creative learning, work, and social activities at large (UNESCO, 2018). Finally, transversal skills are those typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge but as skills that can be used in a wide variety of situations and work settings. These skills are increasingly in high demand for learners to successfully adapt to changes and to lead meaningful and productive lives. Examples include: critical and innovative thinking, inter-personal skills (e.g. presentation and communication skills, organisational skills, teamwork, etc. (UNESCO, IBE 2013).

1.2 Objectives of the survey:

The objectives reflect the survey design process, where the skills survey was designed to capture labour market needs and inform the most in-demand sustainability and sectoral knowledge areas for the SmUCS Masters and micro-credentials as well as for future educational offerings. The survey results contribute to the broader objectives outlined in Work Package Three, ensuring that the Masters and micro-credential curriculum is tailored to industry demands and societal needs and that knowledge-sharing, collaboration and mobility opportunities are maximised for students and staff within the EU-CONEXUS alliance.

Objective one: The report aims to identify the challenges and learning needs of the labour market and industry from 12 sectors across Europe.

Objective two: The outcomes of the report will be utilised to align SmUCS content in the new Joint Masters and micro-credentials with sustainability-specific knowledge areas and skills.

Objective three: The report seeks to explore policy from the EU Commission to inform the integration process necessary for the adaption of essential sustainability competencies and transversal skills for comprehensively designed sustainability curricula and learning environments.

Methodology

2.1 Study Design and Procedures:

The process of building the skills survey commenced in the Spring of 2023. In response to valuable feedback received during an early survey review process, it became evident that adaptions were necessary to refine and enhance the effectiveness of the existing skills survey. Twelve skills scales for thirteen sectors were examined in a consultation process with subject matter experts and academic staff working in each of the fields or sectors contained in the survey. One sector, local/regional authority did not have a developed assigned reliable scale for the current study. The adaptions made to the survey were in a bid to refine some of the questions and include pertinent ones which needed to be included. This consultation process took place over several weeks and Work Package Three members were invited to consult with subject matter experts to edit the survey sectors and questions. Some significant updates to the survey compared to the previous one were implemented. Two new scales were incorporated into the survey to comprehensively capture data on sustainability knowledge and transversal skills needs across all sectors. These two new areas were included to capture important data on general green/digital and sustainability skills from all survey participants to get a clear picture of the skills needs in these extremely significant areas from all survey respondents. Additionally, a significant modification involved survey participants selecting the sector most relevant to them after completing the respective sections, aiming to enhance the specificity and accuracy of the gathered data. These refinements were instrumental in ensuring the survey effectively addressed the identified skills needs and provided valuable insights into the diverse sectors represented in the study. The survey was disseminated to some of the EU-CONEXUS associate partners for feedback on its design and contents following a meeting on 8th June 2023 and feedback received was taken on board into the survey design. The final survey was launched on 26th June 2023.

The final survey included two Likert scales investigating industry perspectives on the importance of green knowledge and skills (Not important - 0, slightly important - 1, moderately important - 2, important - 3, essential - 4) along with twelve sector-specific Likert scales inclusive of:

- Urban Infrastructure Sector
- Tourism Sector
- Port Sector
- Coastal Management Sector
- Fisheries Sector
- Aquaculture Sector

- Agriculture Sector
- Food Science Sector
- Chemical and Life Science Sector
- Energy Sector
- Computer Science
- Environmental Law
- Local Regional Authority (no scale)

The scales were used as tools designed to assess industry representatives' perceptions of the importance of various knowledge areas and skills related to sustainability and other specific skills areas within their respective sectors.

In addition, one open-ended question was included for all industries to respond to. This question aimed to harness a more nuanced understanding of the knowledge gaps of participating industry representatives engaging in the survey. While quantitative methods can identify patterns and trends (Zhang, 2014), qualitative components add depth and meaning to empirical findings. The validity of the findings was sought by triangulating data from the sector-specific scales with perspectives within the industry-focused participant group.

2.2 Participants

To ensure ethical standards, the SETU team applied for ethical approval in May 2023 before implementing the survey, following best practices in research methodology and data protection. Participants invited for inclusion in the study comprised industry representatives from thirteen sectors identified within the survey.

The target participants were industry and stakeholders connected with each of the nine EU-CONEXUS universities. This group included industry partners, collaborators, public bodies, local authorities as well as the associate partners of the EU-CONEXUS+ project.

A dual sampling strategy was employed. A convenience sample of respondents was employed to reach participants readily via platforms such as LinkedIn, while a purposive sampling technique was utilized to engage farther-reaching industries that were difficult to involve, yet relevant to the research goals. Leveraging professional networks allowed the research working group to identify and invite participants to take part in the research based on their expertise and industry experience.

In total n=537 respondents engaged with the survey. Post data cleaning and validation, n=263 responses were deemed valid and included in the comprehensive analysis. Among the cohort, n=88 individuals provided valid open-ended responses incorporated into a qualitative analysis framework, enriching the study with elaborate insights. A wide range of responses were attained from each of the nine countries in the alliance, however, there was unequal distribution on the level of country engagement, for example, some countries in the alliance achieved over 60 responses, while others achieved six.

2.3 Data Collection

The data collection process involved the utilization of a structured survey instrument designed to capture information on sustainability knowledge, transversal skills and specific skills needs across the identified sectors through Likert Scales rating each area from not important to essential (0-4).

The survey was distributed electronically using the Surveymonkey.com platform. The electronic distribution method allowed for real-time tracking of responses, allowing the team to address issues or gaps in data collection to the best of their ability. All survey participants were provided with a participant information sheet which outlined key information such as a statement on anonymity, confidentiality, privacy, right to withdraw from the survey, who to contact in the event of questions as well as the expected outcome from the skills survey.

To facilitate the process of data collection, each of the nine EU-CONEXUS partners were asked to nominate a skills survey gatekeeper. This person was tasked with coordinating the distribution of the skills survey within their university and country, with the support of the survey administrators at SETU and other local colleagues.

The survey was hosted on the SurveyMonkey platform launched on 26th June 2023 and initially, it was planned for the survey to be open for 6 weeks. Further extensions to this 6-week open period were made to increase the number of survey responses. The survey was online and was also translated into French and Spanish as well as some other local languages to enhance engagement with the survey (July 2023). Ultimately the survey closure deadline was extended several times up to December 2023 to maximise the number of responses.

2.4 Data Analysis

Quantitative data:

Data were coded and inputted into SPSS Statistics (IBM Corp, IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp). Simple descriptive statistics were used to describe the industry perceptions of the importance of green knowledge and skills in their respective sectors. The Cronbach's Alpha test is a measure of internal consistency reliability, assessing how closely related a set of items are as a group. It enhances confidence in our results. In the context of sustainability knowledge areas and transversal skills, the high Cronbach's Alpha values of .936 and .909, respectively, indicate strong internal consistency within each set of items. This suggests that the sustainability knowledge areas and transversal skills measurements are reliable and the items within each category consistently contribute to the overall construct being measured.

Qualitative data:

Reflexive thematic analysis (Braun and Clarke, 2021; 2006) was used to analyse data. This form of analysis is frequently used in education research (Byrne, 2022). Data from the open-ended survey question were coded and initial themes were generated independently by the work package leads, discussed, and refined by the EU-CONEXUS+ Work Package three members.

Results

3.1 Overall Findings

As outlined above, n = 537 respondents were engaged with the survey, and this translated into n = 263 valid responses. Of the responses, the urban infrastructure sector, Local Regional Authority and energy sectors produced 23%, 15% and 10% of all valid responses while the Chemical and Life Sciences sector as well as Computer science were responsible for 10% and 8% of responses respectively. One important point to note when analysing the skills data arising from this survey is that the combination of Urban Infrastructure (23%) and Local Regional Authority (15%) represented 38% of the total responses. It is reasonable to suggest that many of the industries in these sectors may have been public as opposed to private companies so this should be considered when evaluating the data. In addition to the thirteen sectors outlined above which the survey was targeted towards and under which each respondent would be asked to self-categorise themselves, there was also an “other” category included which included manufacturing, forestry and logistics.

Percentage of responses from each sector

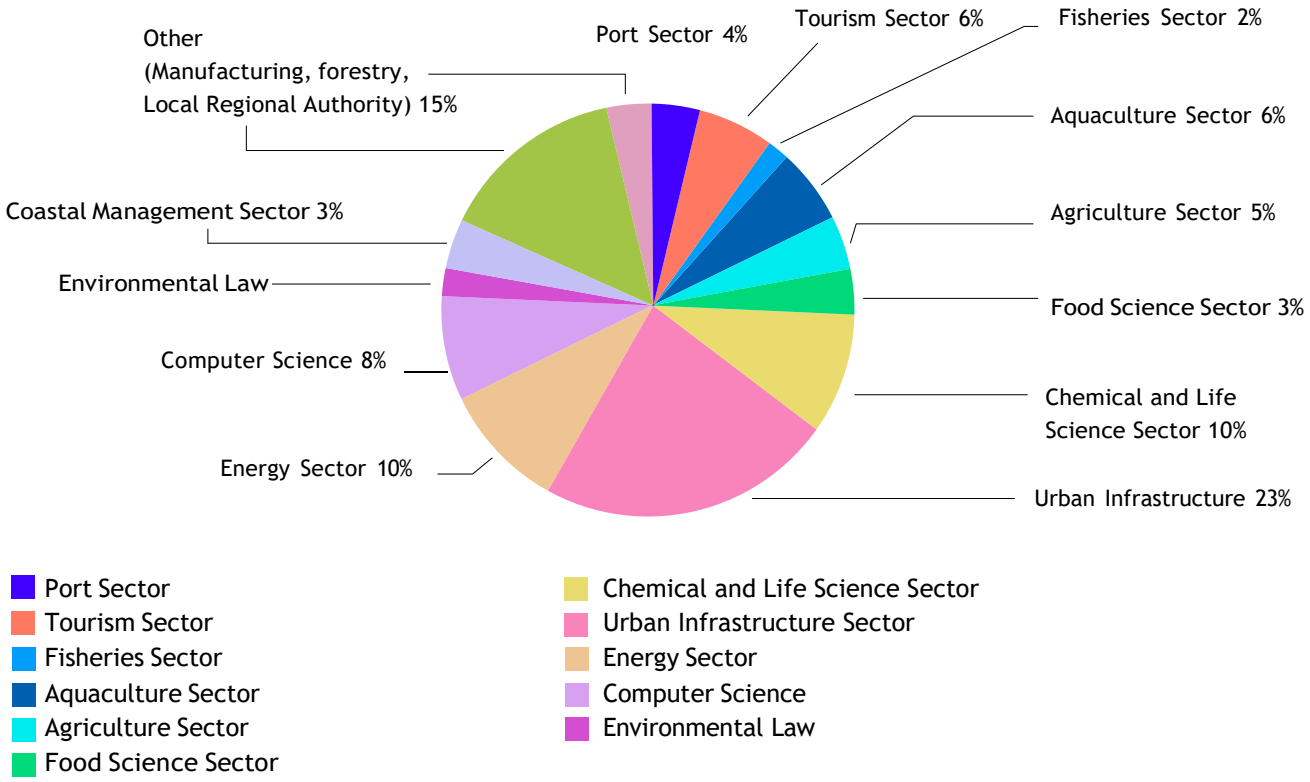

Figure 1: Percentage of responses from each sector

3.2 Sector Perspectives: Assessing Sustainability Knowledge and Transversal Skills

The perceived importance of various sustainability knowledge areas is illustrated through descriptive outcomes, specifically mean rankings of preferred sustainability domains. In the bar chart below, the bottom two areas receiving lower mean ranking include knowledge of UN Sustainable Development Goals and knowledge of Carbon Management, while the top three include; knowledge of responsible digital practices, knowledge of climate change and resilience and knowledge of technologies for sustainable development

