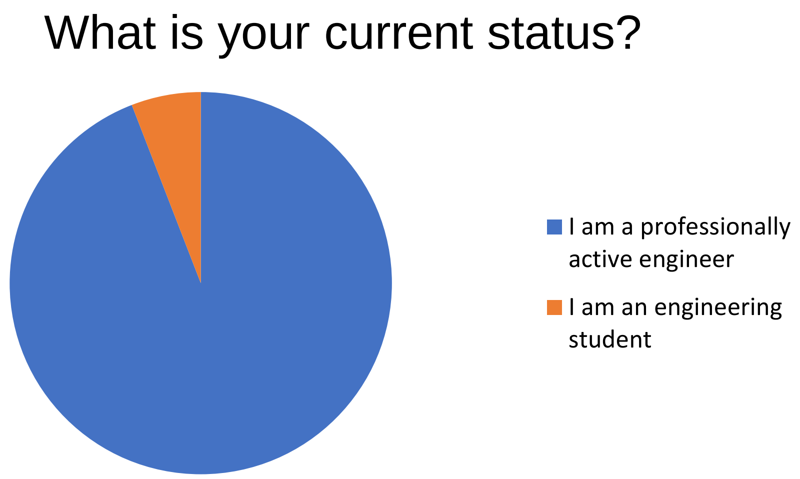
Analysis Engineers4Europe Second Survey

The second survey, conducted from May to June 2024 under the Engineers4Europe (E4E) Project, received responses from 6.489 individuals, with 4.712 engineers completing the full survey. This analysis focuses solely on these complete responses. Respondents had the option to skip certain questions, but only those who submitted the survey are included in the 4.712.

The survey was conducted using SurveyMonkey and disseminated through various (social media) channels of the partners in the project and members in the ENGINEERS EUROPE network.

Of the 4.712 respondents, 4.435 are professionally active engineers (94,12%) and 277 of them are engineering students (5,88%).



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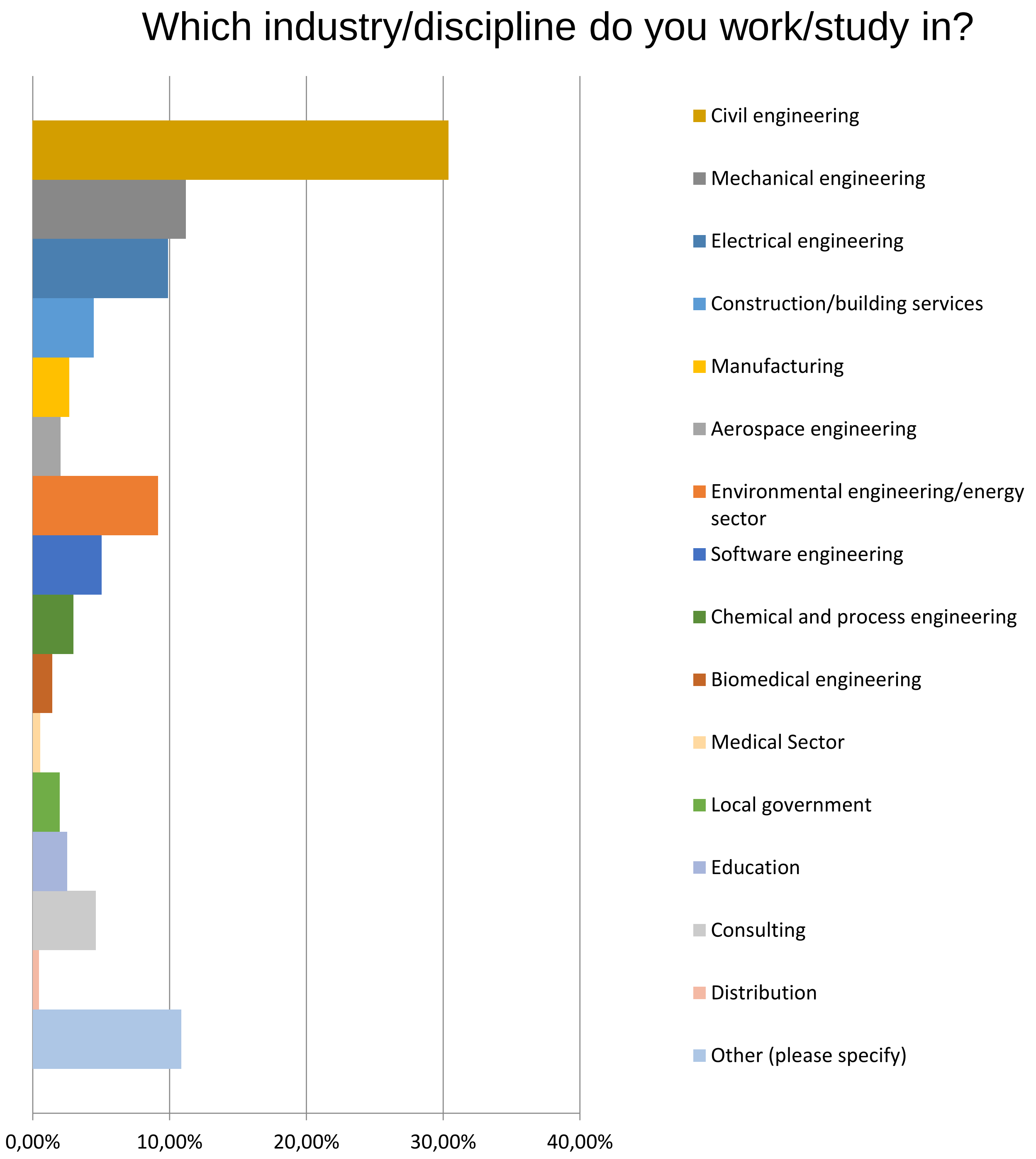
The survey's personal questions inquired about the **industry or discipline** in which the respondents work or study. The top three disciplines are civil engineering (30.39%), mechanical engineering (11.18%), and electrical engineering (9.89%).



