ERASMUS-EDU-2023-PI-ALL-INNO

Curricula Assessment Research Report

TECONAUT

USING DEEP TECH TO FACILITATE THE ECO TRANSITION IN THE NAUTICAL SECTOR

Co-funded by the European Union

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Executive Summary

The TEcoNaut project, an Erasmus+ initiative, conducted an extensive study to evaluate the *status-quo* of training programs in the shipbuilding and boatbuilding sectors across Europe. The research aimed to identify skill gaps, particularly in green content and advanced technologies, by reviewing existing curricula.

Initially, the project partners from seven countries planned to assess 20 curricula per country, totalling 140. However, due to a lack of relevant studies, the scope was expanded to include nine additional European countries, leading to the evaluation of 151 curricula. Of these, 141 were validated and categorised into Vocational Education and Training (VET), Higher Education (HE), and other training courses.

Key findings revealed significant gaps in the integration of advanced technologies (deep-tech materials) and environmental skills (green content and green skills) in the curricula. The majority of evaluated courses were at VET levels, highlighting the prevalence of vocational training in this sector.

The study underscores the urgent need to introduce sustainable vocational training programs in boatbuilding to align with the European Green Deal's goals and ensure the industry's future sustainability.

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Introduction

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Introduction

The collaborative partners of the TEcoNaut project (an Erasmus+ initiative) conducted an in-depth study of the current state of the boatbuilding sector by evaluating the curricula of existing training programmes across Europe. The research aimed to identify skill gaps between traditional and disruptive technologies, including green content and green skills gaps related to the sourcing, use, application, and end-of-life management of materials in the boatbuilding sector.

Initially, the participating partners from seven different countries agreed to evaluate 20 curricula per country, totalling 140 study plans. However, during the investigation, it was discovered that the predetermined number of evaluated curricula could not be reached within these seven countries due to a lack of relevant studies in the area. Consequently, it was proposed to include additional European countries in the research to enhance the database with valuable insights from countries relevant to the sector.
As a result, the consortium decided to include the curricula of Cyprus, Estonia, Italy, the Netherlands, Norway, Portugal, Sweden, Switzerland, and the United Kingdom for evaluation. Furthermore, some of the collaborating partners included non-maritime-related studies due to the sector's needs and the lack of professionals directly related to the field, incorporating study plans such as Aeronautics and Vehicles.

Ultimately, from a total of 151 identified assessments by the project partners, 141 study plans were validated and evaluated in detail using a common and standardised framework. Of these assessed curricula, 82 belonged to Vocational Education and Training (VET) courses (European Qualification Framework (EQF) levels 3, 4, and 5), 42 to Higher Education (HE) (EQF levels 6, 7 and 8), and 17 fell under the classification of "other", which includes employment training courses, informal and/or unclassified skill development courses, and craft courses.

This approach allowed partners to efficiently assess the current state and key aspects, such as the level of studies, professional focus, green skills, deep tech materials, and environmental content in training programms related to boat construction needs in each country.

Methods

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Methodology

To achieve the project's objective of identifying existing training courses in Europe and identifying skill gaps, a comprehensive review was conducted. This review guided the team's efforts in analysing the content of existing curricula, ensuring the provision of relevant and fundamental information in a standardised and effective manner for the project's needs. To this end, the members of TEcoNaut designed an assessment template to gather essential data that would populate the research with meaningful outcomes for the project objectives, while being expeditious and easy to complete.

Figure 1 - Methodological flow of the Research Assessment.

The process of developing the assessment template was through a collaborative and interactive process, involving different project partners through multiple meetings to build the blocks and refine drafts (Figure 1).

This phase involved several steps, such as identifying the topics to be covered and the set of technicalities to be assessed, defining if it would include open-ended questions - where respondents provide answers in their own words, and closed-ended questions - where respondents would select from a list of pre-defined options, and to define the meaning of the three key words (green skills, deep-tech materials and green content),please note the definition below, being assessed in order to ensure that all respondents would interpret it the same way. Finally, the majority of the assessment included close-ended questions, only providing open-end options in those where the participants could specify the answers and contribute with specific insights/observations.

Key words of the assessment

Green Skills The list of skills from the "Eco-Boat building Guide and Directory" (to be published) was used and is directly linked to another stage of the project that involves conducting a deep "Skills gaps" identification. The results will be connected to ESCO and the new EU Green Taxonomy. ESCO being the multilingual classification of European Skills, Competences, and Occupations relevant for the EU labour market and education and training, which by the end of this project will be able to include a new set of green skills from the boating building sector.

Green Content The inclusion of content related to eco-friendly and sustainable practices in the boat construction process. This can involve aspects such as the use of recycled or biodegradable materials, construction techniques that minimise environmental impact, waste management methods, renewable energies applied to navigation, among other topics that promote sustainability and eco-efficiency in the maritime industry.

Deep-Tech materials The research, development, engineering and production of advanced materials with engineered properties, including ceramics, high value added metals, electronic materials, composites, polymers, and biomaterials. The technologies are diverse and include, among others, nanostructures, synthetic fabrics and wearable technology, enhanced wood-based products, etc.[1]

Geographical Scope of the assessment

The initial proposal was to assess 20 curricula per partner country. However, after encountering difficulties in reaching this target due to a lack of specific training in several participant countries, the scope was expanded to include other countries significant to the boat industry and the nautical sector (Figure 2). These countries are:

- Italy,
- The Netherlands,
- United Kingdom,
- Sweden,
- Norway,
- Switzerland,
- Portugal,
- Estonia, and
- Cyprus.

Figure 2 - Geographical Scope of the Research Assessment.

[1] https://www.eitdeeptechtalent.eu/wp-content/uploads/gb/2023/02/deeptech-definitions.pdf

Standardisation and Data Treatment

Accessing the full versions of the curricula presented some challenges, and interpretations varied. Nevertheless, the information gathered provides sufficient insights into the current presence of green skills, knowledge, and competences in the curricula of boat builders and offers an overview of the sector's educational and professional offerings.
Outliers were found when analysing the data that required attention to ensure the accuracy and integrity of the research. The identified outliers were categorised into three distinct types: duplicate entries, out-of-scope entries and non-identified entries, which were removed from the analysis. The identification and management of these outliers were critical steps in maintaining the reliability and validity of the data analysis, thereby providing a solid foundation for the conclusions drawn.

Business and Management	Construction and Maintenance	Engineering and Technology	Marine Carpentry and Design
Business	Aeronautics	Marine Engineering and Mechanics	Carpentry
Project Management	Shipbuilding/ Boatbuilding	Maritime Engineering	Craft and Design
	Repair and Restoration	Naval Architecture	
	Vehicles	Technology	

Figure 3 - Categories considered in the Research Report (Professional Family and Fields of Study).

To analyse and compare the 152 assessment templates that were completed by the participating partners, standardisation was necessary to organise the information and ensure that a structured report with accurate conclusions could be reached. The standardisation process involved categorising the data into Professional Families and Fields of Study as outlined in Figure 3.
The distribution of Fields of Study and Professional Families was conducted based on the assessment results and the industry's main areas of interest. The categorisation was performed by grouping Professional Families and Fields that shared similarities by considering course descriptions, subjects, and professional outcomes. Furthermore, the differentiation was established using department and school/centre descriptions, resulting in four distinct categories, each with their sub-categories. It is important to note that under the Construction and Maintenance category, there are five courses not directly related to the maritime/marine field. The Aeronautics and Vehicles fields were included by two project partners due to the scarcity of professionals and specialised courses in the maritime field. These areas are considered major workforce sources for maritime companies.

Results

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Results by Educational Level

The initial idea was to assess the presence of "green skills, knowledge, and competencies" in the existing curricula of boat builders within VET courses, as this sector is closest to the labor market. However, due to the lack of specialised training courses in this field, the assessment was expanded to include HE courses and other forms of training, such as private courses not included in formal curricula and that are not vocational training.

Out of the 141 assessed curricula 82 are VET courses (levels 3, 4 and 5), 42 are HE (level 6, 7 and 8) and 17 fall under the classification of "other", which includes employment training courses, unofficial not classified skill development courses and craft courses.

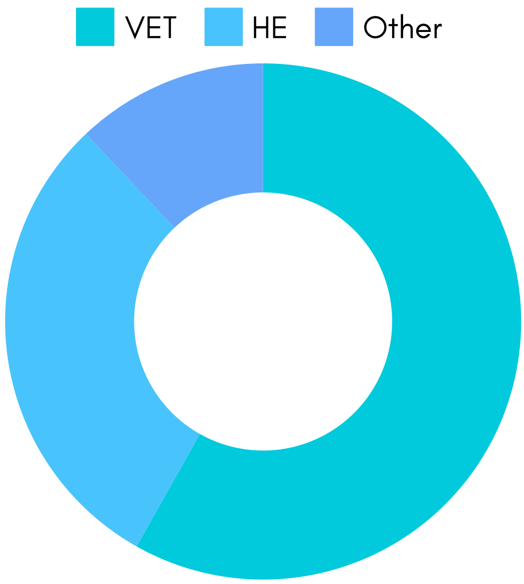


Figure 4: Results by educational level (number).

To address the differences across various educational levels and countries, the template included both the National Qualifications Framework (NQF) and the equivalent level in EQF. This approach enabled a comprehensive comparison of diverse training programs, shaped by each countries specific socio-economic contexts and labour market characteristics.

