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D2.1: Generative AI education and training offerings and skills needs

GenAISA

Generative AI Skills Academy

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1 Introduction

1.1 Goals

This report is a deliverable for D2.1 Generative AI education and training offerings and skills needs.

The report focuses on generative artificial intelligence (generative AI) and its education and training. Generative AI has become a very popular topic of discussion across every sector, including education, business, and industry. Simultaneously, it creates new learning opportunities and needs for professionals and students in any sector. Especially, new AI technologies, their models, applications, and development methods affect the education of engineers, developers, and designers in the field of software and ICT industries.

Universities, vocational institutions, and training organizations provide education and training in artificial intelligence, such as algorithms, data science, machine learning methods, programming, and various AI-related models, frameworks, and technologies. However, there is little education and training available for generative AI since it is quite a new topic in both working life and education. Thus, this project, Erasmus+ GenAISA (https://genaisa.eu/), aimed to survey the current state of generative AI training and education offerings.

The goal of this report is to present the results of desk research and a survey about the current state of generative AI offerings in Europe. This report describes, based on the aforementioned research work, the current education and training offerings in the domain of AI with a special focus on generative AI. Thus, this report presents in a comprehensive way relevant academic programs or courses of higher education institutes (HEIs), training programs of vocational education providers (VETs) providers and other training centers in the domain of generative AI.

1.2 Needs

Although millions of people across Europe are benefiting from the use of generative AI, few understand how generative AI works in practice and how to apply and develop its technologies to customize it for various needs. While USA-based organizations are currently leading the development of generative AI technologies and their customer- and business-driven applications (e.g. Cottier, et al., 2023; Cieslak, 2025), Europeans also need to rapidly respond to this challenge. Rapidly developing AI technologies, especially the adoption and application of their models, frameworks, and software solutions, set new requirements for the educational needs of AI engineers, software designers, and developers.

The timing for investing in learning resources for generative AI is optimal. Although computers and their early versions of software were able to create some content even in the 1950s, modern generative AI is a relatively new innovation. Artificial intelligence has experienced two major "AI winters" since then, but AI-related innovations have always broken through, thanks to continuous scientific research in this field. The “AI winters” are periods in the history of AI, when people’s belief in, investments in and interests in AI

declined. The development of transformer technologies in 2017 enabled robust architectural models (e.g. GPT, BERT) for effective generative AI, in addition to more advanced neural networks and deep learning technologies. Furthermore, increased computing power, powerful cloud technologies, and advancements on the Internet, where the amount of various open data has exploded, have created technical and content-based opportunities for robust generative AI solutions. Generative AI is primarily based on large language models (LLMs) and natural language processing (NLP) methods. Although generative AI can create text, speech, images, videos, or even code, it handles numbers in its algorithms by using, for example, vector computing.

Generative AI is evidently creating new requirements for the education of software developers and ICT consultants and specialists, from data management, algorithms, and model development to the practical applications of generative AI. Currently, software designers, developers, ICT consultants, and specialists are, for example, customizing and tuning LLMs, integrating LLMs and data sources through application programming interfaces (APIs), adopting commercial GenAI applications, and developing AI agents, which are computer software that can independently conclude and adapt to various tasks.

Generative AI has brought many new features, technologies, and models that most traditional AI and machine learning courses and learning resources cannot meet those learning needs. Similarly, the work of software developers and IT specialists has changed due to the revolution of generative AI. Thus, this Erasmus+ GenAISA project aims to research and survey both the current state of generative AI education and training, as well as the skills requirements in the domain of generative AI.

Cottier, B., Besiroglu, T., & Owen, D. (2023). Who is leading in AI? An analysis of industry AI research. arXiv preprint arXiv:2312.00043.

Cieslak, M. (2025) DeepSeek shows AI's centre of power could shift away from US. BBC, https://www.bbc.com/news/articles/c9w5d9new0yo

1.3 Definition

Generative artificial intelligence

Generative artificial intelligence is computer software that utilizes specific artificial intelligence technologies to create content such as text, images, videos, programming code, or music. The content is not necessarily entirely new, as generative AI produces content using pre-trained models that have been trained on existing data and refined through user feedback.

Desk Research

In this report, desk research refers to research work in which experts collected and reviewed existing courses related to artificial intelligence from the perspective of generative AI. They analyzed these courses based on materials they found on the Internet.

Higher Education

Higher education refers to university-level education, including academic universities and universities of applied sciences in Europe. Typically, students can enter higher education after completing high school, vocational school, or other related secondary education.

Skills

In this report, skills refer to professional abilities required to manage specific tasks in the domain of generative AI.

Hard Skills

In this report, hard skills are measurable, teachable abilities that are typically acquired through formal education, structured training, or hands-on experience. These skills are technical or job-specific and are required to perform defined tasks or operate tools and systems. Examples include proficiency in programming languages, understanding of artificial intelligence and machine learning principles, familiarity with development frameworks, and experience with cloud computing platforms.

Soft Skills

Soft skills are interpersonal and self-management abilities that shape how individuals communicate, collaborate, and perform in a team or organizational context. While they may be influenced by personality, soft skills can be actively developed through experience, reflection, and targeted training. Examples include adaptability, emotional intelligence, communication and problem-solving.

Transversal Skills

Transversal skills are transferable competencies that span across disciplines, industries, and job roles. They can fall into either the hard or soft skill categories but are defined by their broad applicability and relevance in diverse professional contexts. These skills support cross-functional work, career mobility, and continuous learning.

Survey

In this report, a survey refers to a research methodology in which respondents answer a questionnaire that researchers use to collect data related to generative AI, its education and training, and the associated skill requirements. The survey also includes background information such as demographics.

Vocational Education

Vocational education refers to secondary education that students can enter after primary education. It is positioned between primary and higher education and typically aims to provide vocational expertise in selected professions.

2 Desk Research

2.1 Objectives for the desk research

The objective of this desk research is to identify what kind of training offering of Generative AI there is available from different education and training providers, like universities and commercial suppliers. Also, we will be looking to find reference material and best practices for Generative AI curriculum development.

The second objective is to understand what kind of content these courses are containing and for what level of expertise these courses are meant to.

The main questions for the research are,

- What kind of Generative AI course offering can be identified?
- What kind of characteristics can be identified?
- What kind of references can be identified?