Other sectors frequently mentioned include mechatronics, automotive engineering, architecture, telecommunications, and railway engineering.

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The survey then asked respondents which **country** they currently work or study in. Given the overrepresentation of Italian engineers, this analysis weighed the Italian responses to avoid bias. Considering that Italians made up 13% of the European population in January 2023 (Eurostat, 2024), we applied a weighing factor of 0.13 to the Italian responses.

Austria	0,62%	29
Belgium	2,44%	115
Bulgaria	0,49%	23
Croatia	0,02%	1
Cyprus	0,02%	1
Czech Republic	0,51%	24
Denmark	0,11%	5
Estonia	0,15%	7
Finland	0,02%	1
France	0,36%	17
Germany	7,94%	374
Greece	1,68%	79
Hungary	0,04%	2
Iceland	0,04%	2
Ireland	1,17%	55
Italy	52,19%	2459
Kazakhstan	0,00%	0
Latvia	0,04%	2
Lithuania	0,02%	1
Luxembourg	0,02%	1
Malta	0,51%	24
The Netherlands	1,72%	81
North Macedonia	0,06%	3
Norway	0,30%	14
Poland	11,44%	539
Portugal	4,20%	198
Romania	1,29%	61
Serbia	1,63%	77
Slovakia	0,93%	44
Slovenia	0,17%	8
Spain	6,47%	305
Sweden	0,11%	5
Switzerland	1,87%	88
Turkey	0,06%	3
Ukraine	0,00%	0
United Kingdom	0,64%	30
Other	0,72%	34

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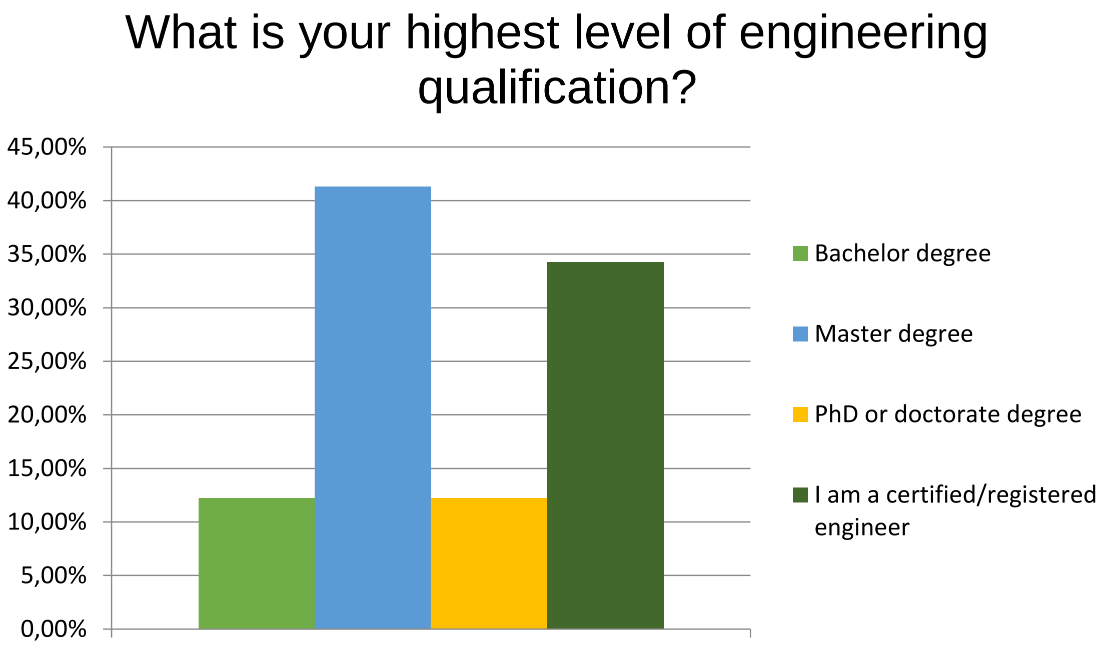
The questionnaire inquired about the **highest level of engineering qualification** achieved by the respondents, excluding those who identified as students. Most respondents have a master's degree in engineering, followed by a significant number of certified or registered engineers.