The EQF is an 8-level, learning outcome-based framework for all types of qualifications. It serves as a translation tool between different national qualifications frameworks, enhancing the transparency, comparability, and portability of people's qualifications, making it possible to compare qualifications from different countries and institutions.[2]
While NQFs link qualifications to EQF level descriptors, tailored to national contexts, enhancing understanding and comparison of qualifications in terms of knowledge, skills, autonomy, and responsibility.

All participating countries, even the new incorporations, are committed to the EQF and have developed or implemented national frameworks covering all levels and types of qualifications. However, Spain, though committed, is still in the process of aligning its NQF with the EQF and has yet to relate its national qualifications framework to the EQF.

[2] https://europass.europa.eu/pt/description-eight-eqf-levels

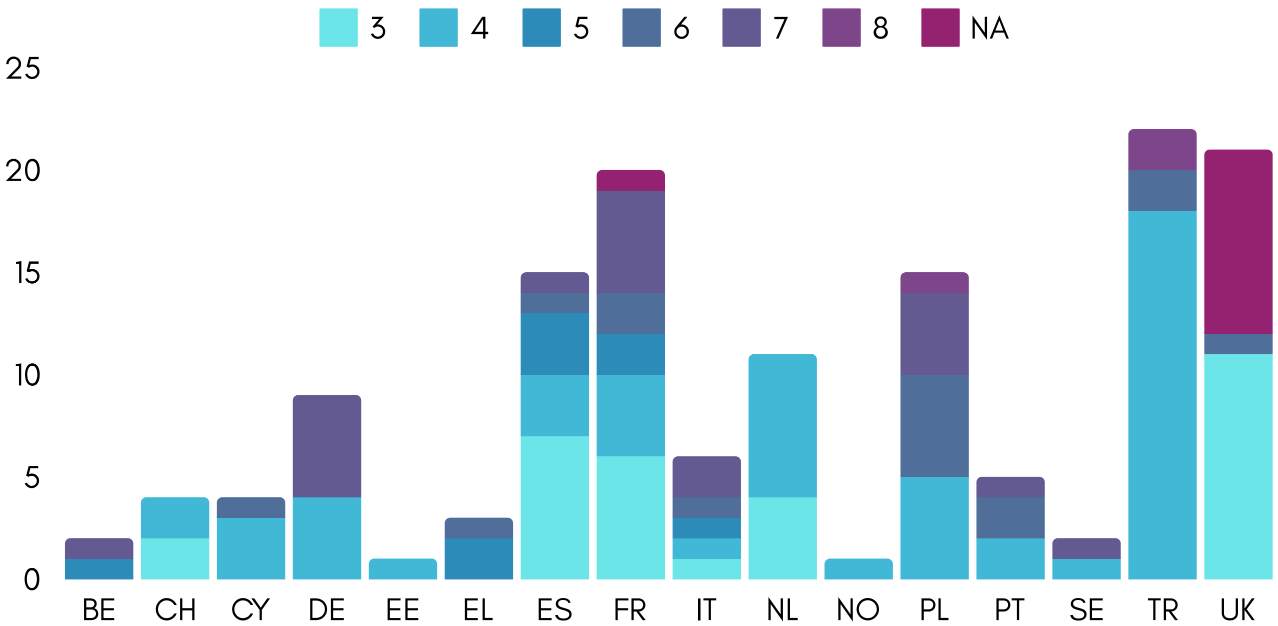


Figure 5: Results by EQF level and country (number).

Looking into the results by EQF level, it is notable that all the assessed countries, except for three (Belgium, Greece and the United Kingdom) have initial VET qualifications at EQF level 4 within the boat building field, but the EQF levels 3 and 5 were those less represented.
On the other hand, HE (EQF levels 6 and 7) represents 25.5% of the analysed curricula. And the results show a small, but relatively homogeneous representation in nearly every country assessed (Figure 5).

It is noteworthy to highlight that the results reveal significant differences between countries, particularly in terms of subjects and study options. For example, from the initially selected countries, Greece and Belgium, strongly lack of relevant studies on the ship/ boat building sector at any level, with nearly non-existent training programms.

The results indicate variations in the percentage of curricula that include green skills, green content, and/or deep tech materials. While higher education findings show consistency in the inclusion of this content, vocational education and training courses exhibit a growing presence of these topics in their curricula.
However, in the three cases (VET, HE and Other) the majority of answers show a lack of green skills in their curricula on boat building, and are not yet including subjects on deep-tech materials and green content. Among the templates received that have detected green skills, deep-tech materials, and green content, only fifteen courses include all three—nine VET courses and six HE courses.

Results by Professional Family

Having considered 4 Professional Families, divided into sub-categories (Fields), the results (Figure 6) provide a direction towards the *status-quo* of the courses in the field. This analysis allows, for both, the institutions to explore and expand their formative offer, and also for students and future students, to have a broader and comprehensive view of their opportunities, labour market status and of their skills' value. It is important to mention that the set of skills presented in the assessment was broad, whereas presence of such courses was scarce in most of the countries assessed.

From the 141 curricula assessed, 67 were included in the Construction and Maintenance and 55 Engineering and Technology, representing together 86% of the total. Clearly, demonstrating that both PF are the most prevalent across countries. In the next section, a brief outlook into the Fields per PF is displayed.

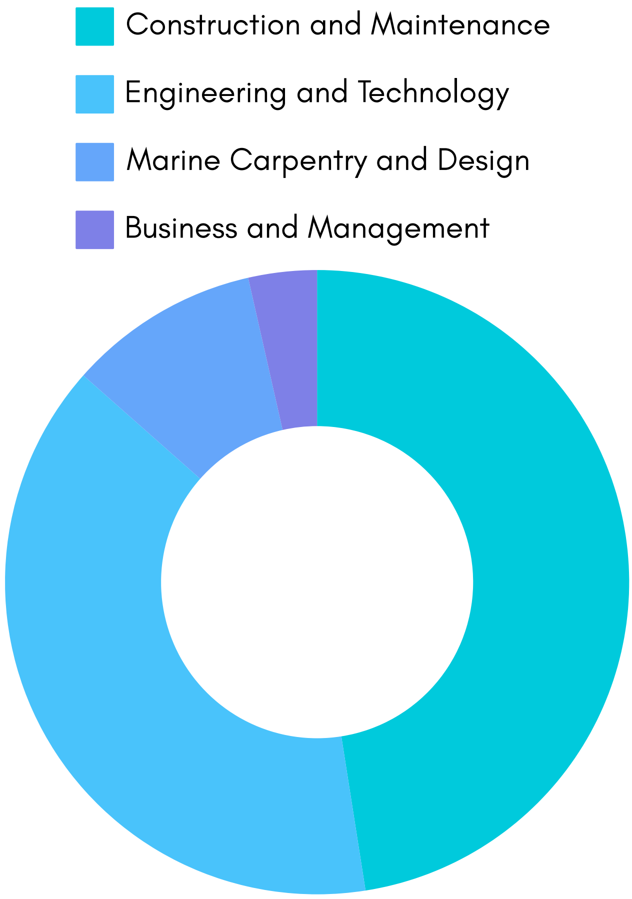


Figure 6: Assessed curricula by Professional Family.

Results by Professional Family

Construction and Maintenance

The category of Construction and Maintenance was the one where most curricula were assessed with 67 entries, representing 47% of the total assessments.

As noted in the Standardisation Process and Data Treatment section, Vehicles and Aeronautics studies are included in the analysis due to their relevance in the workforce of maritime industry activities. These sectors are crucial due to the high demand for professionals with specialised skills in vehicle maintenance and aeronautical systems, which are essential for effectively supporting maritime operations. Shipbuilding/ Boatbuilding was undoubtedly the most assessed, comprising 63 % of the category with 42 entries. Repair and Restoration accounted for 21 % (14 entries), while courses with a strong presence of both construction and repair represented 9% (6 entries). Vehicles accounted for 6 % (4 entries) and Aeronautics with 1 % (1 entry), see Figure 7.

The majority of the courses were Vocational Educational Trainings courses (50 entries), representing 74.6 % from the total of the courses assessed, on the other hand Other type of trainings represent around 18 % (12 entries) and High Education courses assessed only 7.4 % (5 entries) of the total courses assessed (Figure 8).