Sustainability Knowledge Perceived Importance Across All Sectors

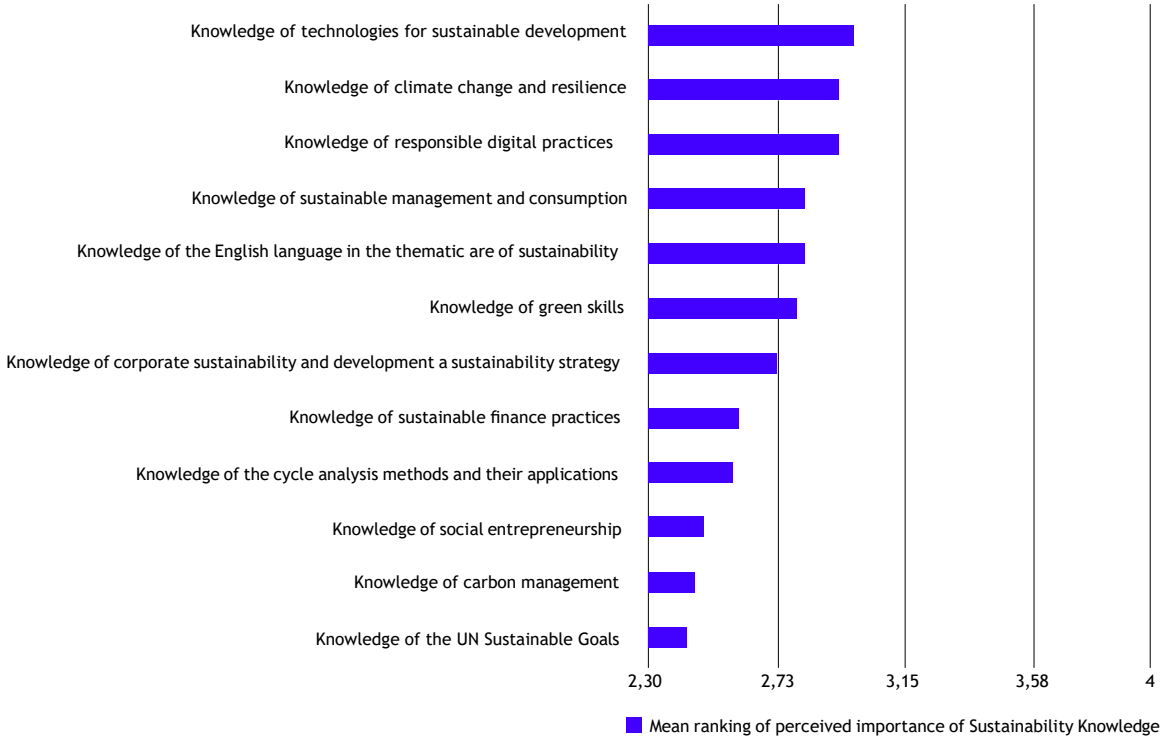

Figure 2: Mean ranking of perceived importance of Sustainability Knowledge

In relation to transversal skills, the sector's responses were again presented as mean outcomes of the industry's perceived importance of each of the transversal skills presented in the graph (see Figure 3 below). Here, global citizenship ranked the lowest, along with media and information literacy, whilst teamwork and collaboration, problem-solving and critical thinking ranked the highest.

Transversal Skills Preference Across All Sectors

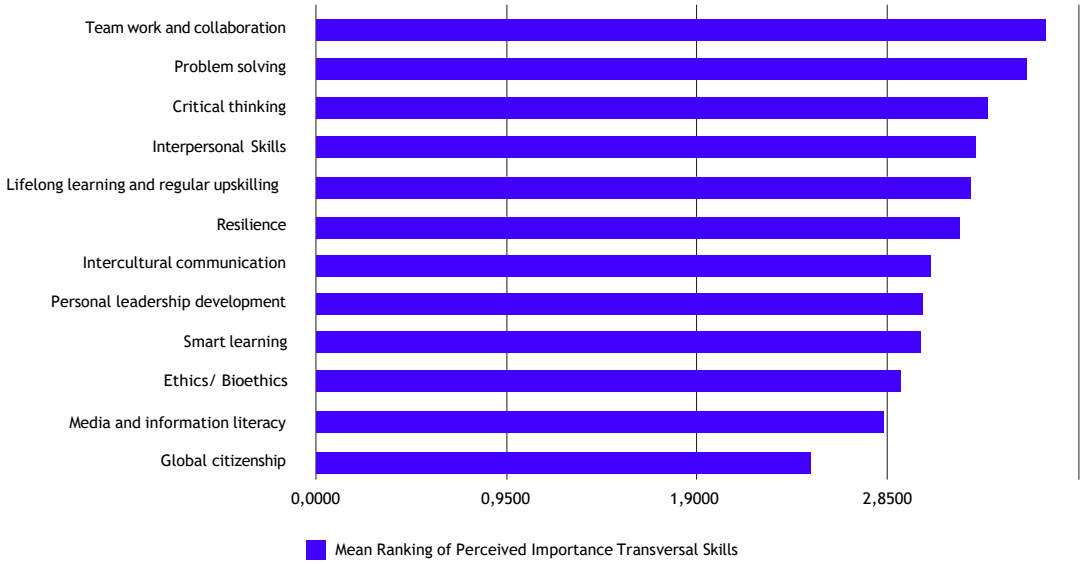

Figure 3: Mean ranking of perceived importance of transversal Skills

In the qualitative data analysis, industry respondents consistently underscored the importance of various skills deemed essential in their respective fields. Communication emerged as a focal point, with participants expressing a unanimous view of its high value in professional settings. One respondent remarked ‘Communication and teamwork skills are critically important in all aspects of our activities’, while another asserted

> ‘I believe that the most important skills for the future in our area must concentrate on carbon reduction and so skills in technology, engineering, natural environment, problem-solving, and communication with a particular emphasis on change management because big changes are required to achieve carbon reduction targets.’

Collaboration and teamwork skills were recurrent themes in respondents' narratives, often highlighted as critical factors for success in a dynamic work environment. Participants frequently maintained that employees need to function as a team to solve problems.

Problem-solving skills, particularly in the context of addressing sustainable challenges, were another prominent aspect. Respondents provided instances where innovative problem-solving approaches will lead to more sustainable outcomes. One participant maintained that key ‘skills include multidisciplinary, collaboration, teamwork, moving away from operating in silos, and putting nature at the centre of future development’. Critical thinking emerged as a key competency, often intertwined with problem-solving. Industry professionals consistently emphasise the need for employees who can analyse complex situations, question assumptions, and propose innovative solutions that are holistic and considerate of the interlinkages of all systems. One participant articulated that ‘Critical thinking and understanding all the different ways a small mistake can affect thousands of lives, as well as being able to solve any issues that may arise, are also essential skills’.

Furthermore, openness to life-long learning and personal development was cited as integral to professional growth and adaptability. Respondents shared instances where a commitment to continuous learning enabled them to stay abreast of industry developments. One industry expert remarked, ‘being an engineer is a lifelong career that needs lifelong training and development and that in the early stages of employment, the driving factor should be learning as much as possible and not money’.

Lastly, the importance of green and digital skills resonated throughout the qualitative data. Industry professionals expressed a growing demand for individuals equipped with competencies aligned with sustainable practices and digital green skills so that they could ‘build a "greener" and more environmentally-friendly portfolio… to give back to local communities, our investors, our tenants, our partners, and our staff who work in or live nearby our buildings’. It was identified in the data that participants felt the future of sustainable development for industry needed to be green, digital and smart.

3.3 Sector-Specific Skills and Qualitative Insights

The following results and illustrating scales demonstrate the particular priority areas of knowledge of skills required by each of the thirteen sectors. Relevant qualitative thematic areas matched to the responding sectors are also presented to support the quantitative outcomes.

3.3.1 Urban Infrastructure

As previously outlined, the urban infrastructure was the most represented sector within this skills analysis report, with 23% of respondents from the survey being affiliated with this sector. The top five ranked sectoral skills needed here were construction techniques for durability, efficiency and safety, lifelong learning and regular upskilling, innovative materials for sustainable buildings, infrastructure recycling and green and near zero energy buildings. Key sustainability skills in this sector included knowledge of the English language in the area of sustainability, responsible digital practices, technologies for sustainable development, carbon management and green skills. Transversal skills in most demand here included teamwork and collaboration, problem-solving, lifelong learning and regular upskilling, critical thinking and resilience.