Regarding professional experience, excluding students, respondents reported an **average of 21 years** in the engineering field.

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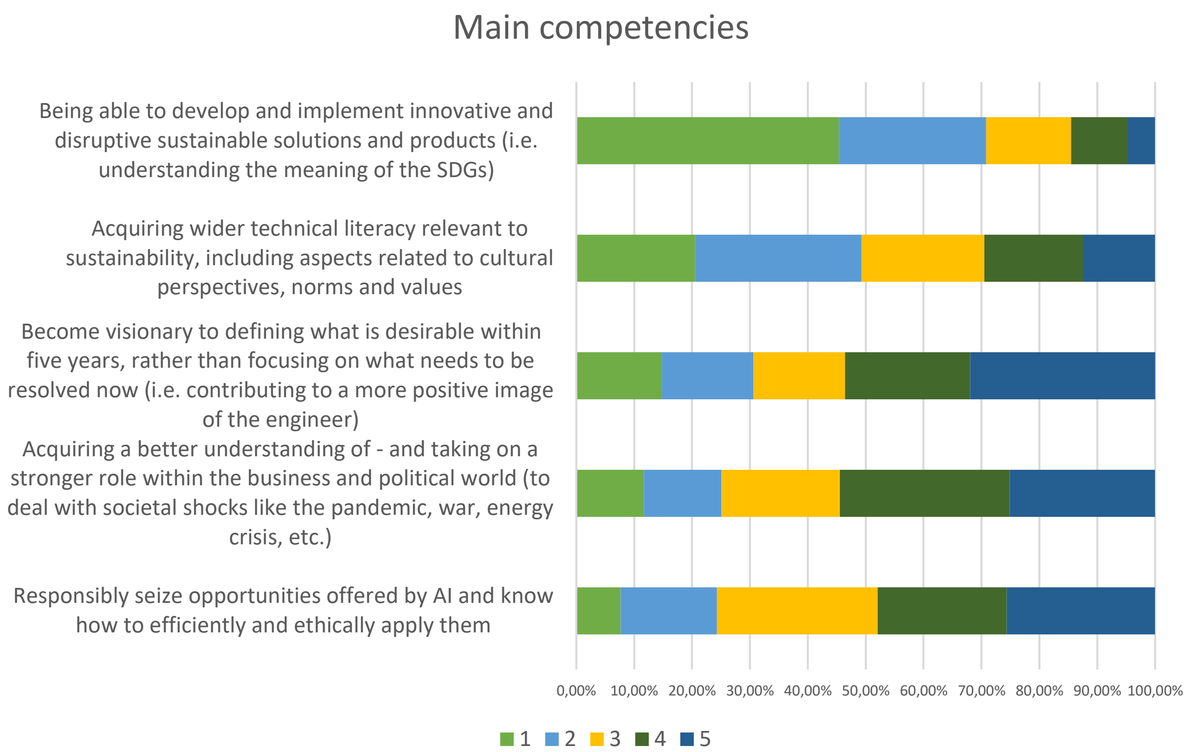
In the sixth question, respondents were asked to rank the **main competencies** they believe are essential for the future of the engineering profession. Italian responses were weighted with a factor of 0.13 in this analysis.