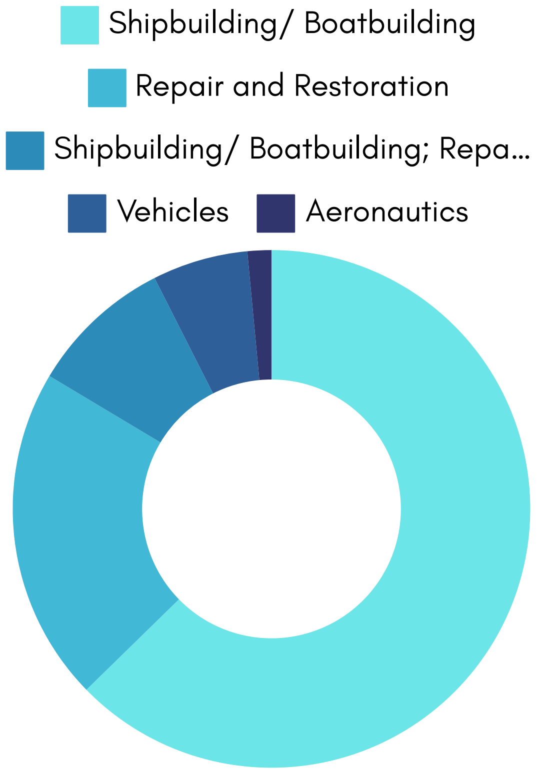


Figure 7: Distribution of the study fields in Construction and Maintenance

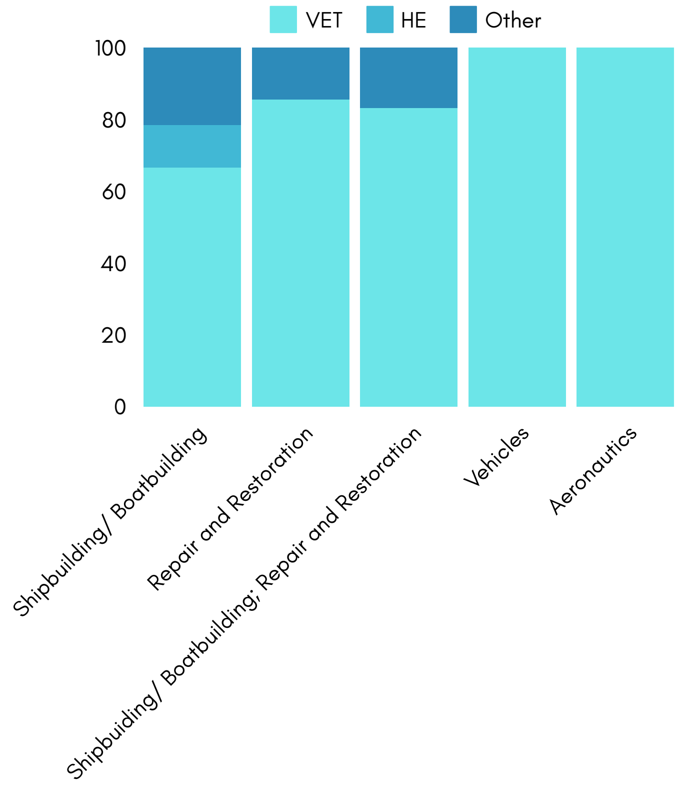


Figure 8: Distribution of the study fields in Construction and Maintenance by Type of Education

Results by Professional Family

Engineering and Technology

Under the broad category of Engineering and Technology, 55 curricula were assessed, representing 39% of the total assessment. This area of study is widely recognised for encompassing scientific, economic, social, and practical knowledge by planning, designing, building, maintaining, and restoring structures, machines, systems, materials, and processes.

Naval Architecture encompasses courses focused on the building and design of ships and marine vessels. Marine Engineering and Mechanics includes courses that involve the design, construction, maintenance and repair of marine propulsion systems and machinery, ensuring their efficient operation. Technology courses within this category cover the study of materials, structures, and elements essential for engineering applications. Maritime Engineering specifically focuses on the study of infrastructure, operations, and logistics related to maritime activities, ensuring efficient and safe transport and navigation of goods and people (Figure 9). The most represented field is Marine Engineering and Mechanics with 18 entries (one third of the total of this professional family), followed by Naval Architecture (14 entries), Technology (12 entries) and Marine Engineering (11 entries).

The majority of the courses assessed are HE courses (32 entries) representing 58% from the total of the courses , followed by VET courses (21 entries), representing 38% , and Other type of trainings representing around 4% (2 entries) (Figure 10).

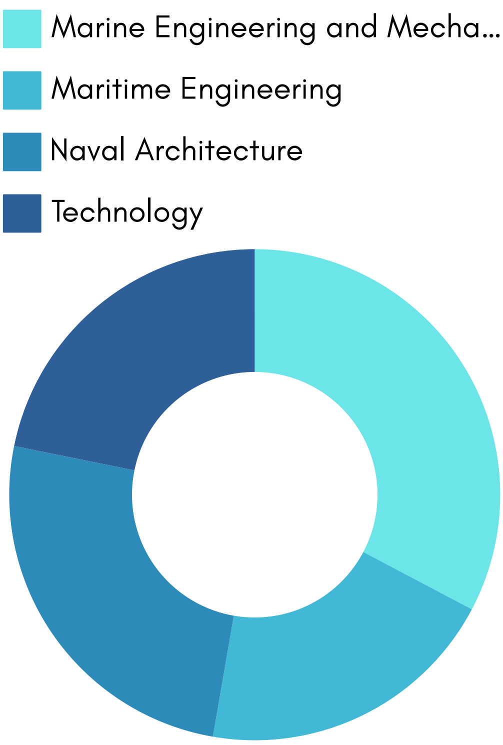


Figure 9: Distribution of the study fields in Engineering and Technology

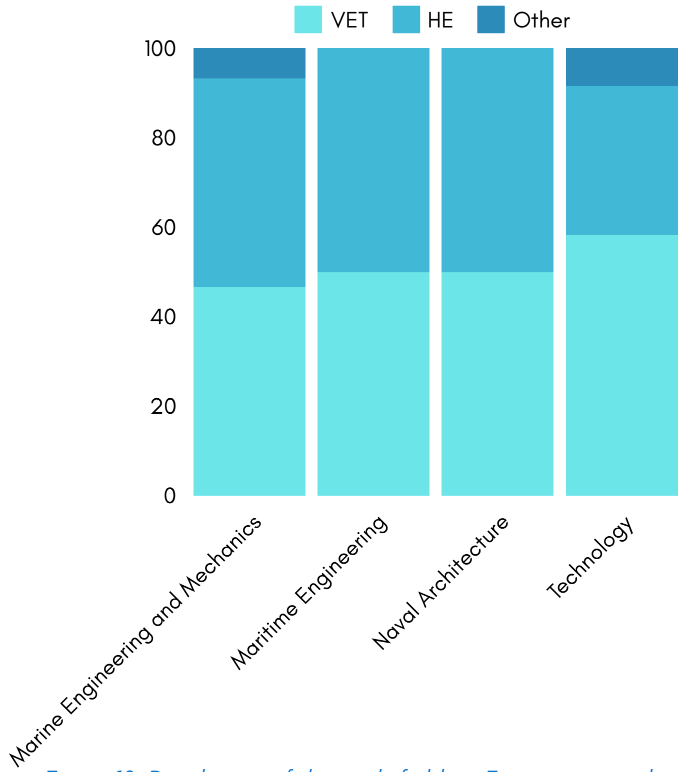


Figure 10: Distribution of the study fields in Engineering and Technology by Type of Education

Results by Professional Family

Marine Carpentry and Design

The Marine Carpentry and Craft Design Professional Family accounted for 14 curricula (10 % of the total assessment), categorised into two distinct fields based on the area of work (Figure 11). The Professional Family of Marine Carpentry and Design provide a specialised angular skill to the maritime sector, in which students are offered the experience of get hands-on on materials and designing techniques, encompassing practical and artistic skills.
The Field of Carpentry involves the skill and trade of cutting, shaping, and installing building materials specifically for maritime applications.

While Craft and Design covers the artistic and functional design of marine-related items and structures through creativity and technical knowledge to produce aesthetically pleasing and practical marine designs.

The categorisation done to include Carpentry (7 entries) accounted with 5 VET courses and 2 Other certification. Regarding Crafts and Design (7 entries), 3 VET courses and 4 Higher Education courses were assessed (Figure 8). So that, the majority of the curricula acessed (71 %) are VET and Other certifications, noting the nature of hands-on activities and practical skills of this Professional Family (Figure 12).

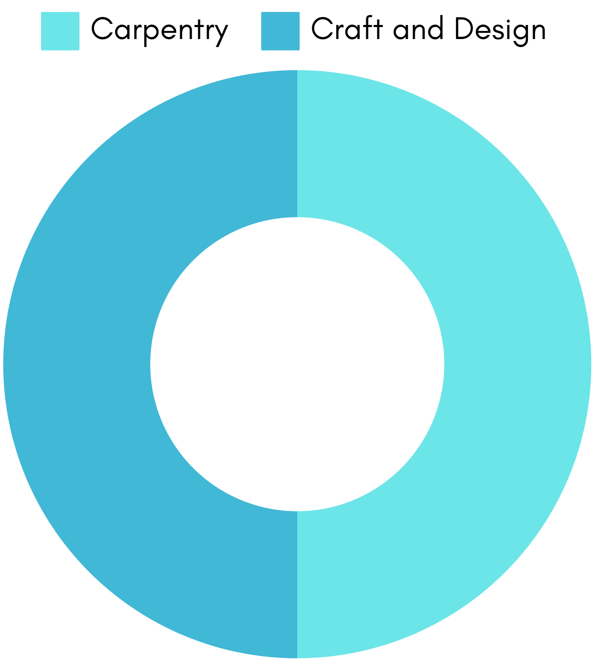


Figure 11: Distribution of the study fields in Marine Carpentry and Design

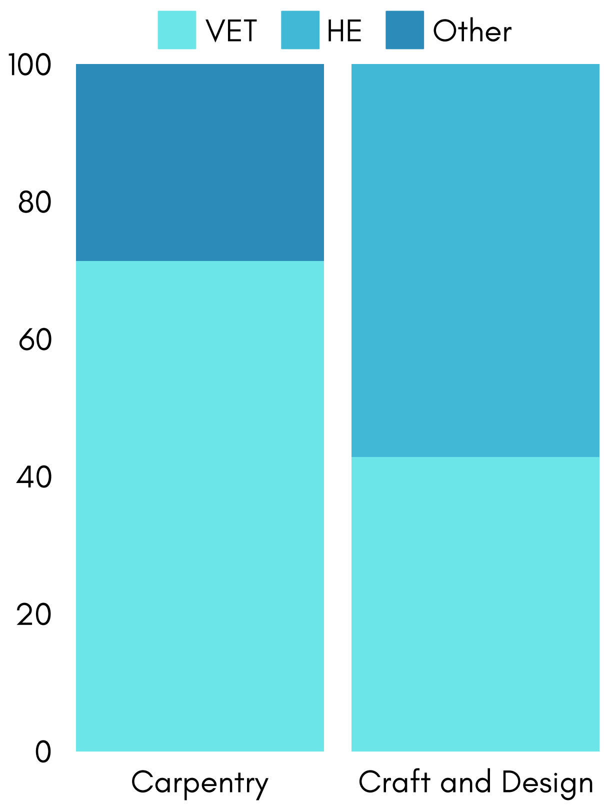


Figure 12: Distribution of the study fields in Marine Carpentry and Design by Type of Education

Results by Professional Family

Business and Management

The least represented Professional Family was Business and Management with only 5 curricula assessed, which represents 4 % of the total assessment, divided by the Fields of Business and Project Management.