2.2 Methods

As a definition for selecting the correct offering was

- organization should provide training or program focusing on Generative AI
- organization should provide beginner or intermediate courses or programs

87 entries were found in the first stage. From this selection 38 organizations with relevant offerings (focusing on generative AI) were selected.

In this research there were chosen organizations with different profiles (e.g. Training organizations, Technology organizations) with an online presence, which offer different kinds of AI-training based on the definitions. Microsoft Copilot was used to create a shortlist of the organizations where to start doing the research.

Copilot prompts used for shortlisting.

- *Can you collect 100 commercial suppliers from Europe which offer AI courses? Add the URL of the courses and use the latest references?*
- *Select only those commercial suppliers which provide Generative AI courses or programs-*

After the organizations, program and course offerings were recognized the relevant courses and programs were selected for this research for further investigations.

The organizations and their offering have been listed as annex Data collection.

2.3 Results

Generative AI is an important topic in the market at the moment. Currently you can find multiple options in terms of training and education and multiple different organizations to offer those.

It is also important to notice that organizations provide more complete AI programs with multiple different topics instead of a few hour courses focusing on certain AI related topics.

The challenge for executing this research was that most of the offers are payable and you can't get detailed information on the courses compared to free of charge courses. There are free courses and programs available, but the ones which had a more holistic approach were mainly provided by big technology companies as others were more for experienced users containing a more technology-oriented approach.

- Of the 38 courses or programs, only 13 were free. It is important to note that detailed information about courses behind a paywall and evaluating course content was challenging and remained at a general level.
- 3 organizations provided mixed programs, where some modules were free of charge

Course and program structures were also found to be mixed and the main theme in most were more holistic instead of focusing on certain topics. Most of the courses and programs were AI Engineering type of training that focused more on technical specifications of the AI and engineering of AI.

- Courses and programs focusing only on Generative AI are in the minority. In most cases the Generative AI was just part of the offering.
- Microsoft and Google programs both focus to Generative AI, also these had the most holistic approach
- Some organizations provided more business-oriented courses and how to utilize Generative AI in Business (DataCamp, Professio).
- organizations like Microsoft (Copilot), NVIDIA and IBM (Watsonx.ai) focused on their own AI powered tools, services and features.
- 4 programs were identified to be suitable for the beginners.
- Programs with similar themes have different content, for example courses identified as Holistic AI for beginners contains
    - Detailed Understanding of Generative AI
    - Key Concepts - LLM, Embeddings, Prompt Engineering, Fine Tuning
    - Industry use cases and ideas that can be implemented
    - Hands-on experience, creating a chatbot
    - Future trends and how to stay relevant in post-GenAI world

      and one contain
    - AI definition, Social impact of AI, Describe the Inner Workings of an Artificial Intelligence Project
    - For example, Elements of AI from the University of Helsinki for as broad a group of people as possible to learn what AI is, what can (and can't) be done with AI, and how to start creating AI methods. This course provides basic details of AI and methodologies, instead of having any technical approach.

Special characteristics of the offerings that were identified,

- Courses and programs focus on different approaches (leadership, business, strategy and technical).
- Most common themes were machine learning, large language models, how to apply in professional environment and how to build AI applications
- Most of the courses and programs focus on concepts via applications.
- Courses are focused on technical and how to use topics, no AI ethics and collaboration topics included.

Also, one assumption can be mentioned that commercial organizations will have a more agile approach in terms of content. Even though the courses and programs had more defined structure and an agenda, some of the organizations provided tailored programs to match organization needs.

The overall quality was very high even in the free courses and programs. Lots of video, audio and interactive solutions have been used in content and production values were very high.

2.4 Conclusions

According to research the Generative AI training offered by different suppliers is very wide. You may find the right courses and programs for different kinds of roles and professions, but there are differences between the contents of courses and programs for example.

- Most of the courses and programs were for the experienced users and previous experience is expected -> Entry level courses in minority
- The definition between beginner and advanced user varies

Also, when we talk about commercial suppliers it is important to understand that these organizations also allow tailoring to match their clients' needs and therefore these courses have a more business-related approach instead of general. However, the analysis of the payable courses were not detailed enough to get a clear understanding of what is actually included in those programs due to the restrictions made by a payment wall.

From the perspective of developing generative AI curricula, one for higher education and another for vocational education and training, the research shows that there is a need for this kind of offering. As offering is limited by the payment walls and free of charge courses are in minority there is a market for quality courses which are free of charge.

In the research there was identified Google and Udemy Generative AI training programs which could support and provide some best practices for the development of Generative AI curriculums, for example.

- How use content efficiently
- How to use multimedia efficiently
- How to use interactive elements efficiently
- Course structure

By using these courses as examples, they would provide a well-established presentation of how to create a decent learning experience.

GenAITrainings provided a course structure about general AI, which could be used as an example of what kind of content could be included in courses developed by the GenAISA project.

The overall and production quality varies between the courses. In the top end there was google which utilized audio, video and interactions in the courses. Overall the quality was well established and courses focused heavily on maximizing learning experience, which can be seen as a great asset as it set a high level of learning dynamics.

The training and programs offered by commercial suppliers cannot be seen as direct competitors for public education, but more as an example of high quality and how to maximize the learning experience.

3 Survey

3.1 Objectives for the survey

The survey reviewed generative artificial intelligence training or education offering in Europe. The aim of this survey was to two-fold: (a) to make a state-of-the-art analysis regarding current AI education and training offerings with a special focus on generative AI, as well as b) to identify skills needed in the domain of generative AI. The state-of-the-art analysis covered initial and continuous higher education, vocational training, training centers and training organizations. The survey was intended for universities, vocational educational and training centers currently offering education and training in the domain of generative AI.

3.2 Methods

The method of the survey is quantitative study including multiple choice questions, Likert-type questions and open-ended questions. The responsible organization in the study is Haaga-Helia University of Applied Sciences, Helsinki, Finland. The data was collected by Webropol-survey tool (https://webropol.co.uk/) in January-March 2025. It was shared by project partners who shared the survey link directly to their contacts. The survey was also shared on social media channels. The questionnaire was anonymous, thus names or other personal identity is not collected or connected to the answers.

The survey question has been listed as annex Survey Questions.