Urban Infrastructure
N=58

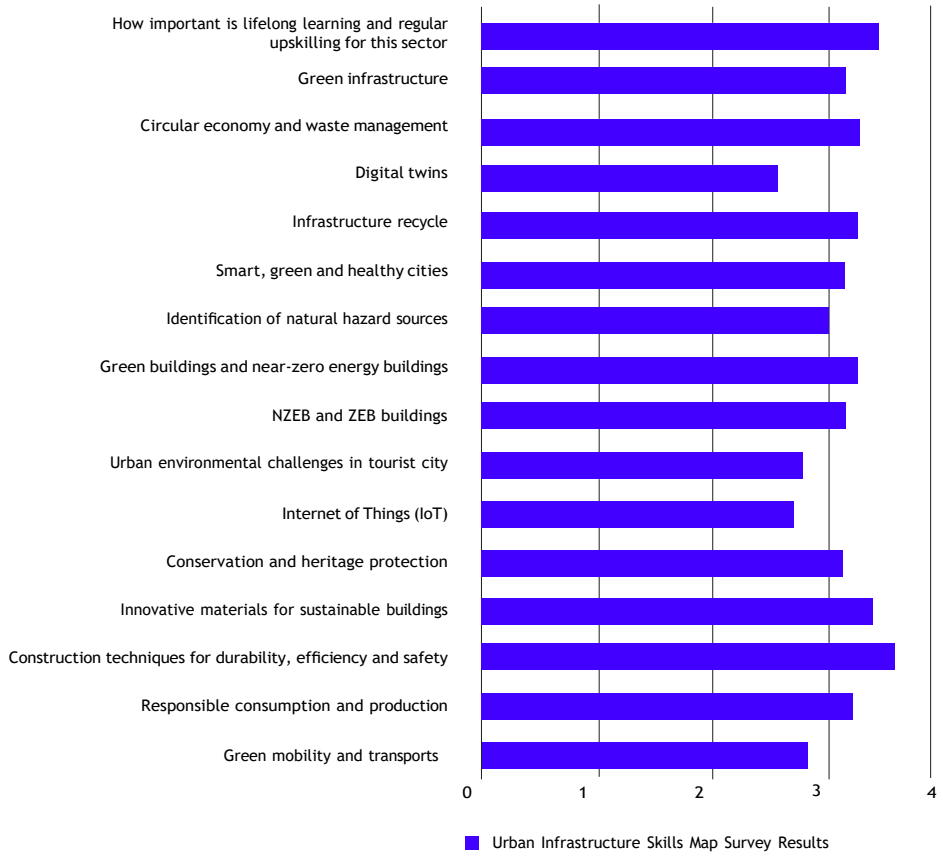

Figure 4 Urban Infrastructure Skills Map

Qualitative data indicated that for rban Infrastructure, themes regarding sustainability, efficiency regulations and environmental awareness were of high importance for the sector. One respondent summarised ‘Competence needs: Knowledge of European Union regulations at the level of producers. The requirements of the European directives can help develop the manufacturers and the technologies put on the builders' market’. Specific to engineering an understanding of engineering regulations, and general knowledge of how disciplines interact in engineering were regarded as essential. For example, as expressed by one urban infrastructure industry it is understood that we are ‘moving away from operating in silos, and putting nature at the centre of future development. Grey infrastructure dependent only development is not an option anymore’. In construction, particular green skills acquisition in water in waste, including hydraulics, water chemistry and biology, and digitization of water systems operation for the water and wastewater treatment sector was seen as essential. Additionally, themes highlighting the need for knowledge of emerging smart technologies for sustainable building economy principles and sustainable practices in urban mobility were identified.

3.3.2 Tourism

The tourism sector reported lifelong learning and regular upskilling, use of information and communication technology, sustainable development of tourist destinations, natural and cultural heritage as well as planning business processes and developing tourism destinations as the top five most in-demand sectoral areas. In sustainability skills in the tourism sector, the most highly ranked skills were social entrepreneurship, responsible digital practices, technologies for sustainable development, carbon management, green skills and sustainable management and consumption. In terms of transversal skills, critical thinking, interpersonal skills, problem-solving, teamwork and collaboration followed by intercultural communication were seen as the most in-demand areas. The key thematic areas identified in this sector in the qualitative data indicated that the industry requires more knowledge and skills in heritage conservation and promotion, climate change mitigation and social impact assessment.

Tourism
N=14

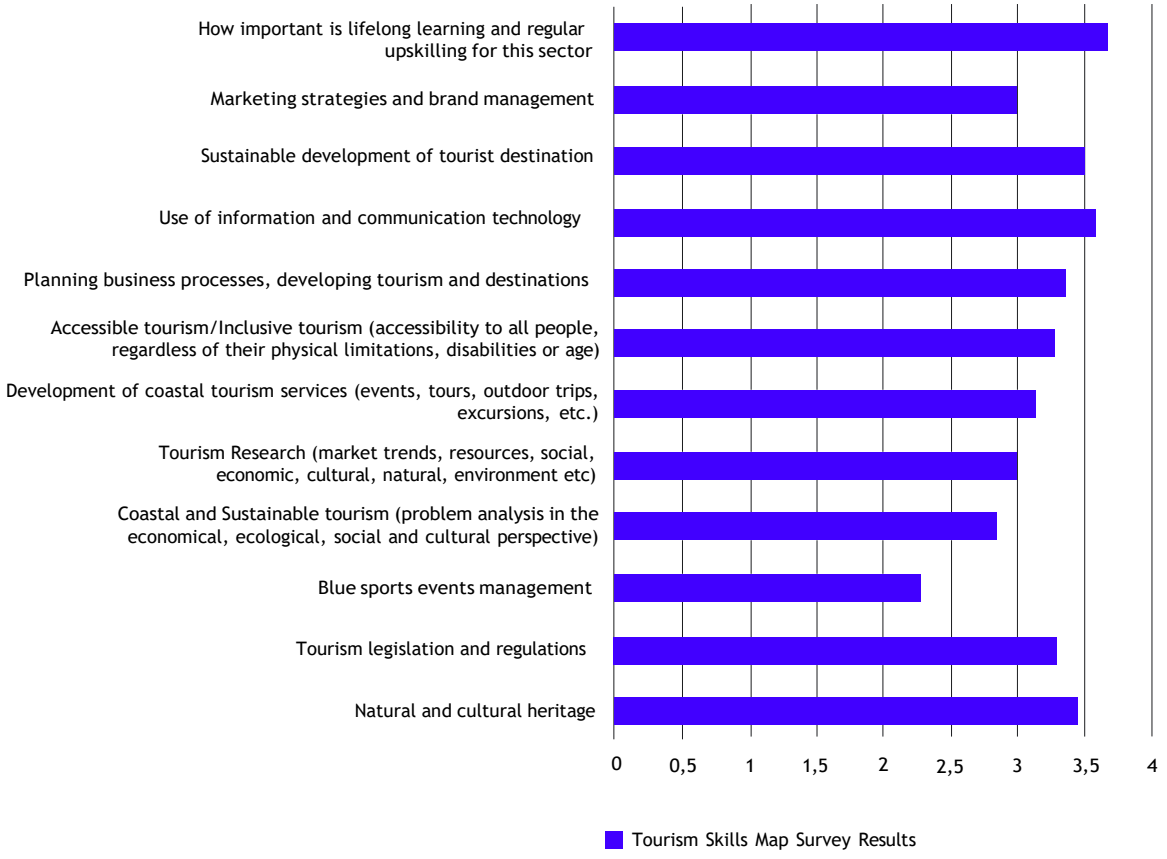

Figure 5 Tourism Skills Map

3.3.3 Port Sector

The port sector reported its most prevalent skills demands areas as knowledge and understanding of smart sustainable ports, port management, port terminal planning for future green ports, maritime and port legislation and regulation and integration of low emissions energy supply and production at ports. Interestingly, all of these areas feature sustainable/green ports or management as the top priority. The specific sustainability skills reported as being most relevant to ports include knowledge of the English language in the thematic area of sustainability, knowledge of green skills, sustainable management and consumption, knowledge of responsible digital practices and knowledge of carbon management. In terms of transversal skills, problem-solving, intercultural communication, teamwork and collaboration, interpersonal skills and critical thinking skills were deemed to be the most in demand.

Port Sector Skills
N=7

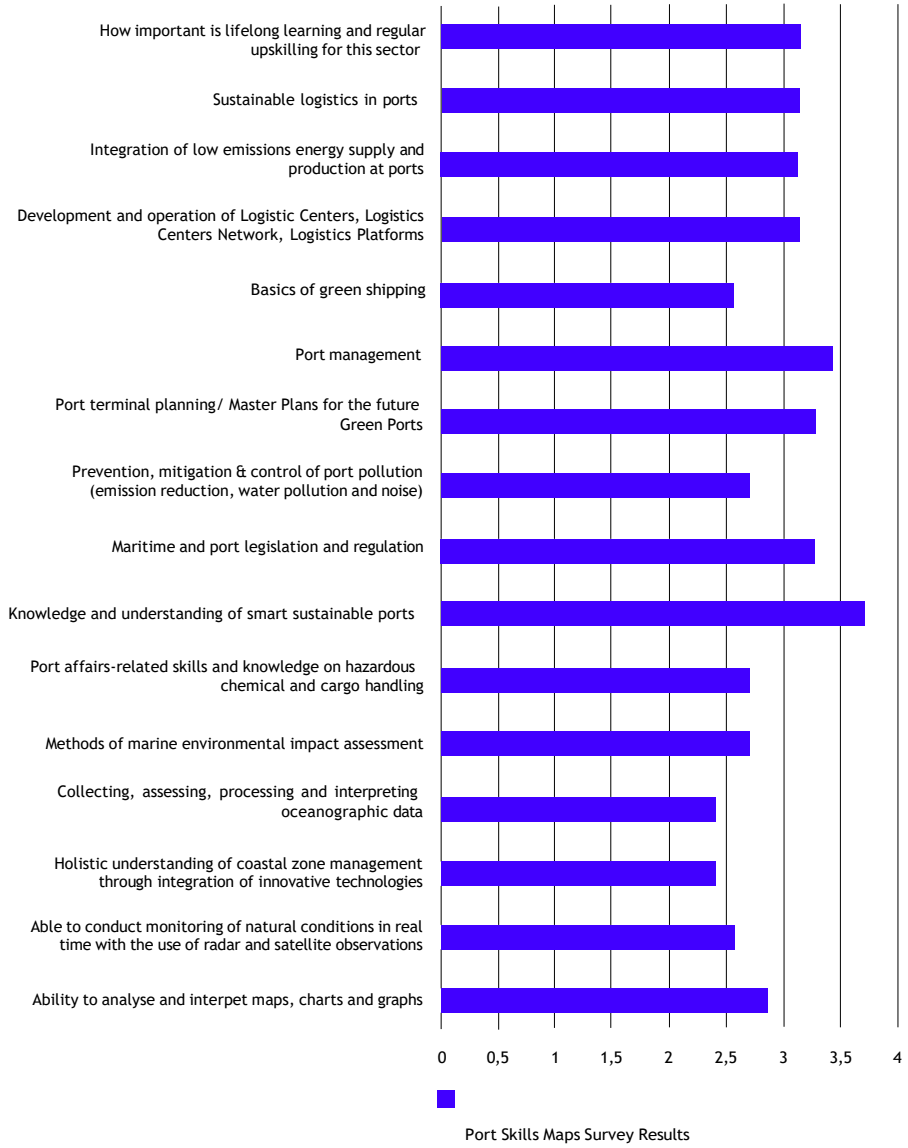

Figure 6 Port Skills Map

The port sector responded to the open-ended questions with a focus on green and digital skills. An industry respondent very clearly stated ‘Seaports have to be green (not only shipping but also stevedoring companies and other maritime industries), digital and safe’. In addition, the port sector reported a demand for a diverse workforce, requiring sailors, technicians, welders, engineers and port personnel.