The highest-ranked competency was “being able to develop and implement innovative and disruptive sustainable solutions and products (i.e. understanding the meaning of the SDGs)”. Surprisingly, "responsibly seizing opportunities offered by AI and applying them efficiently and ethically" was ranked first by less than 10% of respondents. Most respondents placed "becoming visionary in defining what is desirable within five years, rather than focusing on current issues" last.

When comparing the responses of professionally active engineers and engineering students, no clear differences emerge in the ranking of the competences listed above. Similarly, there are no significant differences in rankings when comparing respondents with bachelor’s versus master’s degrees, or when comparing engineers in “traditional disciplines” such as civil, mechanical, and electrical engineering with those in “newer fields” like software, environmental, and biomedical engineering.

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An open-ended question asked respondents about **changes needed in engineering education and training programs to better prepare students.** This question was answered by 2749 respondents. Responses in languages other than English, those with no valuable relation to engineering education, and answers like “I don’t know,” “no,” and “nothing” were excluded from the analysis, leaving around 2500 relevant answers.

In the word cloud on the left, the most frequently used terms in respondents' answers are visualized, with the size of each word corresponding to the number of mentions.

The majority of respondents (over 50%) highlight the engineering education should include more **practical** learning and a stronger **connection to the industry**.

The most recurring theme is the need for more practical training and experience during higher education. Alongside this, many respondents highlight the importance of **better collaboration between universities and industry** to align with the evolving labor market and the demand for innovative technologies and products. There is also a call for aligning the curriculum with the “real world” and addressing “real problems,” as opposed to the traditional focus on theoretical classes and exams.

Respondents frequently mention the need for more **job training sessions** and (mandatory) **practice in companies, laboratories, or construction sites**. They strongly advocate for classes taught by engineering professionals rather than a curriculum solely delivered by academics. Additionally, focusing on projects and real work-related situations, along with applicable **regulations and technical standards**, is suggested as a way to gain more hands-on experience.

Internships and apprenticeships, perhaps mandatory, are highly favored, as are practical case studies that help build a **professional network** already during students’ education. Including student organizations is also mentioned to support engineering students' development through collaborative

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projects with companies. These approaches could additionally provide them with a broader perspective on non-technical aspects, which will be analyzed in detail later.

Around 10% of respondents emphasize the importance of integrating **digitalization and Artificial Intelligence (AI)** into the engineering education. They argue that new professions will emerge in engineering, and educational institutions should prepare future generations for these advancements. Proficiency with the **latest software, programming, design modelling, and computer simulations** will be essential parts of an engineer's career and should therefore be highlighted during their studies. AI is seen as a tool to optimize work and offer cost and time-saving advantages.

There is a clear consensus that engineering education should stay current with these developments, and professors should be knowledgeable in the latest digital tools. However, some respondents express strong doubts about the use of AI in engineering studies, fearing it may lead to students being lazy and a **lack of understanding of underlying calculations**. Others support the integration of AI but advocate for combining it with the **human aspects** of engineering to ensure engineers remain indispensable.

Around 5% of respondents emphasize the importance of **climate change and energy efficiency** in engineering. Several argue that it is an **engineer's duty to be involved in the green transition** and that this topic deserves more focus in courses, as sustainability impacts on various scales and nearly all sectors. Most of these respondents believe that graduate engineers should be more aware of the **sustainable and economic aspects** of the technical solutions they implement. A significant portion of the responses with a "green focus" are oriented towards the construction sector and energy solutions.

Around 20% of the respondents highlight the importance of **professional and non-technical skills**. There is a clear distinction between professional or soft skills, such as critical thinking, communication, collaboration, and creativity, and non-technical skills from other disciplines, such as business and economic understanding, law, languages, and project management. In the word cloud on the right, the most frequently used terms in these answers are visualized, with the size of each word corresponding to the number of mentions.

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About 20% of respondents who mention professional or non-technical skills emphasize **business**, **economics**, and **finance**. These respondents frequently highlight the importance of understanding basic economic and financial principles, as well as business management, for engineers.

Related to these professional skills, **inter- or multidisciplinarity** is mentioned in 3% of the answers. These respondents stress the importance of the **interplay between technology and other disciplines such as social sciences and economics**. They argue that to understand the world behind engineering, one must also learn that "the world is not only a mathematical one." Societal development and impact are frequently mentioned, along with **system thinking** and **inter- or cross-construction learning**. The "bigger picture" is also referenced several times to emphasize the importance of a broader perspective within the engineering curriculum. Additionally, working or studying in **multidisciplinary teams** is suggested as a method to broaden engineering students' viewpoints. Open-mindedness and "thinking outside of the box" are considered by some respondents to be beneficial for the engineering curriculum, as well as a holistic approach to projects.