3.3 Participants

A total of 212 universities and VET-centers from the European Union which provide curriculums or courses related to artificial intelligence were selected. The survey was sent to 191 participants. The total count of respodents was 96. Data was collected mainly from Spain, Greece, Slovakia and Finland. A total of 16 countries participated in this survey.

There were also answers outside Europe, but those can be seen as individual cases and won't have a major effect on the results of this survey.

Majority of the participants were from education organizations (Chart 1) and 57% of them from higher education organizations.

Country	Count of answers
Australia	1
Austria	1
Bulgaria	2
Croatia	1
Finland	10
Greece	17
Italy	1
Lithuania	2
Montenegro	5
Netherlands	3
Norway	1
Poland	1
Slovakia	13
Spain	36
Switzerland	1
Vietnam	1
Grand Total	**96**

Table 1: Participants by country

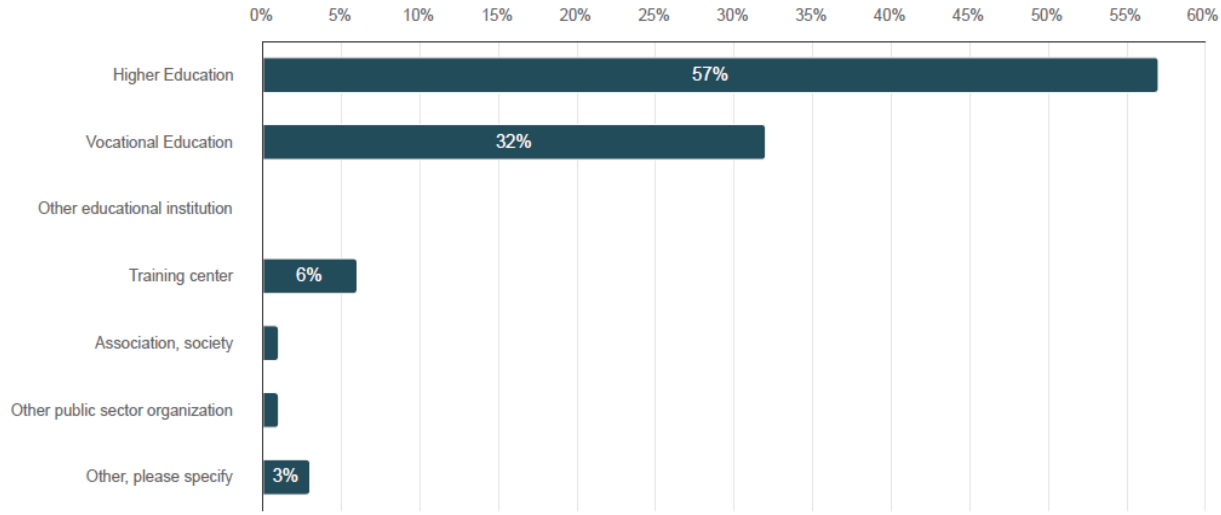

Figure 1: Participants by organization type

Most of the participants represent the educational staff of the organizations (Lecturers or teachers and professors).

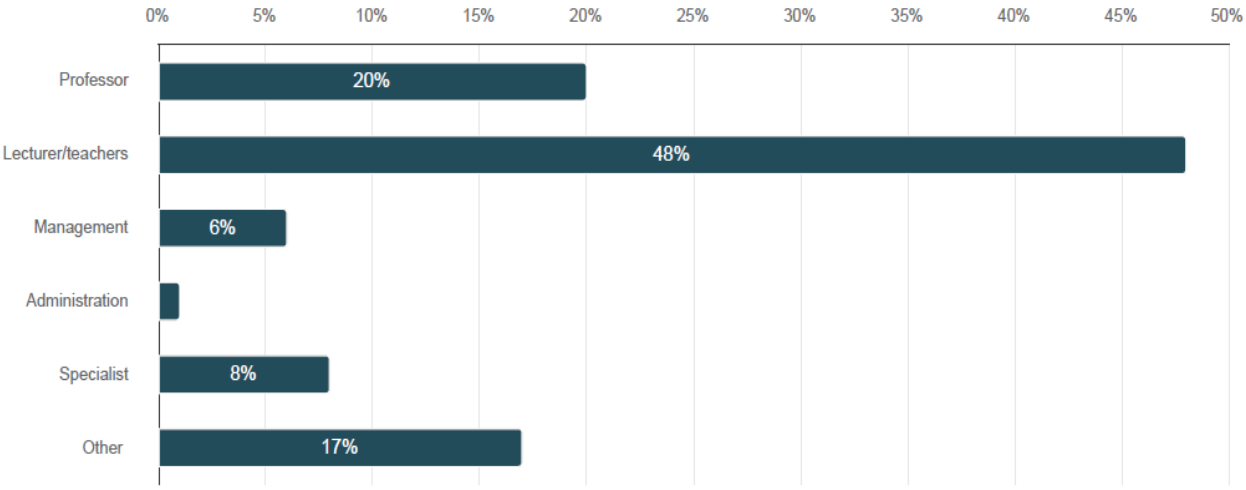

Figure 2: Which educational group do you belong to?

Almost half of the participants represent the engineering area of education. Business studies representatives were in the minority, and this will impact results quite heavily as the technical aspect of engineering studies is more represented especially in the skills section of this survey.

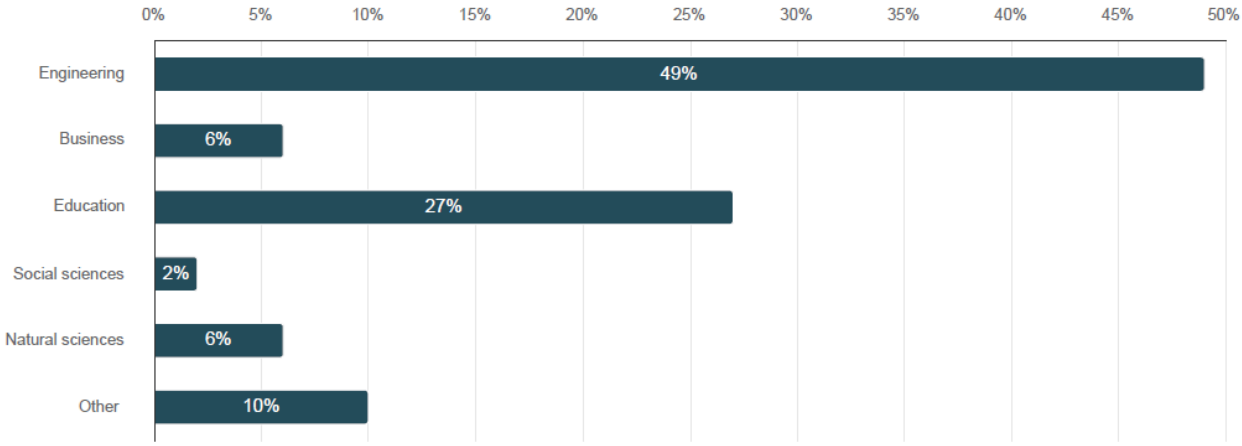

Figure 3: Which discipline are you working for?