3.3.4 Chemical and Life Science Sector

Despite this sector not being traditionally linked to SmUCS, it does however play a key part as it would include companies in the pharmaceutical, biotechnology, biopharmaceutical, medical device, healthcare and scientific sectors, as well as being representative of laboratories including hospital and public laboratories. Within this sector, lifelong learning and regular upskilling were deemed to be particularly important. In terms of technical content in demand in this sector, statistical analysis software systems, process engineering and scale-up, bioinformatic analysis, principles and applications of green chemistry and chromatography and mass spectrometry analysis were the top five skills areas in most demand. Some of these topics, such as statistical analysis are very universal and would be in demand in almost all companies working in the scientific field or any company generating or handling any significant amounts of data. Conversely, areas such as cell culture or extraction of molecules from biological materials and epidemiological approaches were less well featured.

Chemical and Life Science
N=25

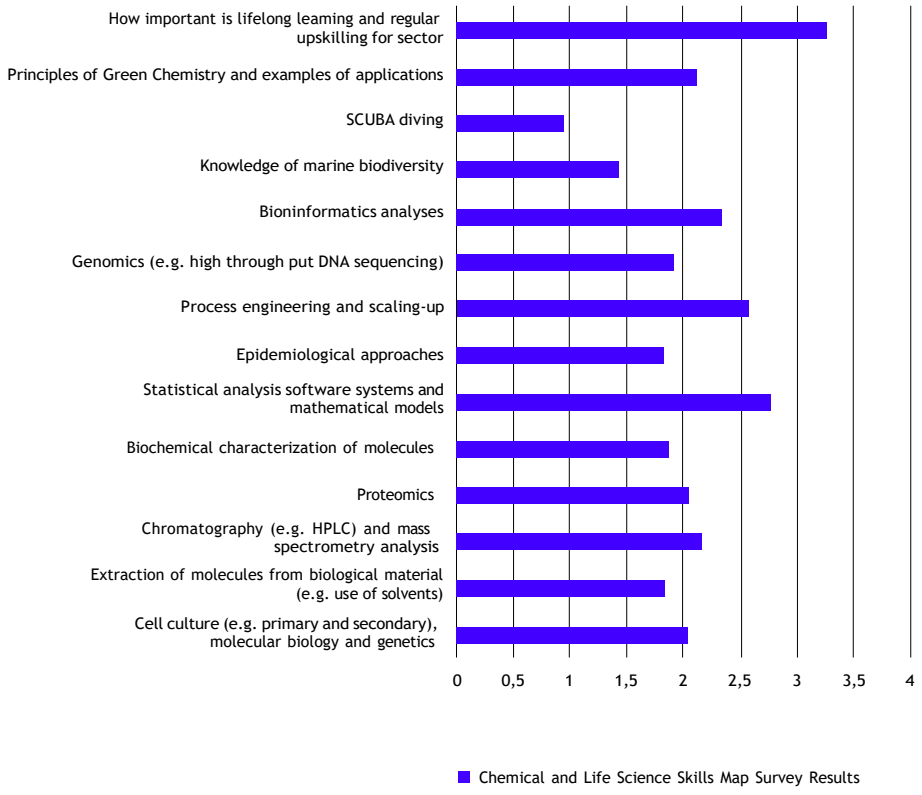

Figure 7 Chemical and Life Science Skills Map

In addition to the aforementioned specific skills areas in the Chemical and Life Sciences sector, transversal skills in demand included teamwork and collaboration, problem-solving, critical thinking, interpersonal skills and resilience. In terms of sustainability skills, the top five reported areas of importance to the sector were knowledge of green skills, technologies for sustainable development, English language in the thematic area of sustainability, knowledge of carbon management as well as sustainable management and consumption. To address as many of these requirements as possible, it would be envisaged to include elements of the transversal skills demands in the programme design and assessment. Sustainability and green skills/green chemistry appeared in the sector-specific and green practices category so would point to a sustainability/green skills type of module to be in high demand for this sector.

Qualitative data from the Life Science Sector respondees indicated that technical skills in the context of laboratory skills in molecular biology and modalities of drug products are required to drive innovation and development in the field. Furthermore, green digital skills, critical thinking and teamwork were maintained as important to the field.

3.3.5 Agriculture Sector

Agriculture is at the heart of all food production. The top five skills areas identified as being the most important were agricultural water management, agriculture bio-economy, sustainable agriculture, greenhouse gas emissions from the animal and food system as well as the carbon footprint of agricultural products. The key sustainability topics reported in the survey from this sector were knowledge of carbon management, green skills, sustainable management and consumption, sustainable finance solutions and knowledge of the SDGs. Skills such as teamwork and collaboration, problem-solving, lifelong learning and upskilling, interpersonal skills, critical thinking and personal leadership development were reported to be the highest transveral skills in demand in this sector. Findings from respondents in the agriculture Sector through qualitative data revealed that knowledge of Corporate Social Responsibility (CSR) and proficiency in industry-specific tools and technical functions were required.

Agriculture
N=10

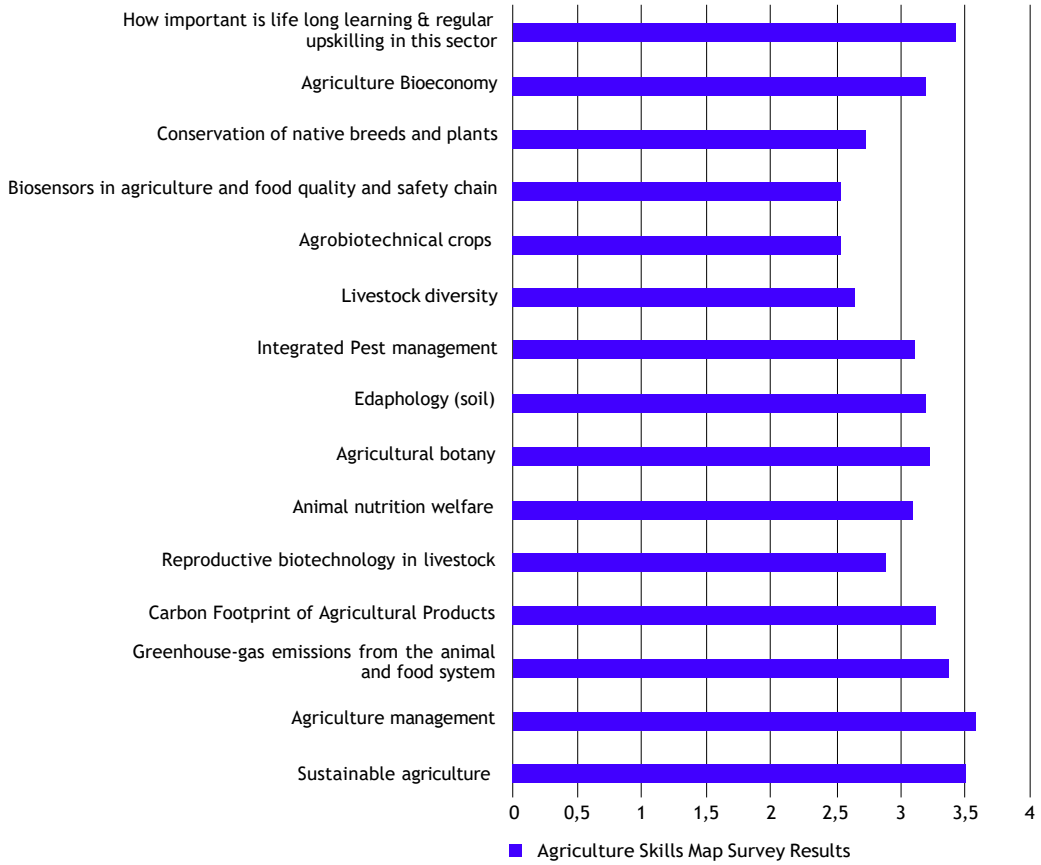

Figure 8 Agriculture Skills Map

3.3.6 Energy Sector

Similar to the agriculture sector, the areas in highest demand here were methods for environmental impact assessment, food energy water systems, photovoltaic powered systems, solar thermal and wind-powered systems as well as sustainable technologies for CO_2 capture and storage. Interestingly, some topics of lower demand in this sector included LNG supply chain development and hydrokinetic-powered systems. This may result from the respondents feeling these areas are either not as important or perhaps under the remit of other sectors (such as other broader engineering programmes). The key sustainability knowledge areas reported as being most important to the energy sector included green skills, knowledge of corporate sustainability and development, sustainable management and consumption, carbon management as well as knowledge of responsible digital practices. Meanwhile, key transversal skills were teamwork and collaboration, problem-solving, smart learning, lifelong learning and regular upskilling, critical thinking and interpersonal skills.