We now shift our focus to the open answers concerning the **structure of engineering curricula** in different European countries, the **competencies and importance of teaching** staff, and **preparation in primary and secondary education**.

There is a notable divide between respondents who advocate for a **modern, innovative curriculum that aligns with technological advancements and societal trends, featuring a high degree of specialization** in contrast with others who prefer a more **traditional engineering curriculum that emphasizes a robust theoretical foundation with a strong focus on mathematics and physics**.

The first group emphasizes the benefits of incorporating online education, practical labs, and new engineering skills to address future challenges. In contrast, the more traditional perspective often expresses a desire for the pre-Bologna system, where there was no separation between bachelor's and master's degrees. Some advocate for a curriculum longer than five years with a mandatory entrance exam to ensure a high level of professionalism among graduates. This viewpoint frequently critiques the current curriculum for "excessive specialization," arguing that it neglects the foundational engineering knowledge.

However, some respondents advocate for a balanced approach, **maintaining high scientific standards and valuing theoretical engineering knowledge** while also calling for **increased practical study opportunities, including internships and apprenticeships**.

Regarding the competencies of **teaching staff**, there is often a desire for more direct contact between students and professors. Additionally, respondents emphasize the importance of professors staying current with technological trends and suggest that having teaching staff with experience in industry or business would be beneficial.

Lastly, a small segment of the responses focuses on enhancing motivation for pursuing engineering from **primary and secondary school** levels. This includes promoting engineering careers and improving technical and mathematical preparation. Additionally, the importance of recognizing the profession's **status and the associated social responsibilities** is frequently highlighted.

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Regarding **assessment and examination**, a similar distinction is evident. Some respondents advocate for more specialized and problem-based exams to better prepare students for professional practice and call for a reduction in theoretical exams. Others then argue for more challenging exams as a response to what they perceive as the “simplification of the curriculum,” as seen in Italy, for instance.

Apart from the curriculum, attention is given as well to **international collaboration** and the standardization of educational requirements in Europe. “In Europe there is a different concept of what “engineer” means depending on the country are in. [...]. With different training plans ranging from 2 to 5 years.” A call is made to push **common European regulation** on the study programs and a push for English taught courses.

Another point raised is the need for increased **student exchanges to foster cooperative networks** and facilitate the sharing of best practices across Europe.

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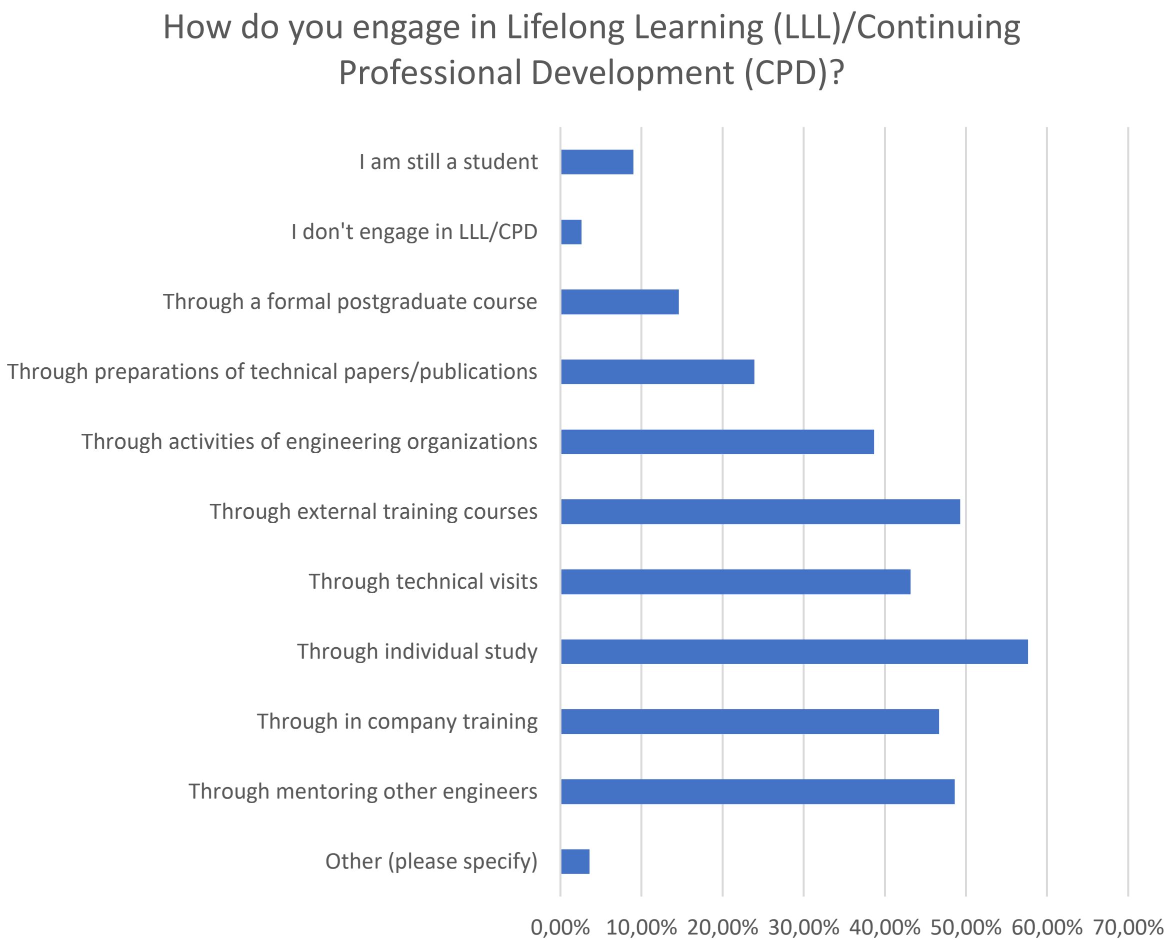
To understand how engineers engage in **Lifelong Learning (LLL) or Continuing Professional Development (CPD)**, the survey allowed respondents to select multiple options. Over half (57.66%) study individually in their field, followed by attending external training courses (49.29%) and mentoring other engineers (48.63%). Italian responses were also weighted in this section.