According to charts, the survey managed to reach educational professionals and therefore the results of this survey present the status of Artificial intelligence education in Europe.

3.4 Results

The current status of artificial intelligence training offering in Europe is developing well. According to the survey 86% of the participants say that they already have AI education available or are planning to do it in the upcoming years.

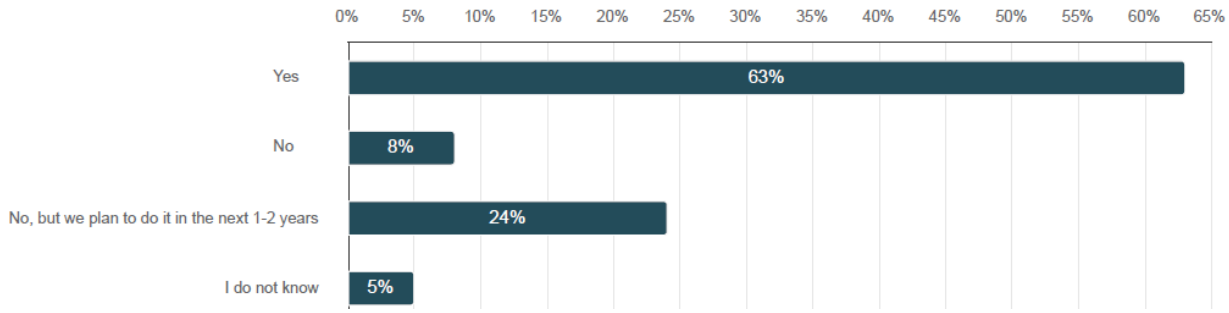

Figure 4: Do you offer to your student or training on AI?

The main reasons why AI-education haven't been developed yet were,

- Challenges to curriculum development
- Access to relevant technology and tools
- Keeping up the rapid advancement advancements in AI

Also limited funding and resources were mentioned. The reasons indicate that Education providers encounter challenges to keep up with the fast-paced technology advancements.

Generative AI training courses are not offered as much as AI training. It seems that generative AI is not part of the AI training offering and according to respondents, the training includes other elements as 25% of participants say they don't offer Generative AI courses at the moment. According to the survey 70% of the participants say that they already have generative AI education available or are planning to do so in upcoming years.

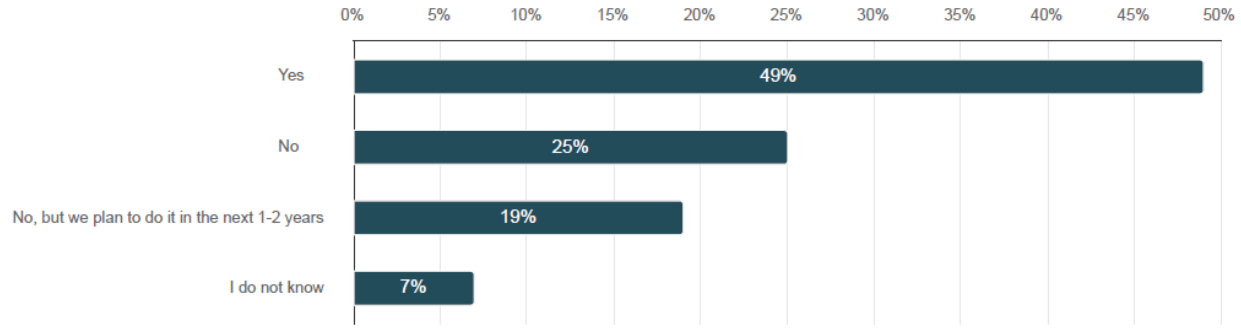

Figure 5: Do you have courses or training programs about generative AI?

The training types of generative AI vary quite heavily. The most common type according to participants is Workshops and seminars. VET, undergraduate and postgraduate courses are in minority.