In the energy sector, qualitative responses underscored that integration of eco-friendly energy sources, reduction of carbon footprint and adoption of sustainable practices were of high priority. In general, this sector pointed to the need to improve and implement safe and reliable renewable energies. Two respondents stated that above all, this sector requires people who can be strategic and future thinking in planning measures of change. The first respondent asserts 'The technologies are less important than understanding the need for change and the ability to communicate the measures for change', while the second respondent maintained 'The energy sector contemplates an approach of technological competencies of present and future, where analysis of different scenarios in the energy sector is contemplated, as well as strategic segments where the competences must be determined…'

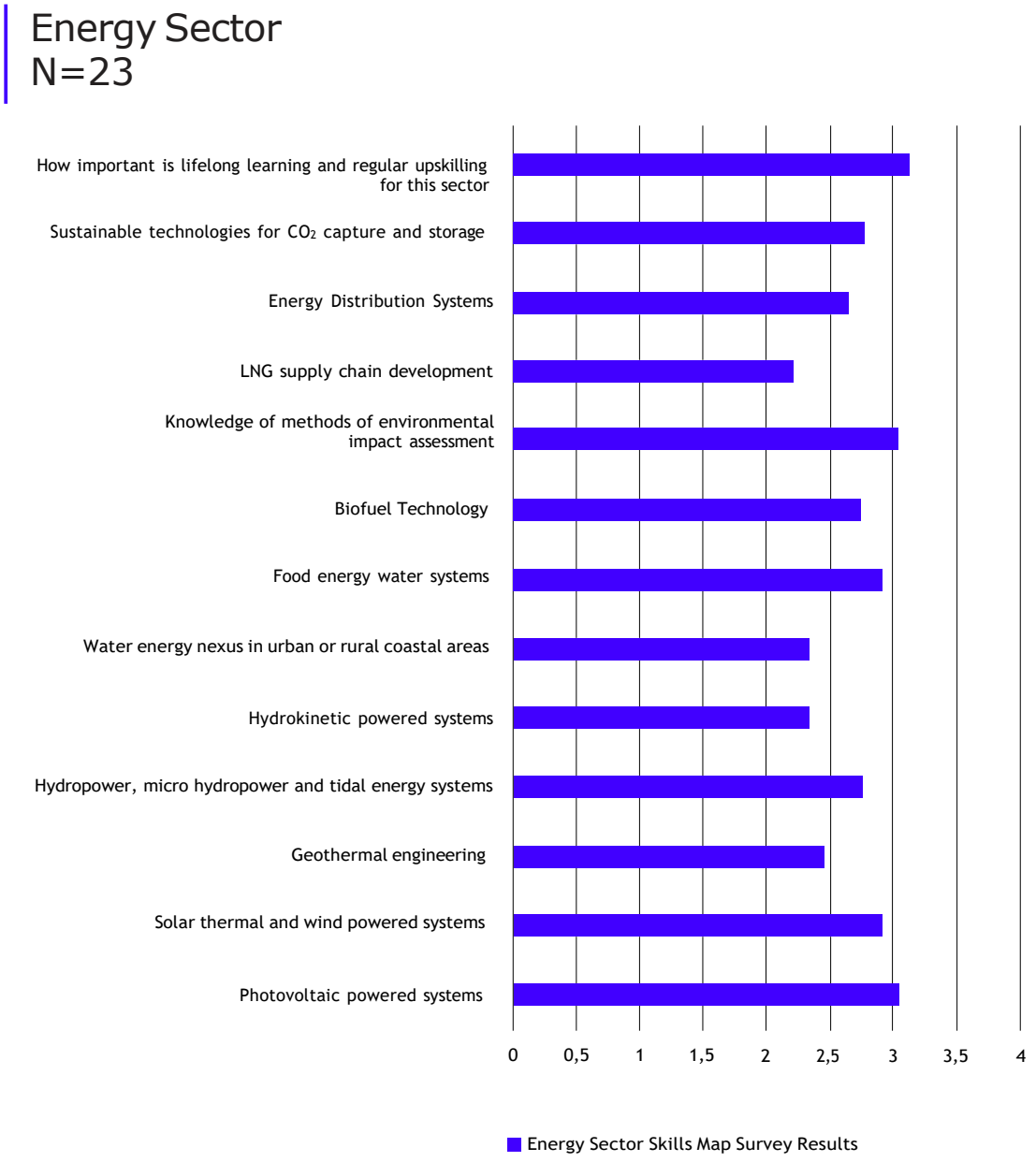

Figure 9 Energy Sector Skills Map

3.3.7 Aquaculture Sector

The most highly ranked skills here were biology and physiology of aquatic animals, fish husbandry and production cycles, fish welfare, quality control and assurance in aquaculture, water quality assessment as well as lifelong learning and regular upskilling. Many of these topics are quite biology and chemical analysis focussed. In terms of sustainability knowledge and skills reported by this sector, the most in-demand of these were carbon management, knowledge of English language in the thematic area of sustainability, responsible digital practices, knowledge of green skills and knowledge of life cycle analysis methods and their applications. Meanwhile, key transversal skills identified as being most important were teamwork and collaboration, problem-solving, lifelong learning and regular upskilling, critical thinking followed by interpersonal skills.

Aquaculture
N=15

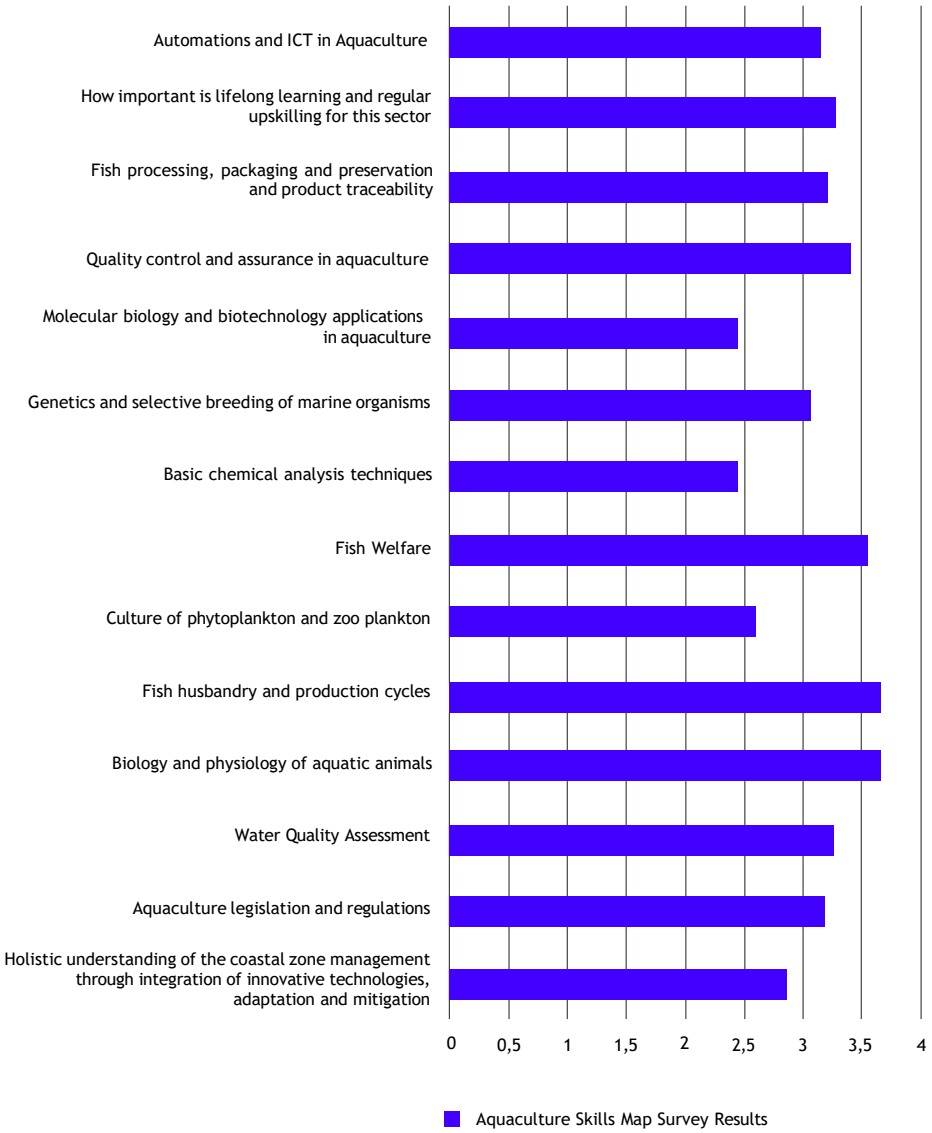

Figure 10: Aquaculture Skills Map

Insights gained from the qualitative responses of aquaculture specify their sector has more manual and operations industry needs for the fish industry. One respondent summarises this succinctly, stating ‘we need people who are willing to "place their feet and hands in the water’’. Others from this industry suggest that ‘it is more difficult to recruit employees and motivate people to work close to the sea environment…’ Nonetheless, the aquaculture industry also requires scientific and environmental expertise and employees with an in-depth understanding of fish biology, behaviour and ecosystems. Specific to aquaculture research the industry believes that ‘skills for proper communication to the society as well as potential collaborators/funders is crucial’.

3.3.8 Food Science Sector

Some of the key sectoral needs from the Food Science respondents included food hygiene and safety legislation, lifelong learning and regular upskilling, product authenticity, identification and traceability systems, food biotechnology and food processing, preservation and packaging. Meanwhile, key sustainability skills included knowledge of sustainable management and consumption, knowledge of the English language in the thematic area of sustainability, lifecycle analysis methods and their applications, knowledge of social entrepreneurship, knowledge of corporate sustainability and development as well as knowledge of climate change and resilience. Transversal skills identified to be a priority in the food science sector included problem-solving, teamwork and collaboration, interpersonal skills, intercultural communication and critical thinking.

The Food Science Sector, as highlighted by the qualitative data, necessitates skills in sustainable food production, with a focus on environmentally friendly and socially responsible practices to ensure long-term viability and ecological balance in food production. As outlined by respondents, this means that skills in digital technologies to improve efficiency, traceability and data-driven decision-making are essential, as well as adherence to regulations and legislation. As one expert remarked ‘sustainability, digitisation and leadership skills are key for us’.