This Professional Family covers the administrative and managerial aspects of business operations, particularly in the marine sector, including strategic planning, organisational skills, and project execution to ensure efficient and effective business practices, as well as sales and commercial skills.
The Project Management field courses include project planning and execution, managing and leadership, as well as customer and people relationships and management. On the other hand, courses in the Business field aim to develop skills in sales and product quality, leadership and operations, market analysis, marketing, legal documentation, and customer relationships.

Project Management represents 60 % of the entries, including two VET courses and one Other certification whereas Business accounted for 40 % of the entries, including one VET course and one High Education course (Figure 12 and Figure 13).

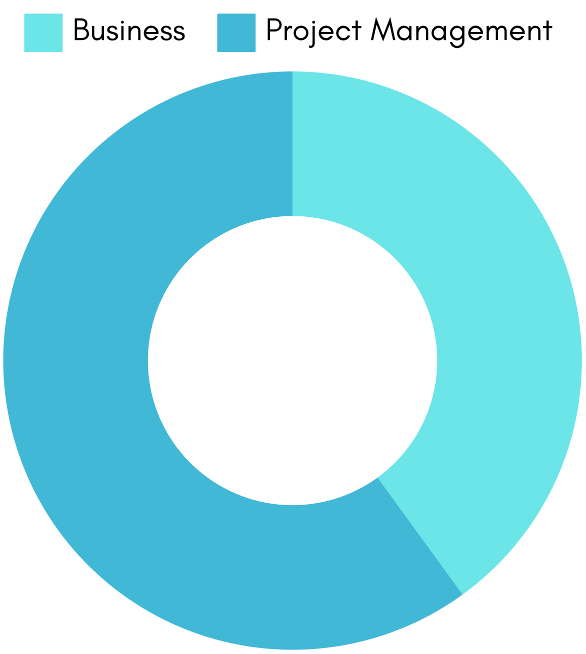


Figure 12: Distribution of the study fields in Business and Management

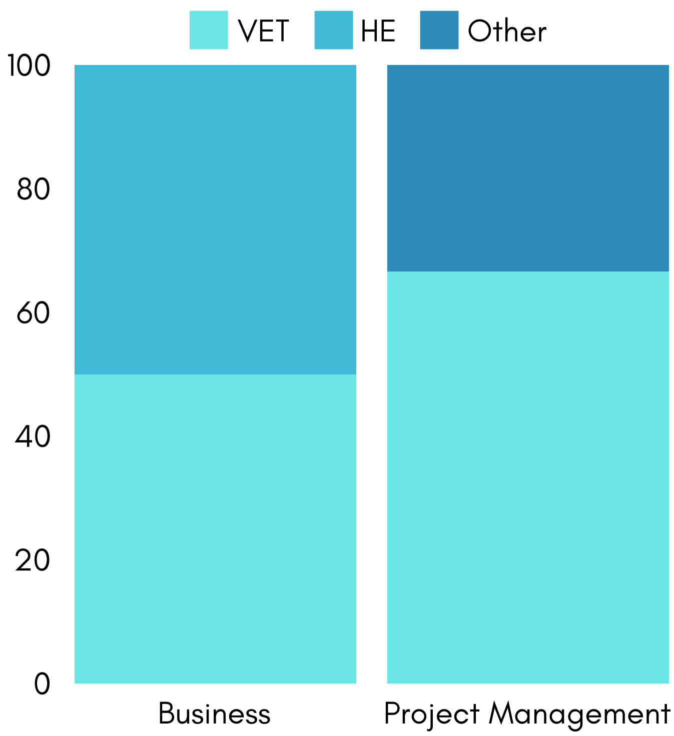


Figure 13: Distribution of the study fields in Business and Management

Results and Analysis of Green Skills

As noted in Figure 14, there is a significant deficit on green skills in the assessed curricula, with only 25% positive responses regarding its inclusion. Nevertheless, several relevant green skills have been identified, including the following:

- Prevention of occupational and environmental risks.
- Pursuit of less polluting alternatives.
- Promotion of sustainable development while maintaining a balance between social, ecological, and economic aspects.
- Utilization of FSC certification to ensure resource sustainability.
- Environmental protection.
- Integration of environmental care in a transversal manner across all work areas.

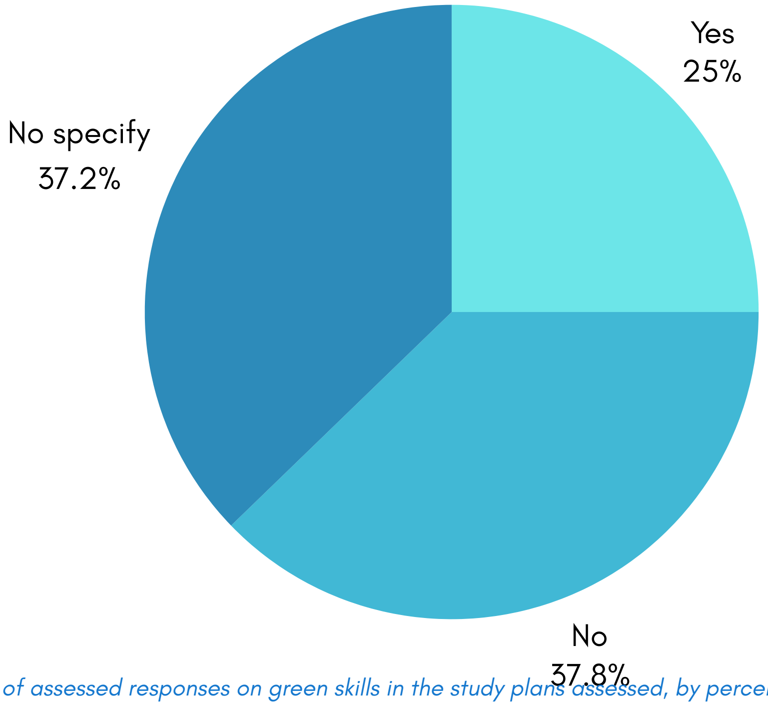


Figure 14: Distribution of assessed responses on green skills in the study plans assessed, by percentage.

Furthermore, it is important to note that many curricula lacked detailed content, turning it's assessment difficult to identify the presence of green skills or green content. However, this limited inclusion directly reflects that sustainable boatbuilding does not have adequate formal training.

In this regard, the questionnaires have revealed a significant lack of knowledge regarding the use of biocomposites, the identification of sustainable materials, the principles of circular economy, KM0 (zero kilometer), the 3Rs (Reduce, Reuse, Recycle), as well as waste separation, reducing water consumption, and eco-design.

In addition to the limitations already mentioned, there is a concerning lack of courses aimed at raising environmental awareness among students. This absence hinders the comprehensive training of future professionals in fields related to sustainability and environmental protection.