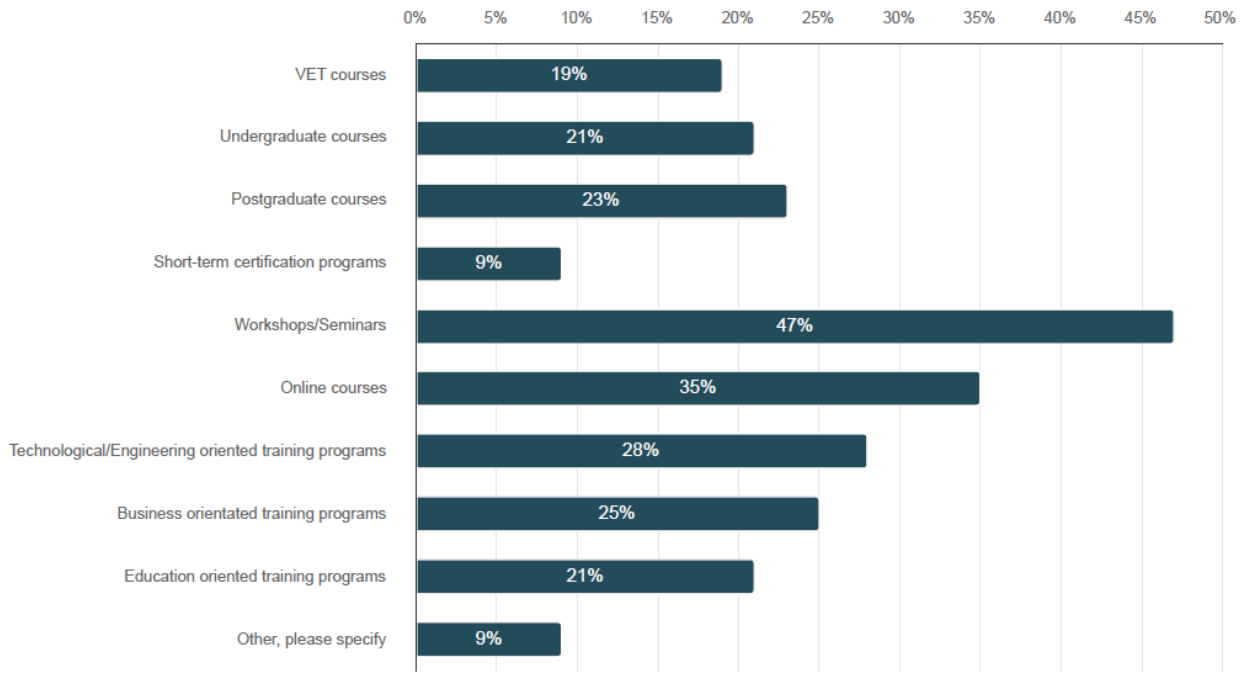

Figure 6: What type of generative AI programs do you offer?

The content of the generative AI courses is focused on engineering and education studies. 28% of respondents had business-oriented content. This reflects the fact that most of the participants represent engineering studies.

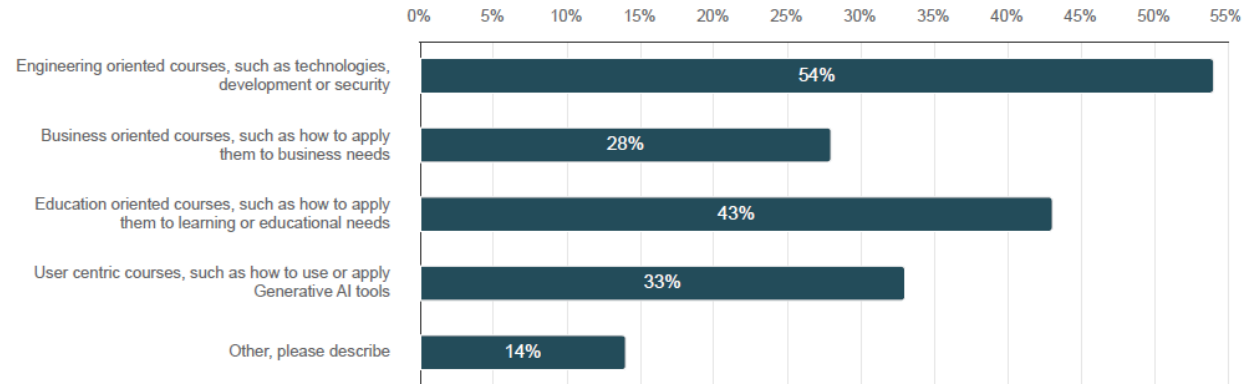

Figure 7: What types of course content does your organization offer related to generative AI?

The technical level of these courses is mainly focused on beginner and intermediate level which reflect the program types offered (Chart 6). As course types are more workshops and online courses. According to a survey different types of courses have similar characteristics from the technical level point of view. The technical level is similar and focuses on beginner and intermediate and not that much on advanced level.

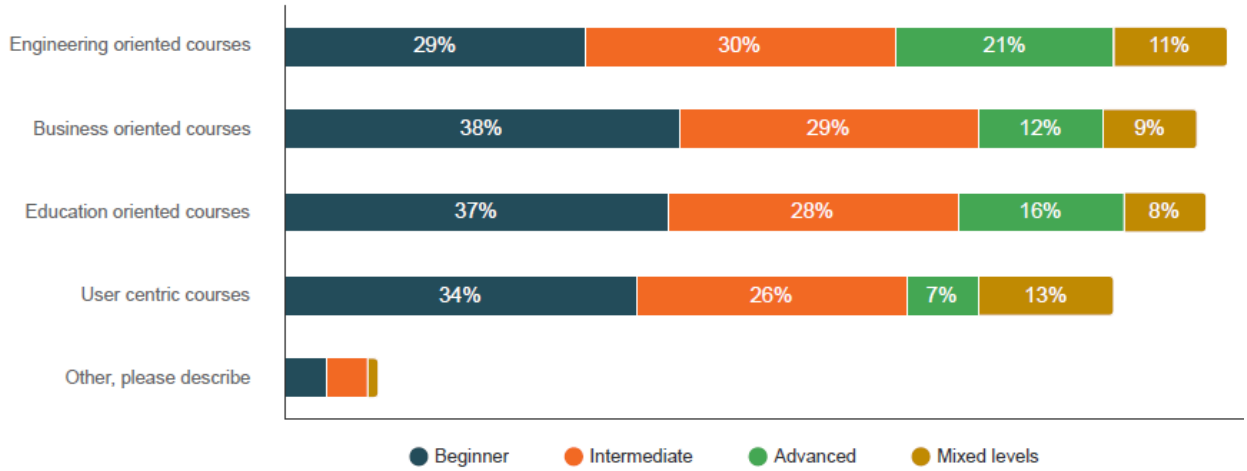

Figure 8: What technical level do these courses target?

The survey investigated the skill demand between higher education (HE) and vocational education (VE) by evaluating the importance of selected skills. The selected skills have been divided in different sections (Likert scale 1 not at all - 5 very important). Only representatives from these organizations were able to answer the skills section.