Food Science
N=9

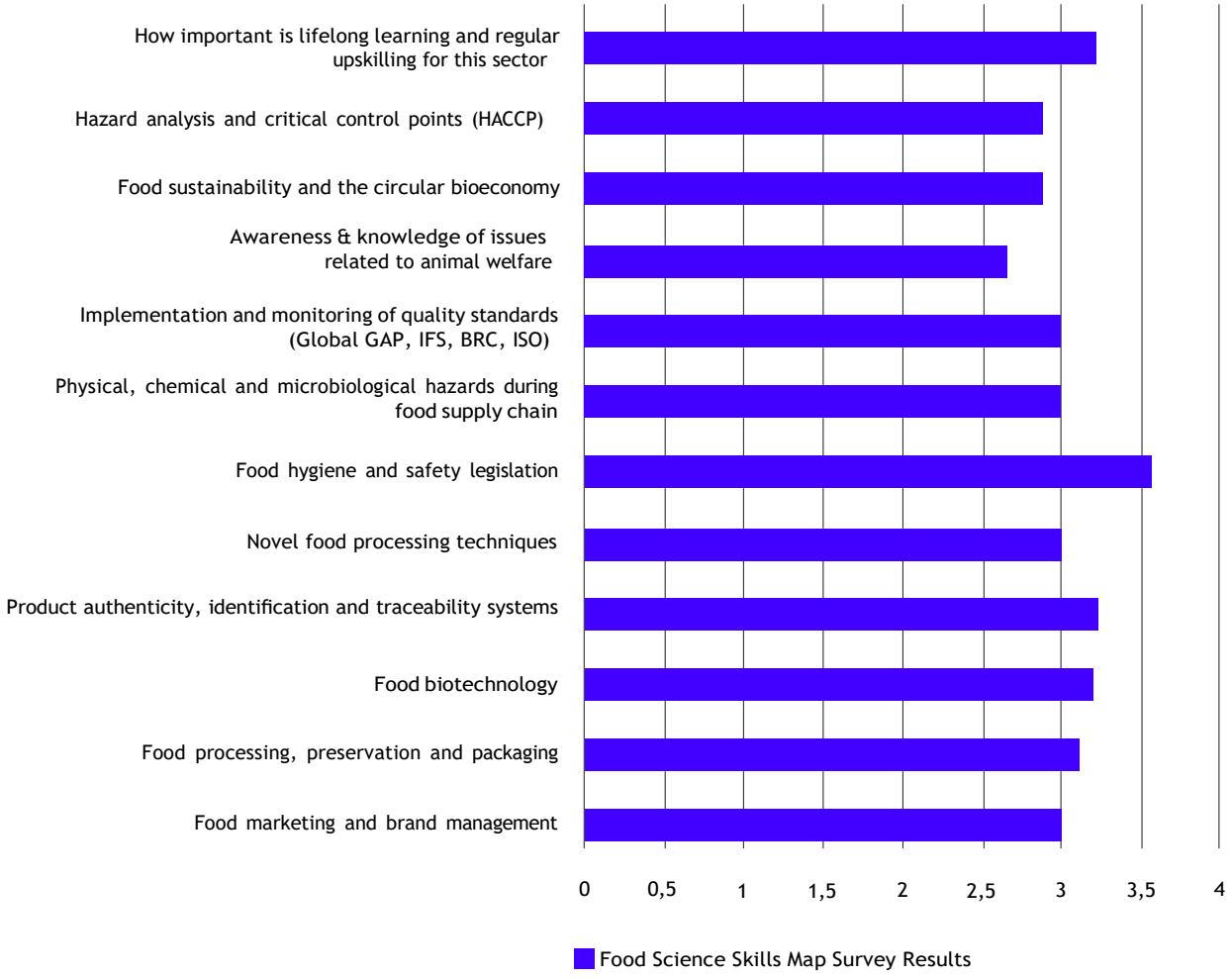

Figure 11: Food Science Skills Map

3.3.9 Computer Science Sector

The Computer Science key sectoral skills included programming and software development, data security, lifelong learning and upskilling, optimisation methods, statistical analysis software systems as well as methods of data collection, preparation and analysis. The most highly ranked sustainability knowledge preferences in this sector included knowledge of technologies for sustainable development, knowledge of the English language in the area of sustainability, knowledge of life cycle analysis and their applications, knowledge of green skills and knowledge of climate change and resilience. Meanwhile, transversal skills preferences in this area included teamwork and collaboration, problem-solving, lifelong learning and regular upskilling, interpersonal skills and critical thinking.

Computer Science Skills
N=20

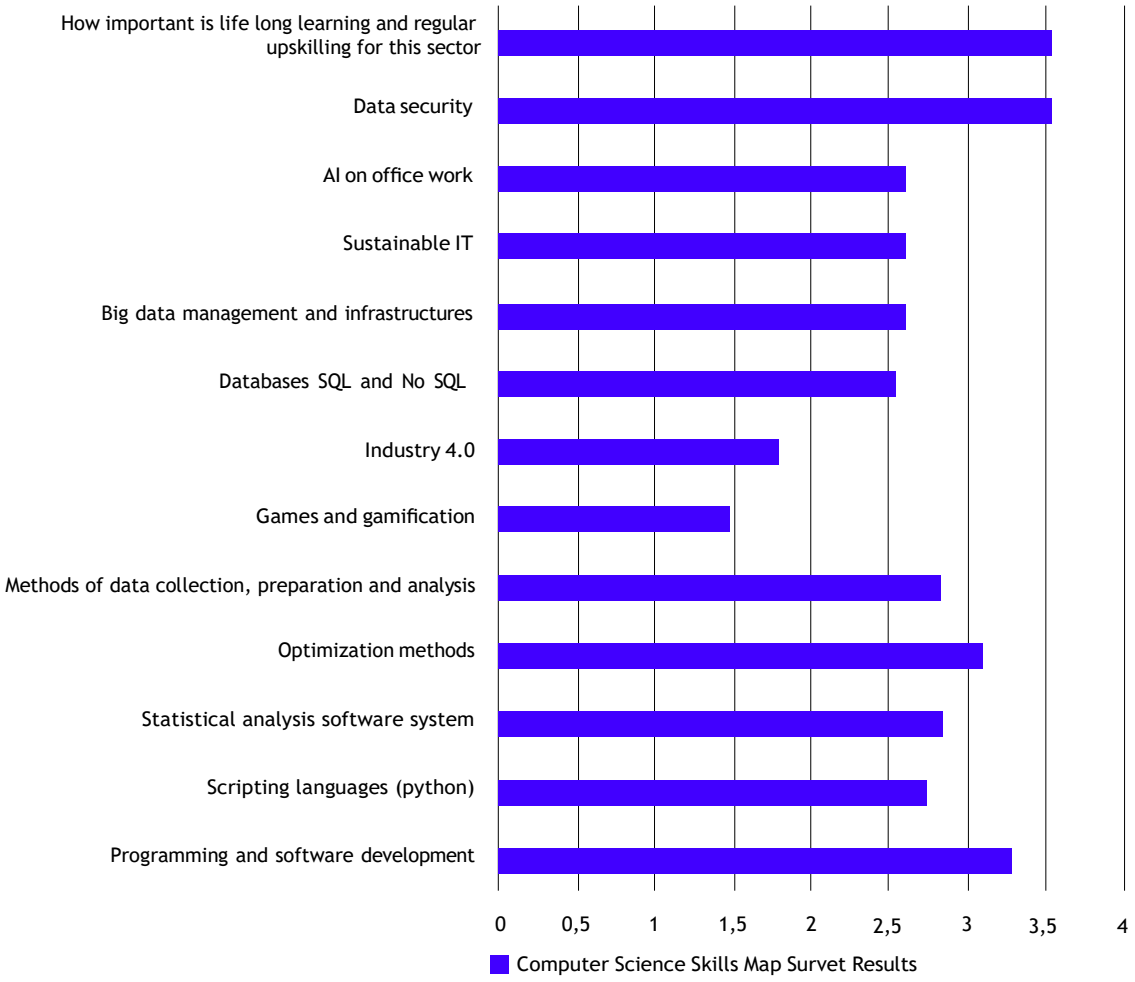

Figure 12: Computer Science Skills Map

Contemporary and ever-changing evolutions in technology have prompted industries to consider how they can harness the value of, and stay up-to-date on digital transformation, as indicated by qualitative data collected in the survey. Skills in artificial intelligence and automation in manufacturing processes are required for the eco-design, programming, and implementation of robotics solutions and digital service, along with skills in optimizing energy usage and implementing energy-efficient solutions. As per the majority of other sectors, the computer science sector needs people who are ‘teamworking, [with] problem-solving capability, communication, ethics and leadership’

3.3.10 Coastal Management Sector

The coastal management sector reported the ability to monitor natural conditions in real-time using GIS as the top skill demand, followed by methods of marine environmental impact assessment, GIS skills, marine ecology and biology as well as knowledge and understanding of ecosystem services. Key sustainability skills in demand reported in this sector included knowledge of green skills, responsible digital practices, knowledge of the English language in the thematic area of sustainability, life cycle analysis methods and their applications as well as carbon management and knowledge of technologies for sustainable development. Transversal skills most in demand in the coastal management sector included teamwork and collaboration, critical thinking, problem-solving, interpersonal skills and intercultural communication.

Key themes from the Coastal management sector identify that there is a diverse range of scientific fields related to marine ecosystems needed. The industry faces challenges in implementing measures to preserve and sustain marine ecosystems and address threats to biodiversity and habitats. Participants suggest that scientific research communication and promotion skills are needed to advocate for marine conservation and sustainable practice and policy.