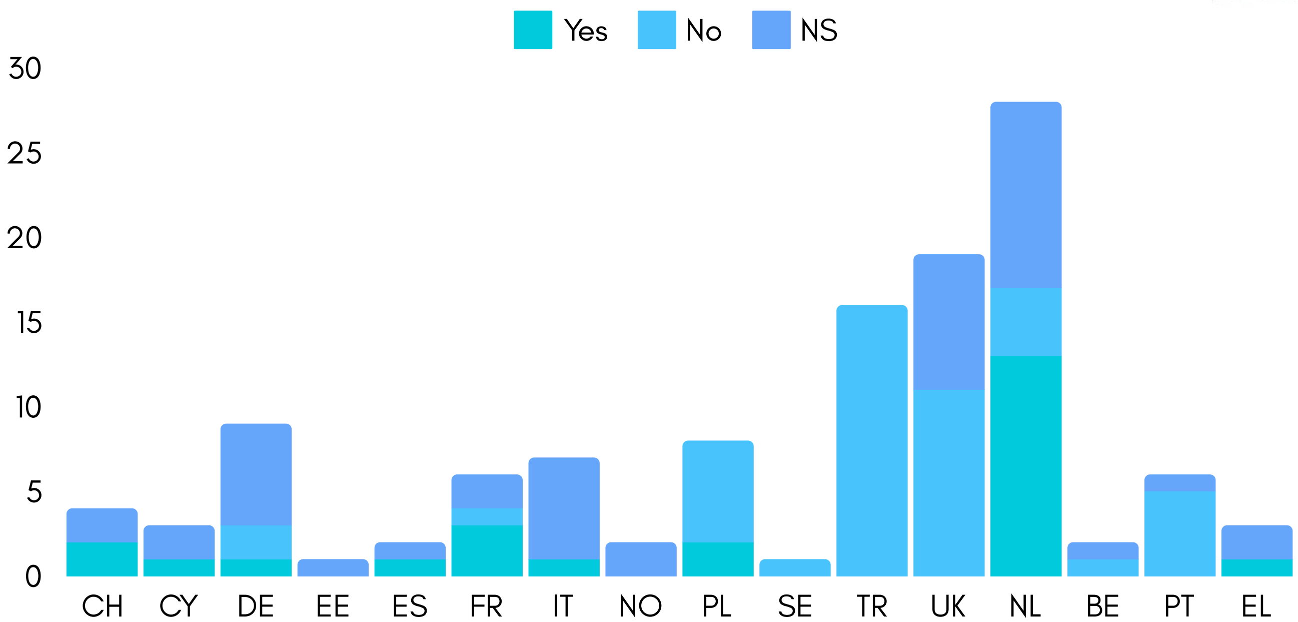


Figure 15: Distribution of assessed responses on green skills in the study plans assessed, by country

Netherlands, France, Spain, Poland, Italy, Switzerland, Germany, Greece and Cyprus are the countries in which Green Skills have been detected in their study plans, as noted in Figure 15, but are still only present in a minority of curricula. Taking into account the scarce information available about this topic in education, it could be due to the following:

Investment in Renewable Energy

Netherlands, France and Spain have made a strong investment in renewable energy in recent years, especially in wind and solar power. This investment creates a demand for green competencies in the workforce, which influences educational priorities.

Active Civil Society and NGOs

In these countries, there is a strong presence of non-governmental organizations and civil society groups that advocate for environmental education and sustainable practices, pushing for the inclusion of green competencies in vocational training.

EU Funding and Programs

As members of the European Union, these countries benefit from various programs and funding aimed at promoting sustainability that supports the development of green skills and competencies.

Collaborative Research Projects

There are many collaborative research initiatives at a regional and international level focused on sustainability, providing educational institutions with resources and experiences that enrich green skills.

Results and Analysis of Deep-Tech Materials

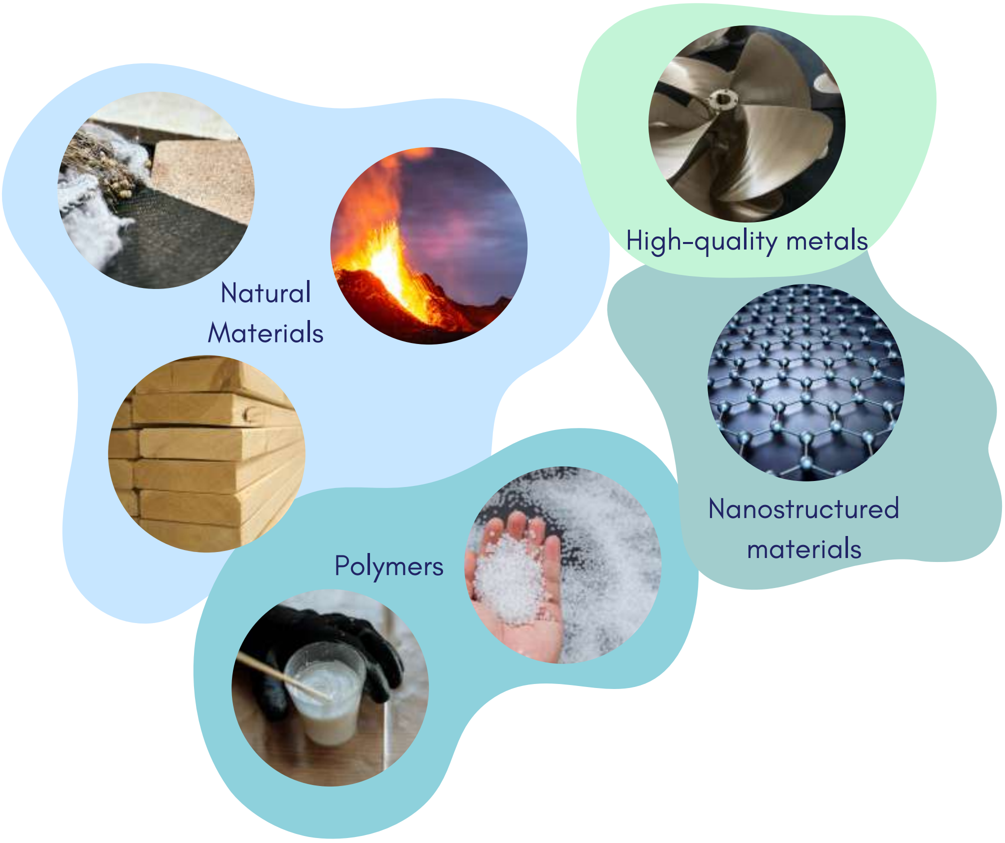


Figure 16: Deep-tech materials used in ship/ boat building

Intensive research is currently being carried out to improve and further develop these materials. The focus is on:

Reinforced composites

Environmental friendly materials

Smart materials

Through these innovations, Deep Tech Materials are helping to significantly improve the performance, durability and efficiency of boats while minimising their environmental impact.

The assessment of deep-tech materials in educational curricula was divided into three categories: included, not included, or not specified. For curricula that did not include deep-tech materials, potential modules for incorporating this content were identified. Eight curricula lacked available syllabi and were marked as "not specified".

Out of the total 141, 48 curricula included deep tech materials, 43 did not, and 42 were not specified. Furthermore, since 8 curricula couldn't be investigaated and detailed, those were categorised as "not specified/no". The distribution is depicted in Figure 17.

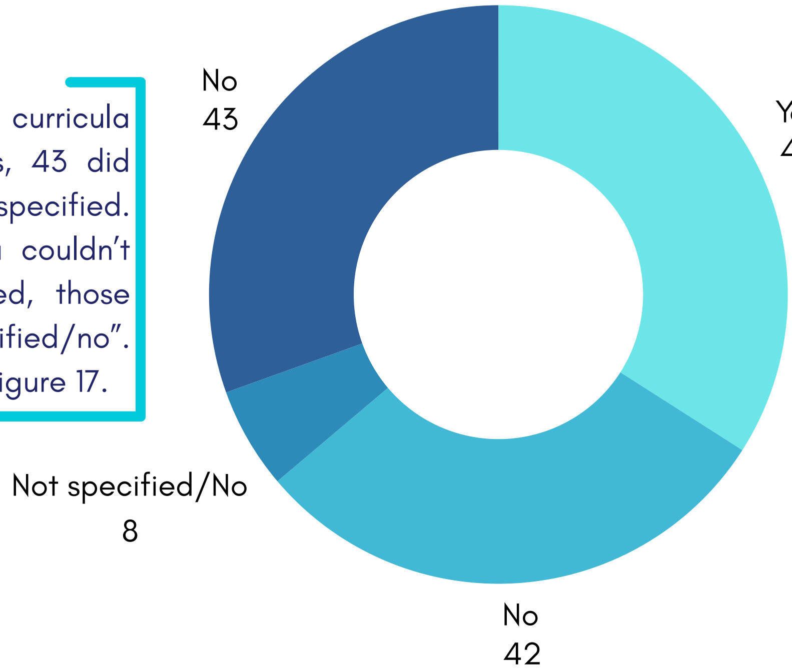


Figure 17: Status of the educational offer in Deep-tech materials.

The distribution across Professional families is illustrated in Figure 18. Non-engineering fields like Business and Management, and Marine Carpentry and Design, had fewer deep-tech material training offerings. Composite materials, on the other hand, were present across all fields, especially ceramics training in Engineering and Technology.