Of the 4.663 engineers who responded to this question, 148 indicated an additional method of LLL/CPD in the “other” category. "**Learning by doing**" was mentioned several times, accompanied by the belief that every engineer should continuously learn on the job. Other responses included participating in **competitions**, attending or delivering **conferences and meetings,** taking **online courses**, and learning through **project involvement**.

A notable recurring comment was that Italian engineers are regulated in their LLL/CPD activities, being required to earn 30 credits annually to practice their profession. However, this regulation is not always seen positively, with some engineers feeling "forced to take non-relevant training courses to fulfill credit requirements." Additionally, engaging in **politics** and **volunteering activities** (in professional engineering organizations, alumni organizations, etc.) were also mentioned. Lastly, another remarkable comment was the practice of "changing jobs (but not employers) every four years."

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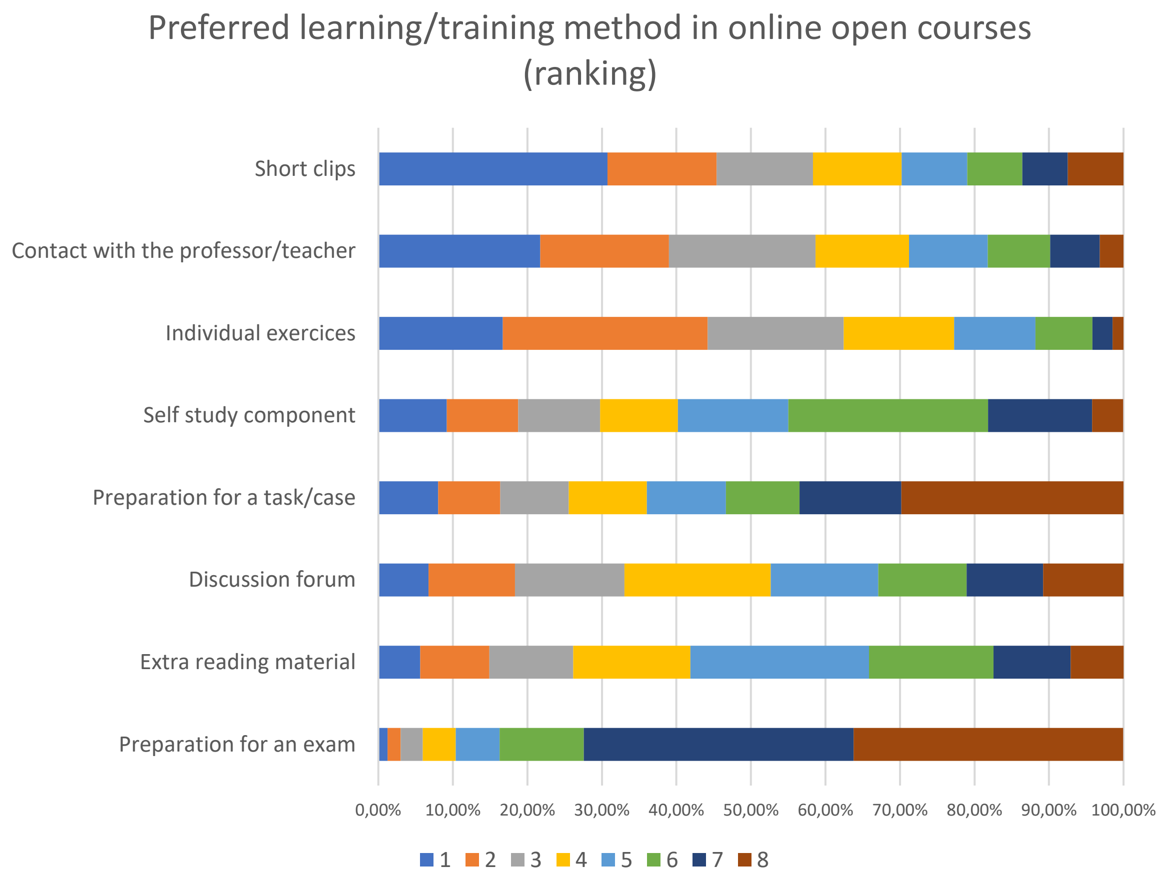
The survey then asked respondents to rank their **preferred training and learning methods in online open courses**. The Italian answers are weighed to avoid bias.