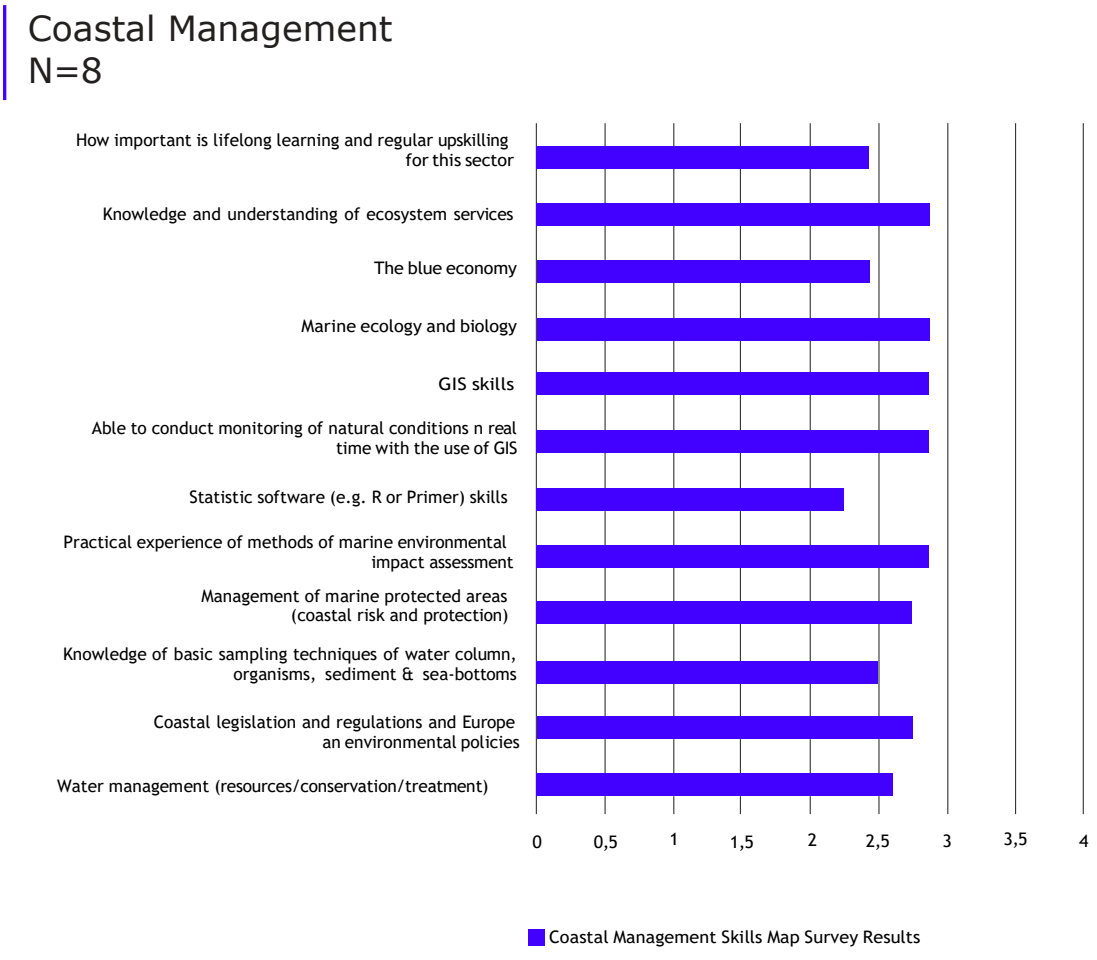

Figure 13: Coastal Management Skills Map

3.3.11 Environmental Law

The Environmental law sector demands environmental assessment procedures, an understanding of the international and European legal environment, lifelong learning and regular upskilling, understanding of the fundamentals of environmental law as well as legal analysis of concrete situations. In terms of sustainability preferences, knowledge of climate change and resilience, knowledge of sustainable finance practices, knowledge of green skills, knowledge of technologies for sustainable development and knowledge of responsible digital practices came out as the top five most in-demand areas. Meanwhile, transversal skills in this sector ranged from problem-solving, teamwork and collaboration, lifelong learning and regular upskilling, critical thinking and resilience. Qualitative data identified thematic areas related to reporting on Environmental, Social, and Governance (ESG) and Corporate Social Responsibility (CSR) performance in the environmental law sector, with an emphasis on ethical governance, ethical decision-making and societal wellbeing.

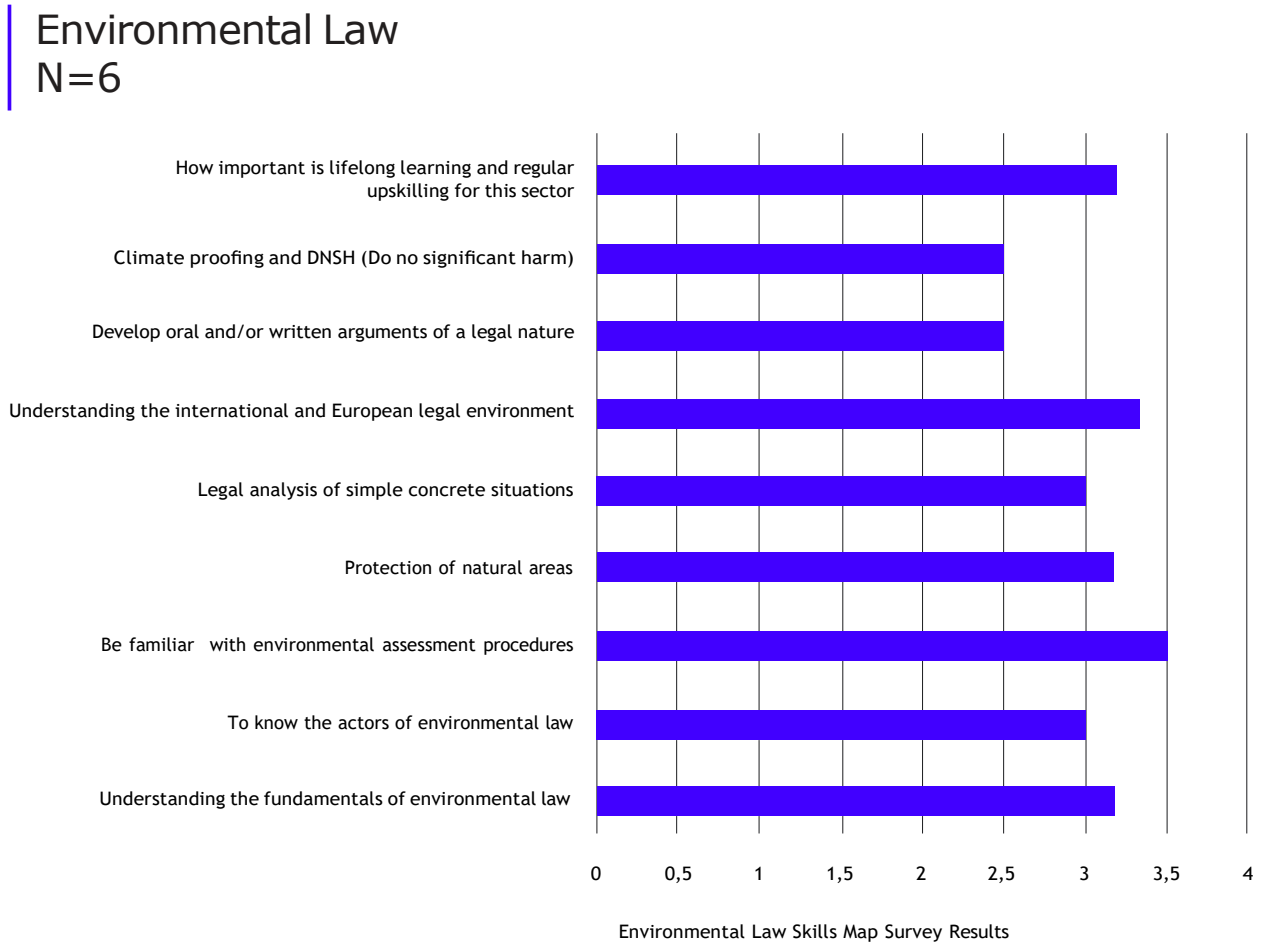

Figure 14: Environmental Law Skills Map

3.3.12 Fisheries

From the survey respondents from fisheries, the key sectoral skills were fisheries technologies, fisheries legislation and regulation, fish processing, knowledge of TACs (total allowable catches), quotas and discards as well as management of protected marine fisheries. This sector prioritised knowledge of the English language in the area of sustainability, life cycle analysis methods and their application, corporate sustainability and development, green skills and carbon management as their top five sustainable knowledge preferences. In transversal skills, resilience, problem solving, teamwork and collaboration, critical thinking as well as lifelong learning and regular upskilling were in greatest demand. Qualitative data unveiled thematic domains associated with knowledge of sustainable environmental practice and protection in fisheries and planning for future skills to anticipate and adapt to emerging industry trends.

Fisheries
N=4

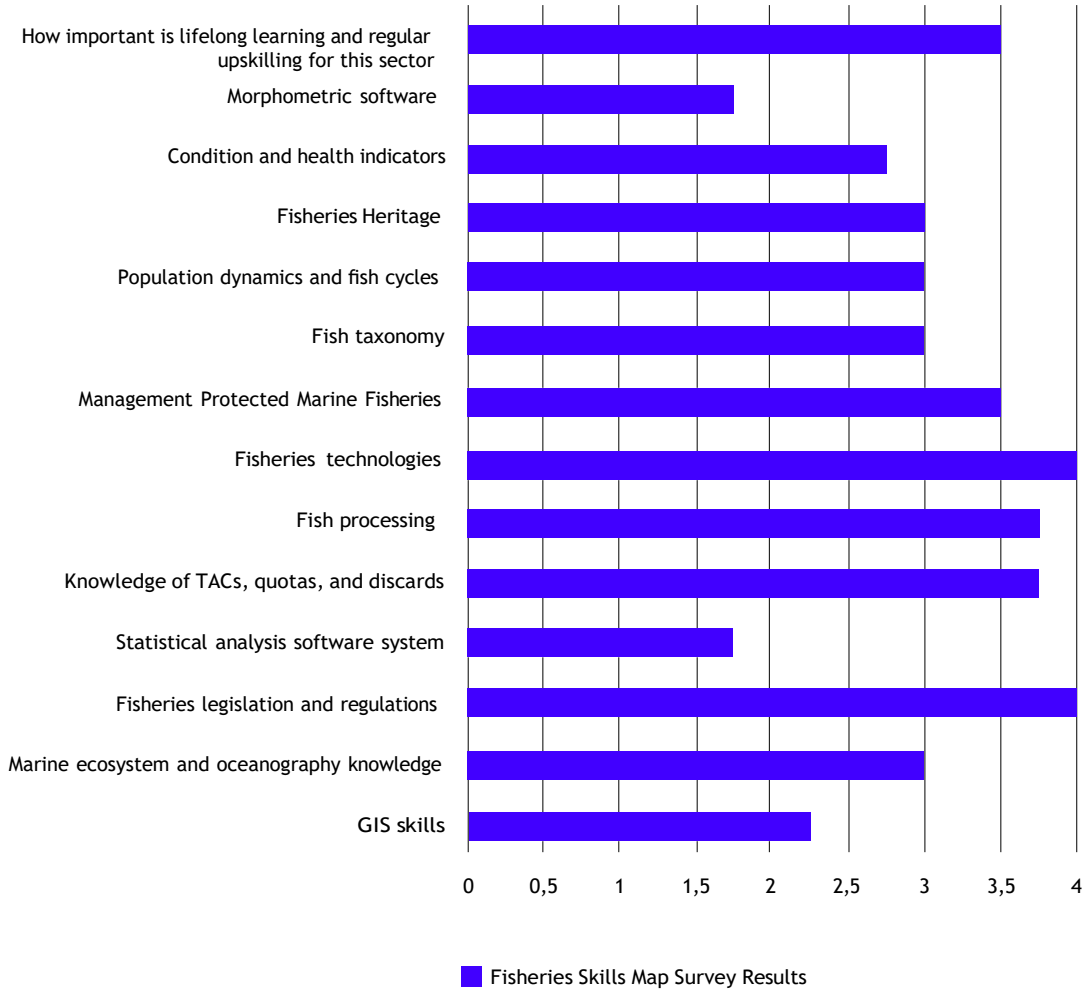

Figure 15: Fisheries Sector Skills Map

3.3.13 Local Regional Authority

Key sustainability preferences reported by the local regional authority sector included green skills, technologies for sustainable development, carbon management, sustainable management and consumption followed by knowledge of lifecycle analysis methods and their applications. In terms of transversal skills, Teamwork and collaboration, problem-solving, critical thinking, interpersonal skills and intercultural communication were the top five reported preferences.

In the qualitative findings, this sector had a diverse range of industries selected as an option due to the range of disciplinary areas in local regional authority bodies. There was an emphasis on cross-disciplinary knowledge, collaborative efforts, and smart green skills to address sustainability challenges and implement solutions across multiple sectors. One respondent asserted that ‘focusing on needs of local communities, green and sustainable development, urban planning, digital commons and equity, advocating and strengthening democracy, cultural studies, inter-cultural relations’ are important. Moreover, insights reveal knowledge and understanding of sustainability principles, and climate change dynamics, emphasising that digital twins, carbon neutrality, safety, security and infrastructure resistant to climate change are top priorities for cities of the future.