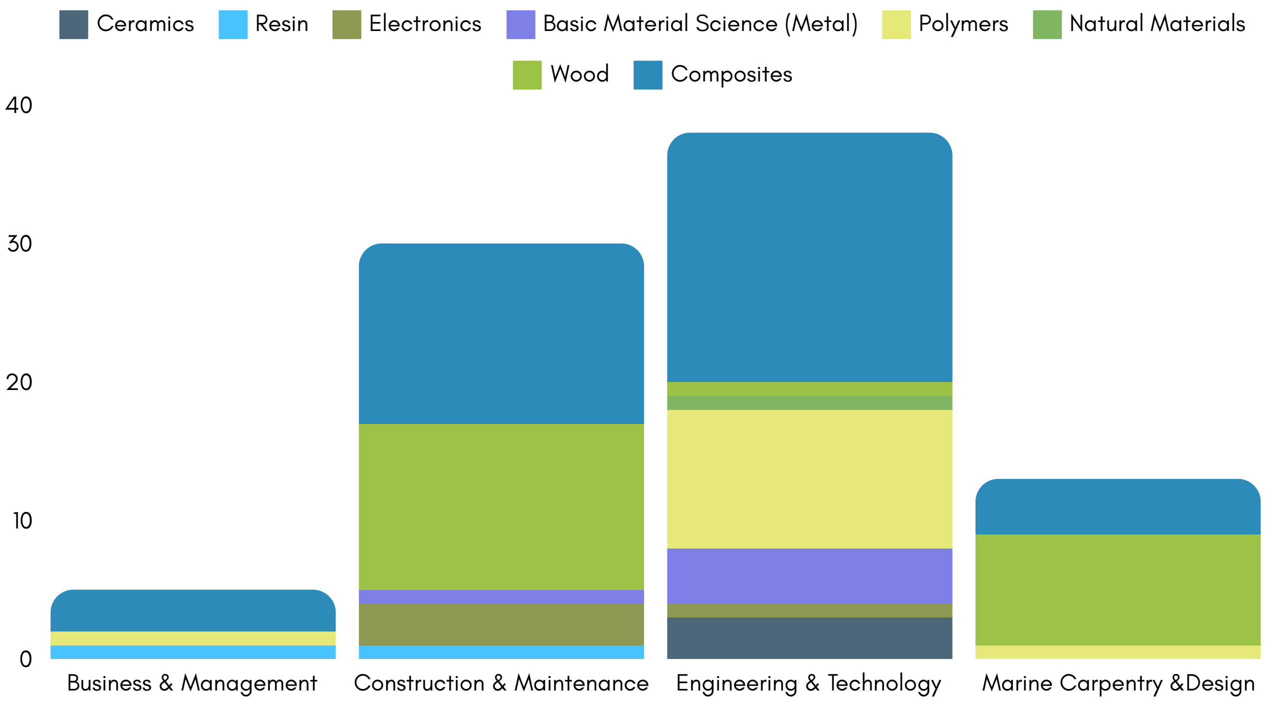


Figure 18: Deep-tech materials distribution by Professional Families

Often, no specific information was provided about the fibre composites or technologies used. It is assumed that glass fibre-reinforced plastics with thermosetting matrices, like epoxy resin systems, are commonly used due to their relative affordability and widespread application compared to natural and carbon fibres. A notable difference between fields of study is that higher education (HE) courses, such as Engineering & Technology, have less wood training compared to vocational education and training (VET) courses like Construction & Maintenance (Figure 19). The types of wood used are not specified, but it is assumed they are common in boat building, such as oak for keels and frames, cedar for hulls and masts, and hardwoods like plywood.

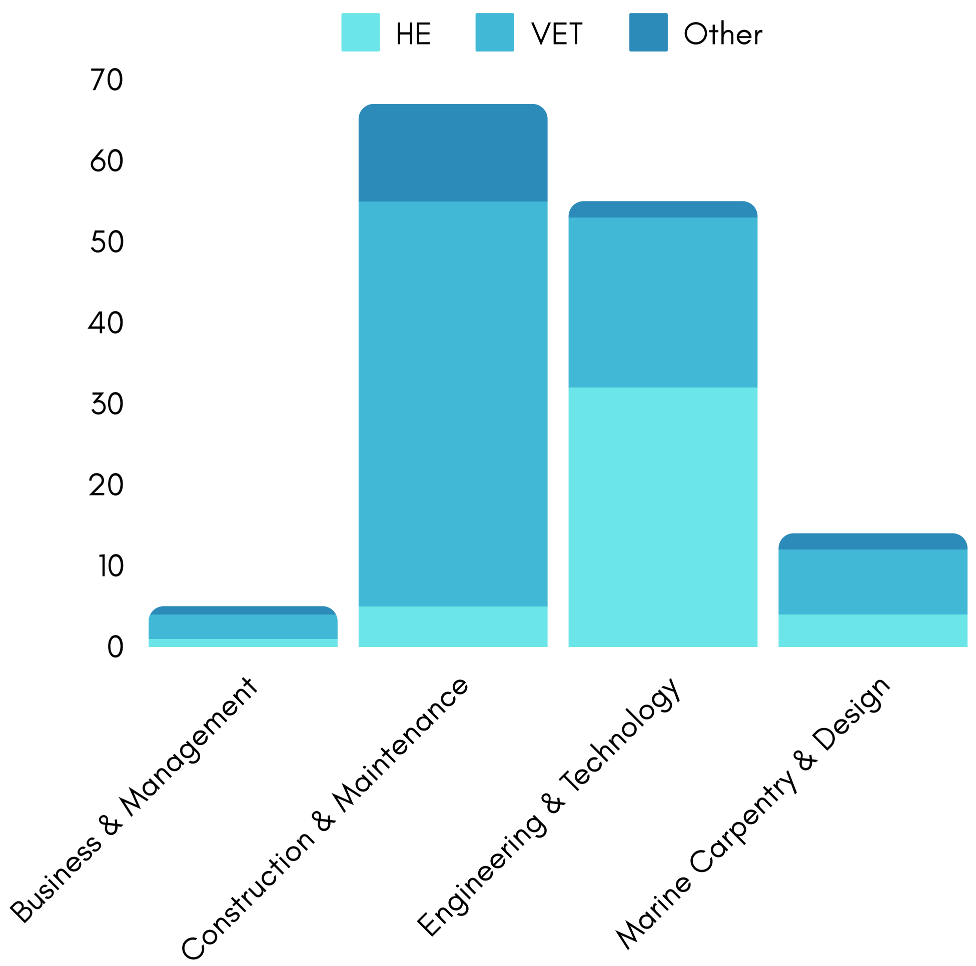


Figure 19: Distribution of quality level across Professional families.

Additionally, it was identified which countries have the highest proportion of curricula including deep tech materials relative to the number of curricula analysed (Figure 20). It is to be highlighted that all French curricula included deep tech materials, followed by the Netherlands with high proportion of curricula containing deep tech materials. Conversely, Portuguese curricula scarcely included deep tech materials, and Polish curricula did not include any deep tech materials. It should be noted that no detailed curricula were available for the eight courses from the United Kingdom, so it could not be assessed whether these courses offer training in deep tech materials. However, from the overview of the content of such courses, some conclusions were able to be made. This information can be of great use in looking up potential teaching content and developing curricula accordingly.

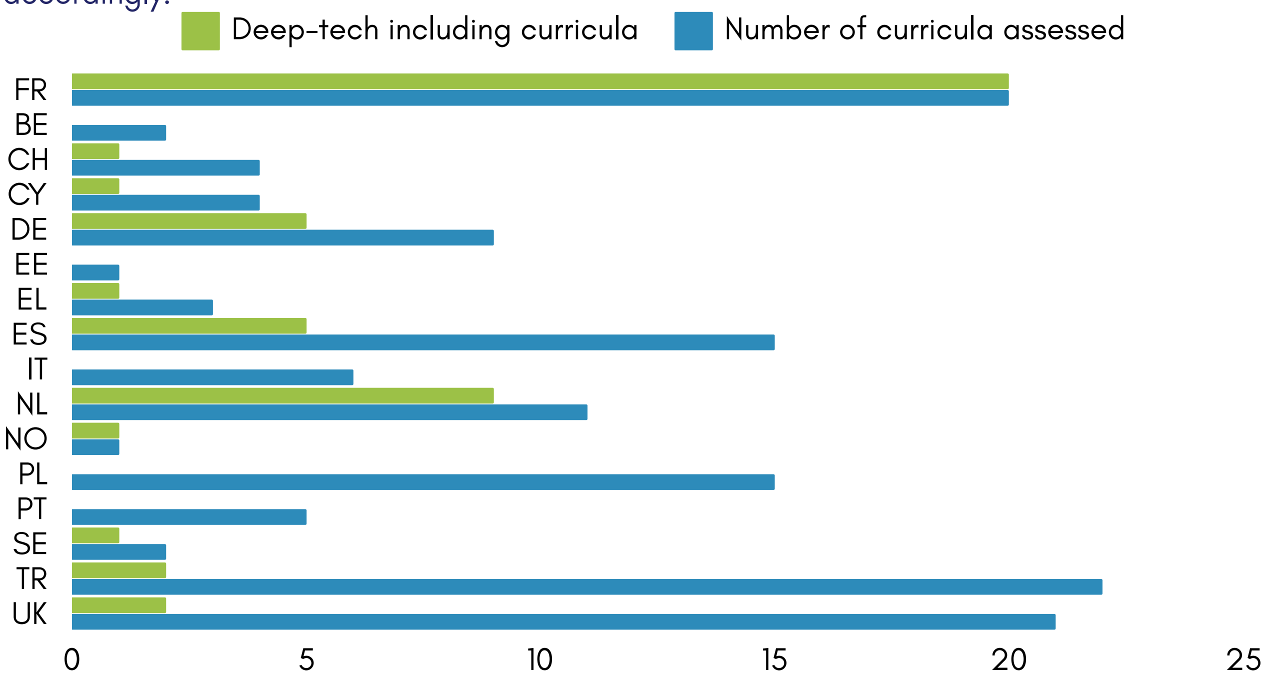
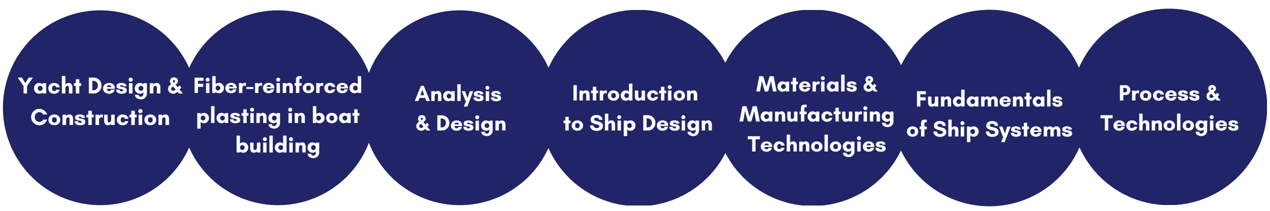


Figure 20: Comparison of the Number of curricula Analysed vs. curricula Including Deep Tech Materials

This analysis offers valuable insights into the current inclusion of deep-tech materials in curricula, identifying gaps and opportunities for development. By addressing these gaps, educational institutions can better align with industry needs and foster innovation. For curricula that did not include deep tech materials, the study identified potential modules, inside the provided syllabus, where such content could be incorporated.