Short clips were the most preferred (ranked first by 30.76% of respondents), followed by contact with the professor/teacher (21.72%) and individual exercises (16.69%). Preparing for an exam was the least favored method.

Based on student responses, discussion forums are rated higher than task/case preparation, with extra reading materials being the least preferred learning method in an online open course.

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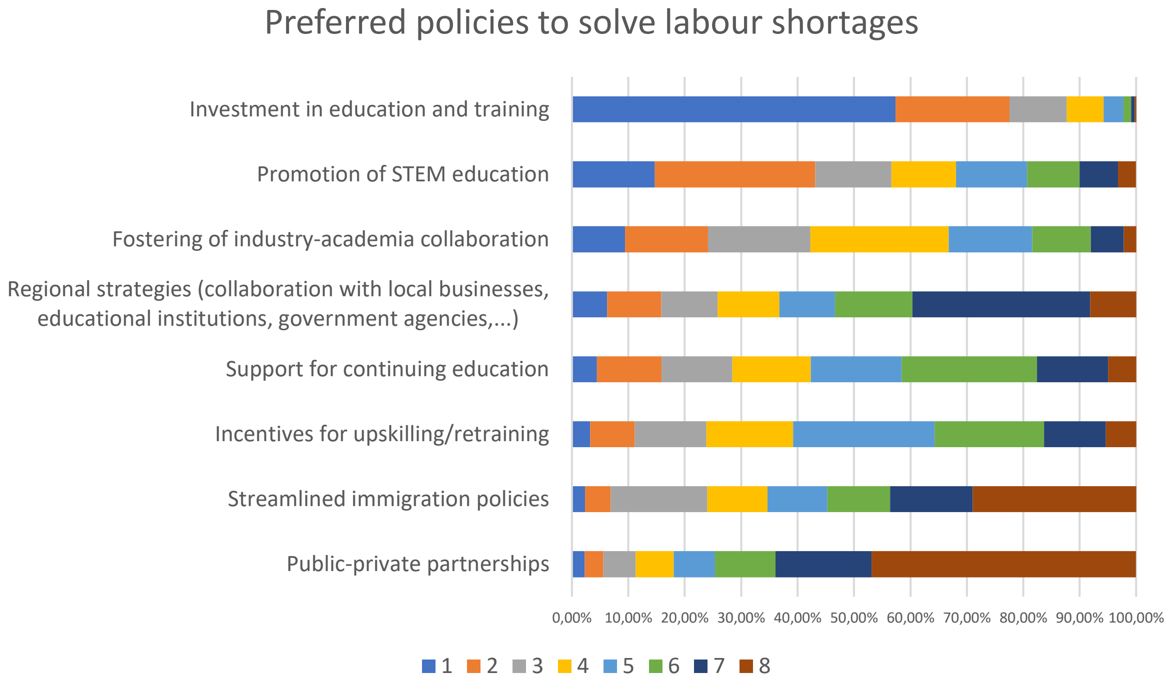
For the tenth question, the survey sought opinions **on effective strategies or policies to address labor shortages**. After weighing the Italian responses, 2.180 respondents answered this question and 392 continued without answering.