3.4 Limitations

The research relied mainly on a convenience sampling technique, therefore it was not possible to measure the absolute per cent response rate since the survey link was distributed on a large scale across social media platforms and alliance university websites. Despite obtaining over 537 responses from participants, it was observed during data collection that when participants were asked to insert their country of origin, a large drop-off rate (almost 50%) was observed. This drop-off rate could have potentially influenced geographical bias, as missing responses were not evenly distributed across regions, with some achieving over 60 and others as low as six. This reduced representation from certain countries in the alliance raises some concerns about the generalisability of the findings. This limitation can also be noted for the distribution across sectors, with some sectors achieving numbers of engagement as low as four responses (fisheries) and six responses (environmental law), and others as high as 58 (Urban Infrastructure). The research team made multiple efforts to achieve an increase in responses, however, the extended survey deadline may have in the end contributed to respondent fatigue.

While the survey incorporates diverse sectors and the unique skills required by industries in each of the sectors, the level of granularity might have been too limiting to capture some nuances for diverse industries. In addition, the self-selection of specific sector scales was possibly too prescriptive for some industries. This resulted in the questions being too restrictive for certain industry representatives who found it difficult to identify themselves within specific sectors. However, in any case where there were invalid responses, data was removed from the dataset to preserve the integrity of the scale-specific results. The open-ended question at the end of the survey was added as an attempt to remedy this, however, limitations to more detailed feedback remained. Further steps to engage the industry were taken by the work package group through holding semi-structured interviews as part of the overall joint master and micro-credential need analysis. However, this information was not formally included in the report research as it was additional to the skills survey. It is important to mention that industry and stakeholder engagement will continue to be of high importance throughout the development, delivery and review process of the education offerings proposed as a result of this report.

Finally, we note that variations in the translation, language and understanding of ‘skills’ across industries might influence the accuracy of the data collected. The clarity around what is meant by various types of skills is a key concern highlighted by the outcomes of the survey and the broader report. Although discussed in more detail further below, interpretations of what green skills, green digital skills, green competencies and transversal or soft skills were not consistently understood. This highlights the importance of refining what is meant by each of the often interchangeably used terms to refine the educational quality of all programmes particularly micro-credentials for quality assurance and effective learning design.

4. Discussion and Recommendations:

The report serves as a needs assessment to inform the development of EU-CONEXUS SmUCS joint master and micro-credential curricula and learning environments. The outcomes provide the necessary information regarding sustainability knowledge and skills required to promote a fair and just green transition through the medium of education for all. The European Green Deal promotes that all facets of society and economic sectors play a role – from the power sector to industry, transport, buildings, agriculture and forestry and to leave nobody behind.

Through the commencement and implications of the report, the work of Work Package Three recognises this call to action, along with the UN Sustainable Development Goals (UN, 2015) and the European Pillar of Social Rights (2017). Successfully making our contribution through the European Universities Initiative requires quality education that can be used as a tool to empower individuals and communities to fully participate in life. The results of our report allow us to focus on the needs of people and industries, and to be responsive to the evidential requirements of the communities associated with the nine European Urban and Coastal Universities.

Emerging from the results it is notable that there is a pronounced emphasis on digital or smart skills, with stakeholders underscoring the demand for enhanced competencies in technologies that serve as digital solutions to sustainability challenges. Our research is in alignment with the European Commission's Next Generation Digital Commission (2022), revealing the imperative to cultivate a digital culture within organisations. This involves not only fostering interdisciplinary learning but also driving sustainable innovation and collaboration. A significant theme in our study highlights the pivotal role of data management, data analysis skills, and innovative technology usage in unlocking sustainable solutions. This theme is indicative of the digital objective to empower transformation, allowing industries to utilise technology for improving sustainable resource efficiency. Moreover, our research emphasises that having appropriate, energy-efficient digital infrastructure to minimise carbon footprint and progress towards carbon neutrality is crucial for all sectors. Achieving technological leadership in digital technologies is also of high importance for the objective of the EU's annual sustainable growth strategy, which places sustainability and social inclusion at the heart of the EU’s economic policymaking. Digital technologies enable businesses to gain a competitive advantage, improve their services and products, and expand their markets, and these technologies have the potential to support the green transition. At the same time, the EU should pave the way towards a human-centric approach to digital technologies, promoting technologies that enhance and uplift human activities and values.

Additionally, our report highlighted a robust prominence on the importance of transversal skills in education across all sectors, evident in both qualitative and quantitative data outcomes. Transversal skills and competencies are “learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity. They are “transversal” because they are not exclusively related to any particular context” (Hart *et al.* 2021, p, 4).

Sectors repeatedly outlined that they require general skills for collaboration, teamwork, communication, critical thinking and problem-solving mostly, but also pronounced their interest in sustainability leadership, life-long learning and personal development. As part of the Skills Agenda (2020), transversal skills were flagged as particularly important for graduates as heading towards a green culture requires citizens to have the cognitive, interpersonal and intrapersonal capacity to deal with the consequences of the climate crisis (Bianchi *et al*, 2022). The OECD Skills Report (2023) discusses the direct correlation between education levels and the tendency to act to reduce environmental footprint. Significantly, it states that seven out of ten young people do not master the emotional, behavioural and cognitive dimensions of environmental sustainability and so are less likely to engage in actions and make changes for the future environmental sustainability of the planet. This is a significant statistic and points to the importance and potential impact of educational offerings of EU-CONEXUS towards creating educational programmes to enhance skills and attitudes towards a sustainable future. It highlights the importance of adopting the 12 competencies for education discussed in the GreenComp Framework (2022) such as futures literacy, systems thinking, critical thinking, supporting fairness, individual initiative and collective action. Learning about environmental sustainability means empowering 'learners to embody sustainability values, and embrace complex systems, to take or request action that restores and maintains ecosystem health and enhances justice, generating visions for sustainable futures (Bianchi, *et al.,* 2022).

4.1 Implications for the EU-CONEXUS Programme Development

At the recent Cedefop and European Economic and Social Committee (EESC) 5th learning forum on upskilling pathways in February 2024 the importance of the EU anticipating trends as opposed to adapting to change was highlighted. This forum discussed the opportunity to reach people with low skills, from disadvantaged economic backgrounds or at risk of social inclusion through flexible pathways to upskilling and lifelong learning. Emerging sector education needs trends from the report will be interpreted by the Work Package Three working group alongside subject matter experts, industries and students to create flexible, online micro-credentials that aim to have an impact and make a social difference in society and people's lives. People require the right set of skills and competencies to avail of employment opportunities, however, traditional pathways have not always lent themselves to equity in education and employment.

In relation to the European University Initiative, to which EU-CONEXUS belongs to, The European Council Recommendation on a European approach to micro-credentials for lifelong learning and employability assert that micro-credentials could help widen learning opportunities to accommodate non-traditional learners and the demand for new skills in the labour market; make the learning experience more flexible and modular; support access to higher education; and engage learners, regardless of their previous qualifications or backgrounds, promoting reskilling and upskilling opportunities, while ensuring quality education (European Commission, 2022).

The OECD Skills Report (2023) stresses the critical role of skills policies in building resilient economies and societies, advocating for investments in education to equip individuals with adaptable mindsets and essential skills to navigate emerging challenges such as environmental degradation and technological risks. Importantly, the report also discusses the role of education programmes which equip participants with skills but also attitudes to manage change as being particularly valuable. It calls upon policymakers to monitor the costs associated with policies promoting the green and digital transition and consider how the transition affects inequalities. More specifically, the report opines that investments in skills and skills policies will help societies anticipate rather than merely react to future challenges in environmental sustainability and ensure human-centred digital technologies that effectively support communication and information exchange. The report quotes high demands for skills related to interacting with technology, thinking creatively, analysing data and information and communicating with actors outside an organisation will grow the most in the period 2019-2030, as confirmed by the outcomes of our report. There is a clear need to scale up knowledge, skills and attitude development in education offerings so that learners can think, plan and act with the sustainability of the planet in mind. Following the adoption of a policy statement towards meeting the goals of the EU Green Deal entitled, “Recommendation on Learning for the Green Transition and Sustainable Development” in June 2022, The European Education Area stated the need to equip learners with the competencies needed to shape a more sustainable economy and society, and stated that learning for the green transition needs to be transformative and interdisciplinary. They continue to discuss the need to focus on cognitive, practical and socio-emotional skills to go beyond just awareness of the climate crisis towards helping learners develop a sense of agency, take action for more sustainability and participate in decision-making processes necessary to enact long-lasting change. Furthermore, the EEA made strong recommendations to bring learning for the green transition as a systemic feature of education and training policy in the EU.

Such a systemic change could perhaps be easier adopted in the context of the new programmes of a European University alliance compared to an existing university where change may be slower to implement. Therefore, EU-CONEXUS, and other alliances, should review these EEA recommendations seriously to reform and embed sustainability and digital skills into new programmes as a key priority and to "actively involve students and staff, local authorities, youth organisations and the research and innovation community in learning for sustainability. Given the vision and goal of EU-CONEXUS, the alliance is well positioned to adopt green competencies from the GreenComp Framework (2022) such as futures literacy, systems thinking, and collective action across the curriculum and embrace how environmental, social, cultural and economic aspects of sustainability are inter-related across disciplines. Through the acquisition of such sustainability competencies transformative learning will equip students with 'knowledge, skills and attitudes that help them become agents of change and contribute individually and collectively to shaping futures within planetary boundaries' (Bainchi *et al.,* 2022).

5. Conclusion and Future Directions

The ambitious targets of the European Green Deal, aiming for a climate-neutral continent by 2050, form the backdrop against which the EU-CONEXUS education initiatives unfold. This report leverages recent industry sustainability needs data to inform the decision-making process for not only what areas of learning education programmes and micro-credentials could be further offered by EU-CONEXUS but also how the education programmes should be offered, ensuring alignment with the transformative goals of the European Green Deal. Bianchi *et al.,* (2022) assert that in learning for environmental sustainability, learners must understand what it takes to think and act sustainably through a transformative holistic approach, where our perspectives are profoundly changed through reflecting on the interconnectedness of our surroundings. Future directions will ensure that the design and delivery of education offerings from EU-CONEXUS are created to support lifelong learning, to upskill and reskill labour market and social impact needs for a just green and digital transition. Adopting and scaling up green competencies as a whole university approach is essential to stimulate a change in mindset and transform how learners interpret the world around them.

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