The assessment results would include this topic in subjects such as:



, and Other (e. g. practical courses pr extra elective modules about “deep-tech materials”).

Results and Analysis of “Green” Content

Regarding green content, the responses align closely with those related to green skills. This correlation is logical, as the inclusion of green skills (both practical and theoretical) in curricula directly depends on the content being taught. Consequently, green content has been confirmed in only 22% of the study plans.

Similarly to the green skills presence, the study plans where green content has been detected, this has been based on:

Eco-efficient design and construction

Learning about design and construction practices that minimise environmental impact, such as the use of sustainable materials, energy-efficient construction techniques, and waste recycling methods.

Natural resource management

Understanding the importance of sustainably using marine natural resources, such as water and marine biodiversity, to ensure the conservation of ecosystems and biodiversity.

New materials

Sustainably sourced wood: Utilising wood certified by organizations like the Forest Stewardship Council (FSC) ensures that materials come from sustainable and responsibly managed sources.

Biocomposites

Composite materials that combine natural fibers such as hemp or flax with biobased resin matrices to create lightweight and strong structures.

Regulations and principles

Application sector regulations on quality, health, safety and sustainability. 3R and forms to produce less waste.

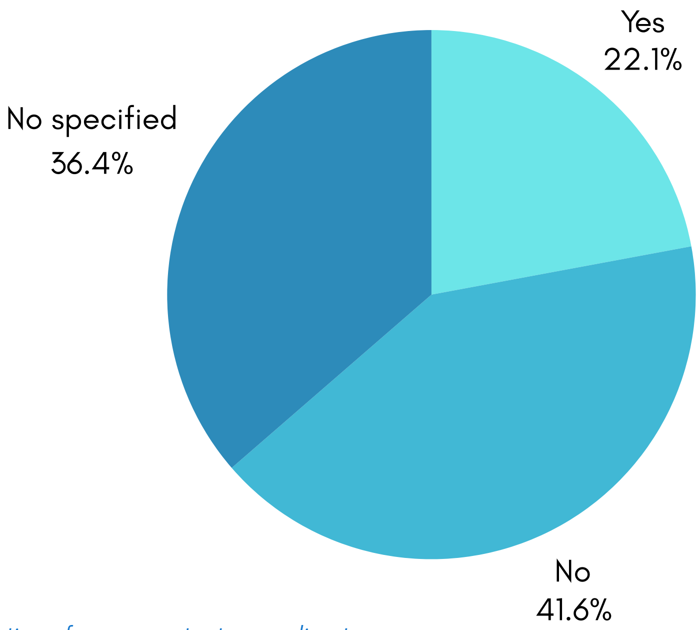


Figure 21: total distribution of green content according to response

Likewise, as illustrated in Figure 22, Netherlands, France and Spain once again emerge as leaders in green content skills. It is noteworthy that France, already identified as the country with the most Deep-Tech content, shows a strong presence of green skills and content as well. However, it is important to keep in mind that the information extracted from the study plans are too limited to draw fully accurate conclusions.

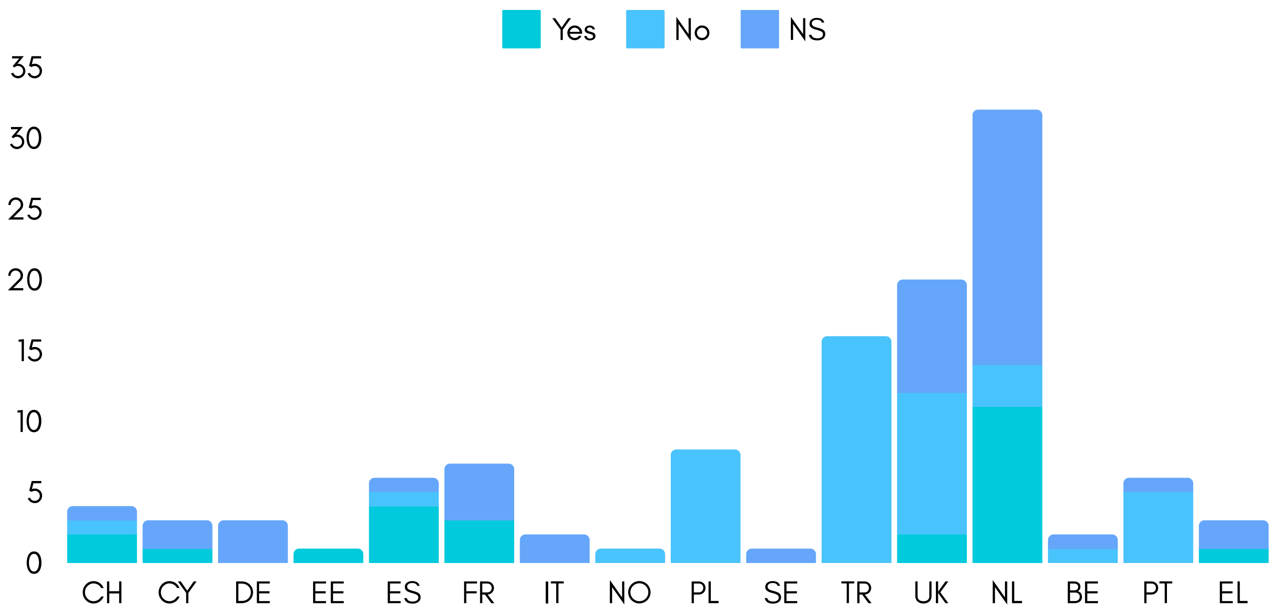


Figure 22: Distribution of green content by country

After analysing the data assessed, it is evident that there is a significant deficiency in core subjects focused on essential topics such as the environment, new sustainable technologies, and the current challenges facing the marine ecosystem. Incorporating this content is crucial to preparing students to address contemporary environmental challenges and equipping them with the necessary tools to innovate and implement responsible practices in their field.

Results and Analysis by Country

As explained in the Methodology section, due to the limited availability of curricula, the analysis was expanded to ensure a comprehensive representation of the educational offerings and industry needs. The assessment includes curricula from 12 EU countries and 48 courses from 4 non-EU countries. Those non-EU countries included 48 courses from two Professional families: Engineering and Technology, and Construction and Maintenance under 7 different fields. In the next section, detailed information is given regarding the individual countries assessed.