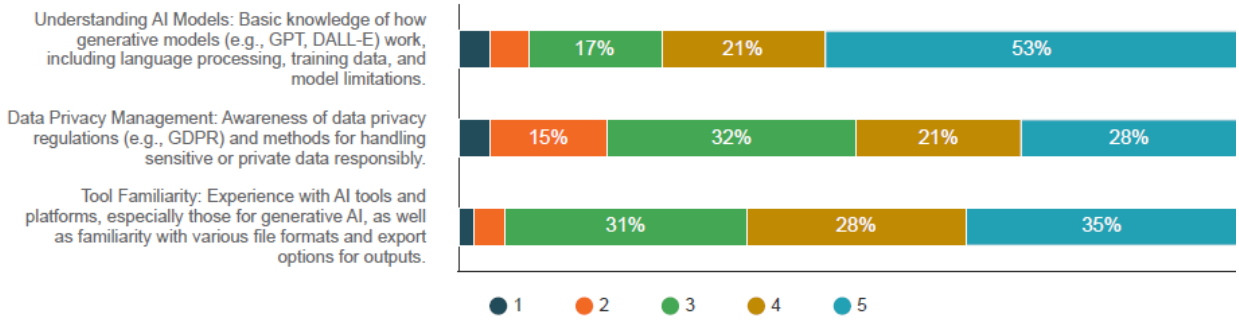

Figure 9: Technical proficiency (HE)

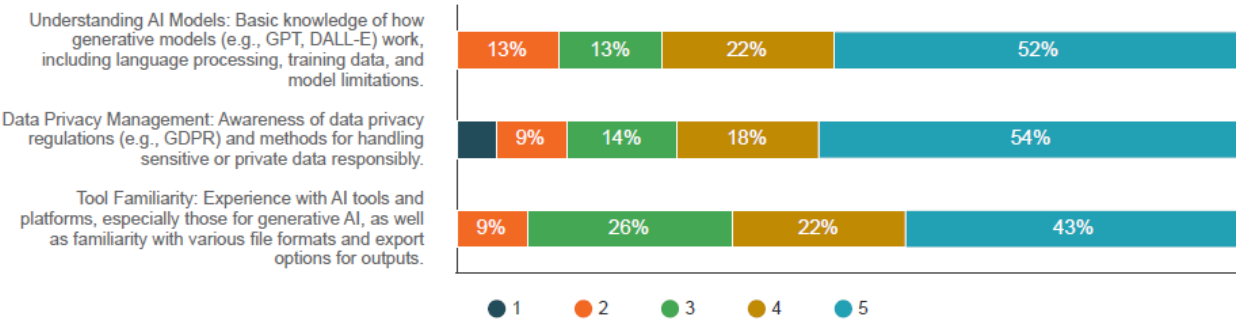

Figure 10: Technical proficiency (VE)

According to participants, understanding of the AI models was very important for both education types. VE appreciates more data and tools related topics when HE is more focusing on AI modelling skills. Higher education is more oriented to technical and more to VE applicable skills.

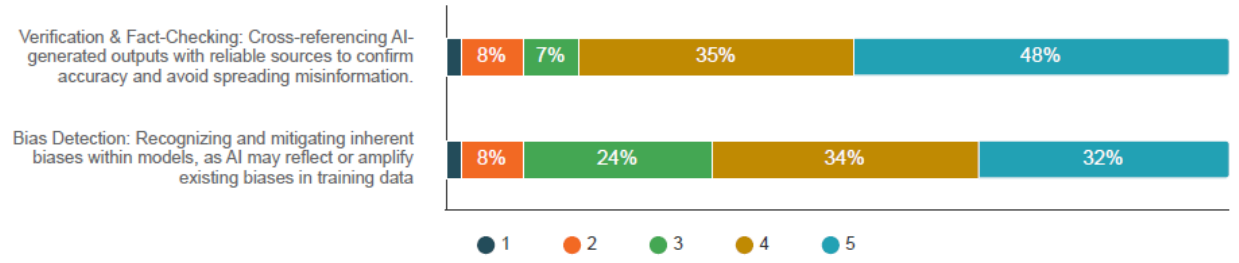

Figure 11: Critical thinking and evaluation skills (HE)

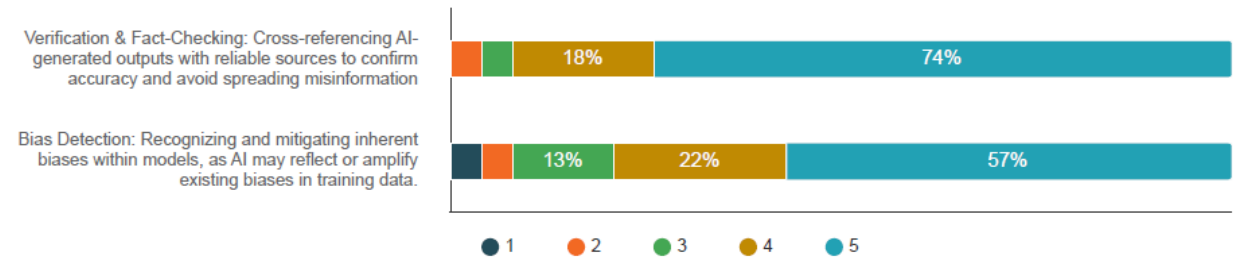

Figure 12: Critical thinking and evaluation skills (VE)

Participants from VE evaluate that critical thinking and evaluation skills are more important than HE participants. For HE verification and fact-checking skills are more important. This pattern is reflected quite well with the technical skills and how HE evaluates them more than VE.

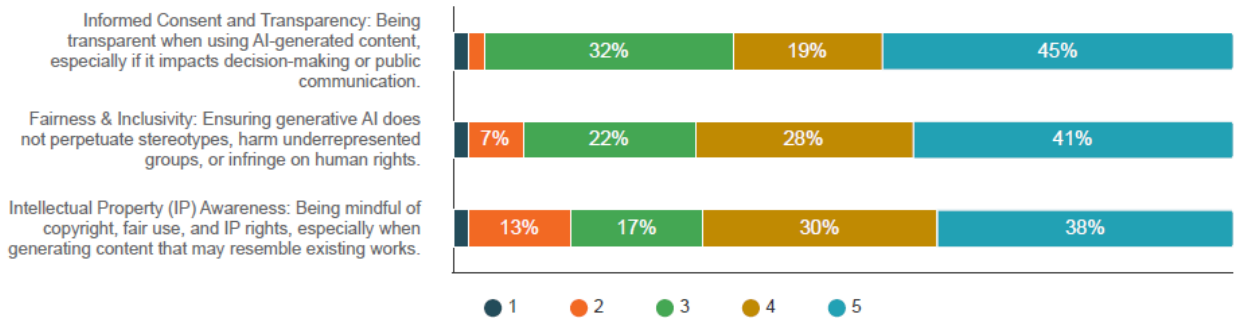

Figure 13: Ethical and social responsibility (HE)