When ranking the options, 57.37% of respondents prioritized "investment in education and training," and 14.72% prioritized the "promotion of STEM education." "Streamlined immigration policies" and "public-private partnerships" were mostly ranked last.

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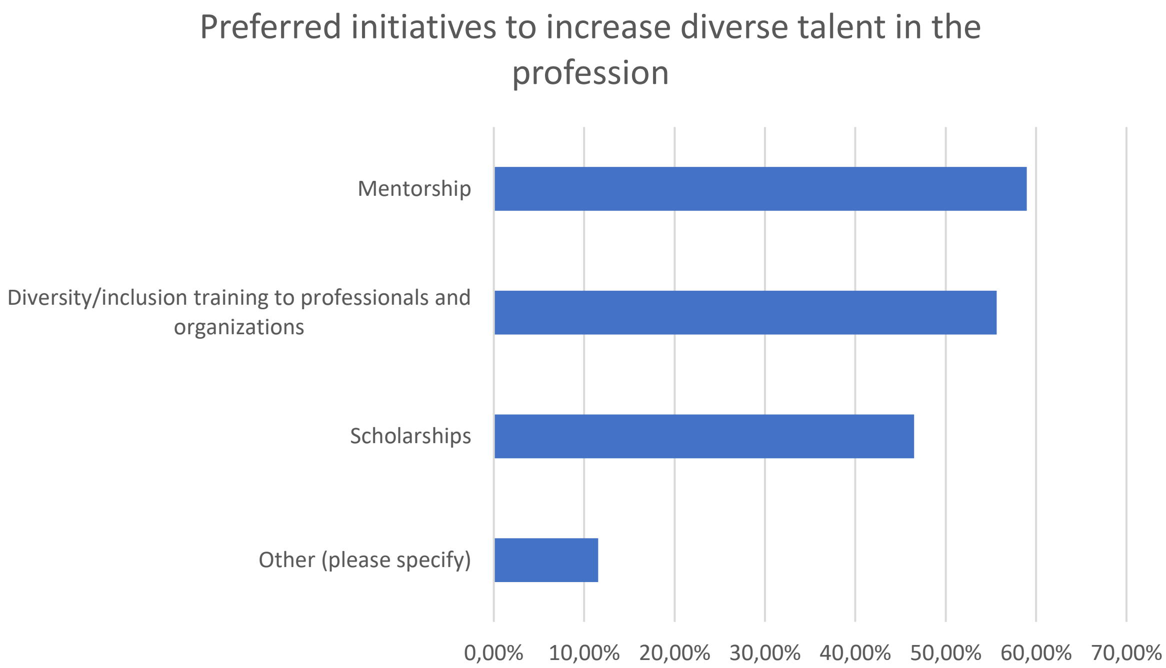
Finally, the survey asked about **preferred initiatives to increase diverse talent** in the engineering profession, clarifying that diverse talent includes underrepresented groups such as women, individuals from different racial and ethnic backgrounds, and individuals with disabilities. Respondents could select multiple answers and provide additional comments.



After weighing the Italian responses, more than half of the respondents supported mentorships and diversity/inclusion training for professionals and organizations. Scholarships were favored by 46.51% of respondents, with over 10% providing additional comments.

Among the 322 additional comments, several recurring themes emerged. Many respondents highlighted that a diverse and inclusive environment benefits everyone and could potentially address part of the labor shortage. **Equal treatment of diverse talent in the workplace, better communication about the profession, and motivating children from a young age** were identified as effective strategies.

Specifically, for female engineers, **promoting and increasing the visibility of successful female engineers, ensuring equal pay, and implementing inclusive marketing strategies** were seen as beneficial. Additionally, **creating accessible spaces, fostering transdisciplinary collaboration, and using inclusive language** were suggested as helpful measures. For older engineers, providing **training and inclusion programs** tailored to those with long careers was recommended.

On the other hand, some critical questions were raised. A number of respondents argued that there is no need for further diversity and inclusion initiatives in the profession or expressed opposition to **artificial modifications and quotas**. Additionally, several respondents emphasized that the primary focus should be on a person's skills, rather than their gender, race, or background.

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