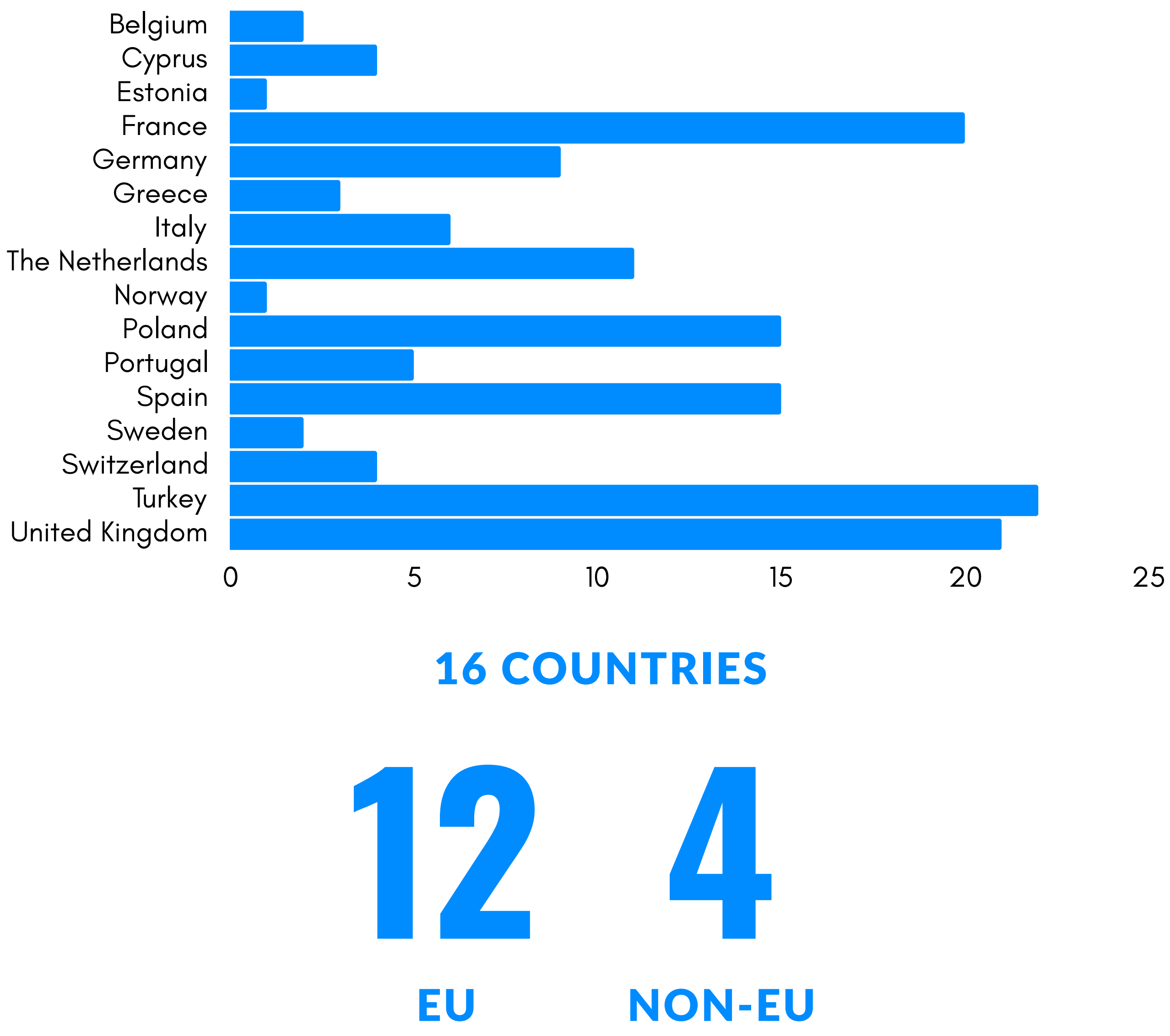


Figure 23: Distribution of green content by country

ESTONIA

1 curriculum

1 VET curricula

- Construction and Maintenance under Shipbuilding/ Boatbuilding.

NORWAY

1 curriculum

1 VET curriculum

- Construction and Maintenance under Shipbuilding/ Boatbuilding

BELGIUM

2 curricula

1 VET curricula

- Engineering and Technology under Marine Engineering and Mechanics

1 HE curricula

- Engineering and Technology under Marine Engineering and Mechanics

SWEDEN

2 curricula

1 VET curriculum

- Construction and Maintenance under Shipbuilding/ Boatbuilding

1 HE curriculum

- Engineering and Technology under Naval Architecture

GREECE

3 curricula

2 VET curricula

- 2 Construction and Maintenance
  - 1 Repair and Restoration
  - 1 Vehicles

1 HE curriculum

- Engineering and Technology under Marine Engineering and Mechanics

CYPRUS

4 curricula

3 VET courses

- Construction and Maintenance
  - 1 Repair and Restoration
  - 1 Vehicles.

1 HE course

- Engineering and Technology under the field of Technology.

PORTUGAL

5 curricula

2 VET curricula

- Engineering and Technology under Marine Engineering and Mechanics

3 HE curricula

- 3 Engineering and Technology
  - 2 Naval Architecture
  - 1 Marine Engineering and Mechanics

SWITZERLAND

4 curricula

4 VET curricula

- Construction and Maintenance
  - 1 Repair and Restoration
  - 3 Shipbuilding/ Boatbuilding

ITALY

6 curricula

3 VET curricula

- 1 Engineering and Technology under Naval Architecture
- 2 Construction and Maintenance
  - 1 Repair and Restoration
  - 1 Shipbuilding/ Boatbuilding; Repair and Restoration

3 HE curricula

- 1 Engineering and Technology under Marine Engineering and Mechanics
- 2 Marine Carpentry and Design under Craft and Design

GERMANY

9 curricula

4 VET curricula

- 1 Engineering and Technology under Technology
- 3 Construction and Maintenance
  - 1 Aeronautics
  - 2 Shipbuilding/ Boatbuilding

5 HE curricula

- 5 Engineering and Technology
  - 1 Maritime Engineering
  - 3 Naval Architecture
  - 1 Marine Engineering and Mechanics

NETHERLANDS

11 curricula

10 VET curricula

- 2 Business and Management
  - 1 Business
  - 1 Project Management
- 5 Engineering and Technology
  - 4 Maritime Engineering
  - 1 Marine Engineering and Mechanics
- 3 Marine Carpentry and Design under Craft and Design

1 HE curriculum

- Marine Carpentry and Design under Craft and Design

SPAIN

15 curricula

9 VET curricula

- 1 Business and Management
  - 1 Project Management
  - 1 Engineering and Technology
  - 1 Naval Architecture
- 1 Marine Carpentry and Design under Carpentry
- 6 Construction and Maintenance
  - 5 Repair and Restoration
  - 1 Shipbuilding/ Boatbuilding

5 HE curricula

- 2 Engineering and Technology
  - 1 Naval Architecture
  - 1 Marine Engineering and Mechanics
- 3 Construction and Maintenance under Shipbuilding/ Boatbuilding

4 Other curricula

- 1 Business and Management under Project Management
- 1 Engineering and Technology under Technology
- 2 Marine Carpentry and Design under Carpentry

POLAND

15 curricula

5 VET curricula

- 5 Construction and Maintenance
  - 1 Shipbuilding/ Boatbuilding
  - 4 Shipbuilding/ Boatbuilding; Repair and Restoration

10 HE curricula

- 7 Engineering and Technology
  - 5 Maritime Engineering
  - 2 Marine Engineering and Mechanics
- 3 Construction and Maintenance under Shipbuilding/ Boatbuilding

FRANCE

20 curricula

11 VET curricula

- 3 Engineering and Technology under Technology
- 4 Marine Carpentry and Design under Carpentry
- 4 Construction and Maintenance
  - 3 Repair and Restoration
  - 1 Vehicles

8 HE curricula

- 1 Business and Management under Business
- 4 Engineering and Technology
  - 2 Naval Architecture
  - 2 Technology
- 1 Marine Carpentry and Design under Craft and Design
- 2 Construction and Maintenance under Shipbuilding/ Boatbuilding

1 Other curriculum

- Construction and Maintenance under Repair and Restoration

UNITED KINGDOM

21 curricula

8 VET curricula

- 2 Construction and Maintenance under Shipbuilding/ Boatbuilding
- 6 Engineering and Technology
  - 3 Technology
  - 3 Marine Engineering and Mechanics

1 HE curriculum

- Engineering and Technology under Maritime Engineering

12 Other curricula

- 11 Construction and Maintenance under
  - 1 Repair and Restoration
  - 9 Shipbuilding/ Boatbuilding
  - 1 Shipbuilding/ Boatbuilding; Repair and Restoration
- 1 Engineering and Technology under Marine Engineering and Mechanics

TURKEY

22 curricula

17 VET curricula

- 16 Construction and Maintenance under Shipbuilding/ Boatbuilding
- 1 Engineering and Technology under Naval Architecture

5 HE curricula

- 5 Engineering and Technology
  - 2 Naval Architecture
  - 1 Technology
  - 2 Marine Engineering and Mechanics

Other Considerations

The findings of this report suggest a broader need for systemic changes within the ship/boat building education sector. The identified gaps in green skills, green content and deep-tech materials are not just academic deficiencies; they reflect a critical need for the industry to evolve in response to global environmental and technological trends. This transformation is vital for maintaining the industry's competitiveness and resilience.

Industry Collaboration: There is an imperative for closer collaboration between educational institutions and industry stakeholders. By aligning curricula with industry needs, educational programs can better prepare students for the evolving demands of the maritime sector. This includes integrating real-world applications of green technologies and sustainable practices into training programs.

Continuous Professional Development and Vocational Educational Training (VET): For current professionals in the industry, CPD and VET programs are essential. These programs should focus on upskilling the workforce with the latest advancements in green technologies and sustainable practices. Industry associations and educational institutions should collaborate to create opportunities that are accessible and relevant.

Technological Integration: The integration of digital tools and technologies in training programs is crucial. These tools can help bridge the gap between theoretical knowledge and practical application, ensuring that trainees are well-prepared for real-world challenges.

Future Research Directions: Finally, the report suggests several avenues for future research. Comparative studies between different regions and educational systems provide deeper insights into effective training models.

By addressing these broader considerations, the boatbuilding industry can not only meet current environmental and technological challenges but also pave the way for a sustainable and innovative future. The TEcoNaut project provides a critical foundation for these efforts, highlighting the need for a coordinated and forward-thinking approach to boatbuilding education and training.

Conclusions

Of the 141 curricula evaluated, a significant gap is revealed in the integration of advanced technologies (deep tech) and environmental skills (green skills) and green content in educational programs in the nautical sector.

This lack of sustainable content highlights the urgency of introducing a sustainable Vocational Training (VET) program in boatbuilding. Although the study is qualitative, its findings underscore the critical need to prepare the boating industry to adapt to greener and more technologically advanced practices, which would be critical for its future development and long-term sustainability.

In this sense, this report reveals the importance of these three concepts, deep-tech, green skills and green content, being connected transversally in all the training subjects in order to ensure that the student finishes this training with technical and theoretical knowledge, with awareness and with capabilities and skills around nautical sustainability.

Moreover, the push for a vocational program in sustainable boatbuilding aligns perfectly with the objectives of the European Green Deal, a transformative strategy aimed at making Europe the world's first climate-neutral continent by 2050. By integrating green skills and practices into the nautical sector through specialised training, we not only address the pressing need for eco-friendly boatbuilding but also contribute to the overarching sustainability goals of the European Union. This synergistic approach not only ensures compliance with the Green Deal's environmental targets but also positions the maritime industry as a key player in the transition towards a greener, more resilient economy.

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