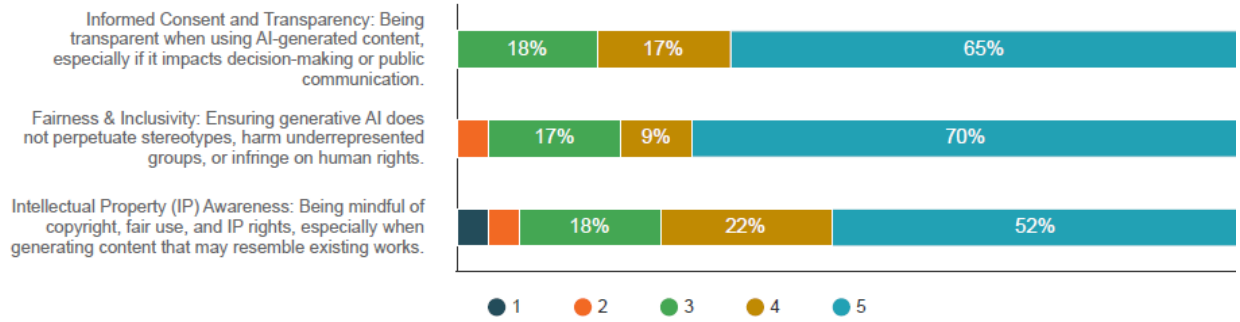

Figure 14: Chart 14. Ethical and social responsibility (VE)

Similar patterns can be found with the Ethical and social responsibility of AI. VE representatives see these topics more important than HE representatives. Yet both groups find these important skills.

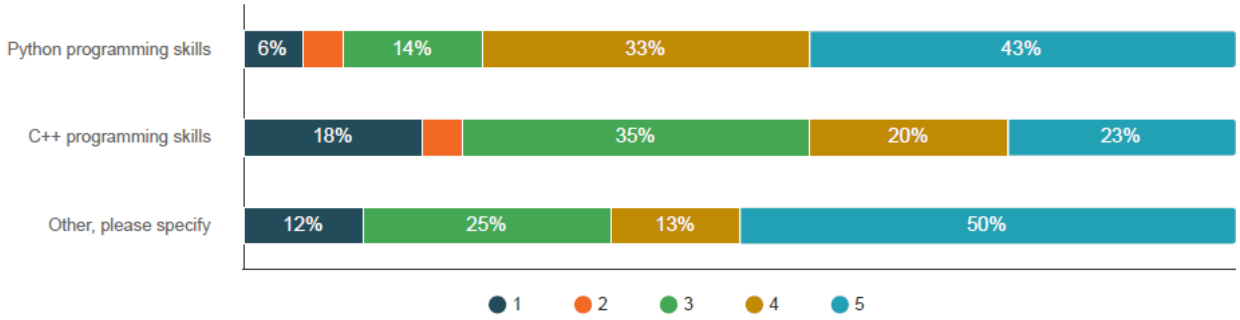

Figure 15: Programming skills (HE)

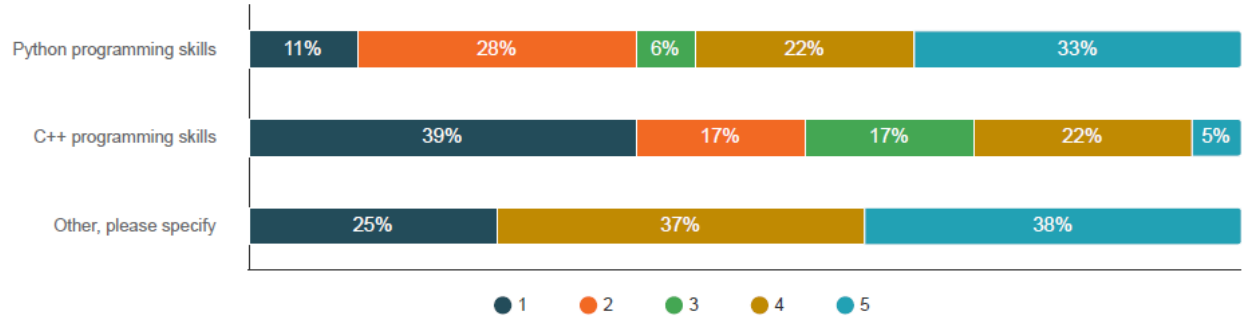

Figure 16: Programming skills (VE)

About programming skills, both HE and VE representatives found Python to be the most important programming skill. Other programming skills like Java and C# were seen as more important than C++. In overall both instances value these skills equally.

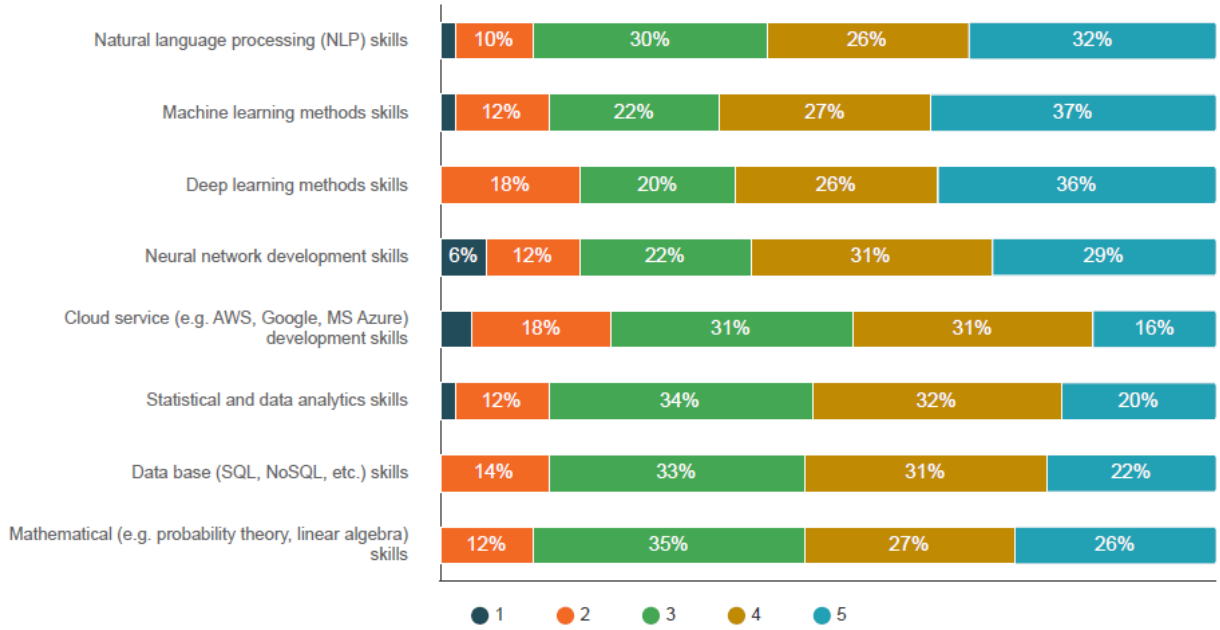

Figure 17: Generic AI developer skills (HE)

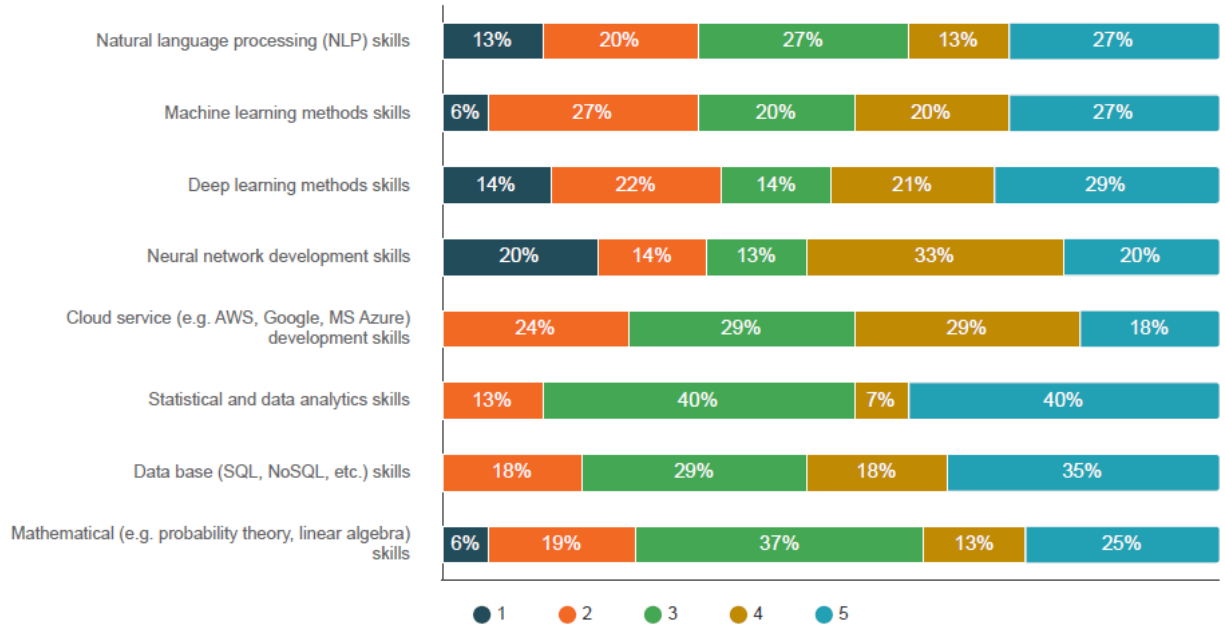

Figure 18: Generic AI developer skills (VE)

Both HE and VE representatives find the importance of Generic AI skills. The major difference between HE and VE comes from statistical and database skills which VE representatives find more important than VE representatives. When excluding engineering representatives from the survey the gap between these two increases wider. Business and education representatives evaluate these two skills as more important.

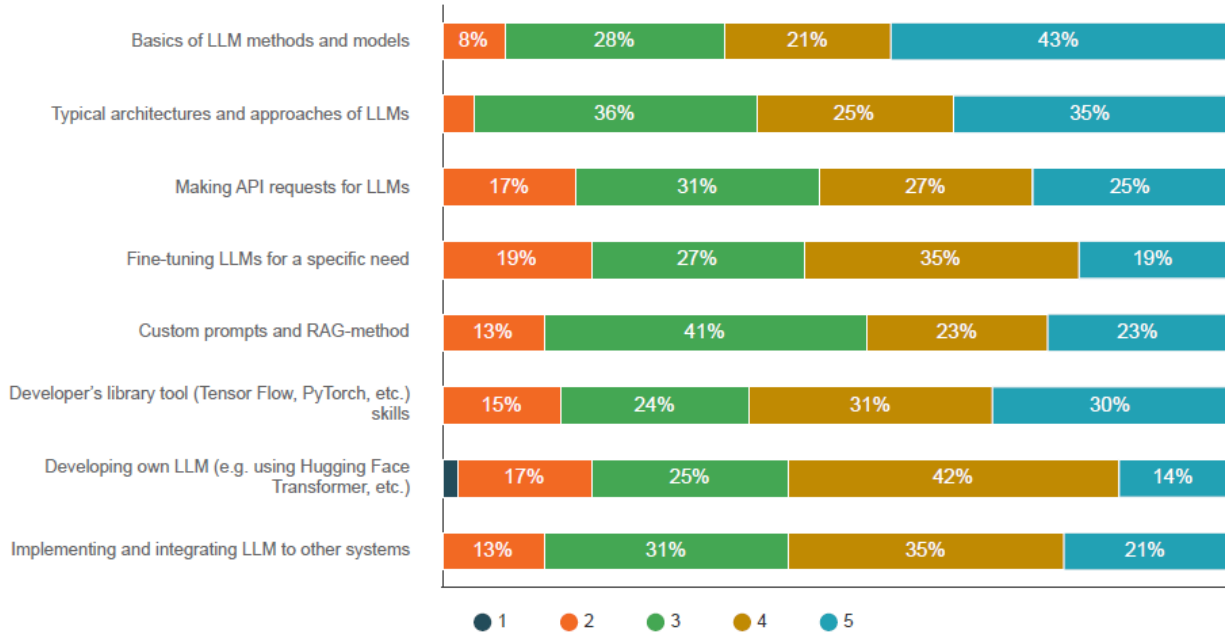

Figure 19: Specific LLM developer skills (HE)

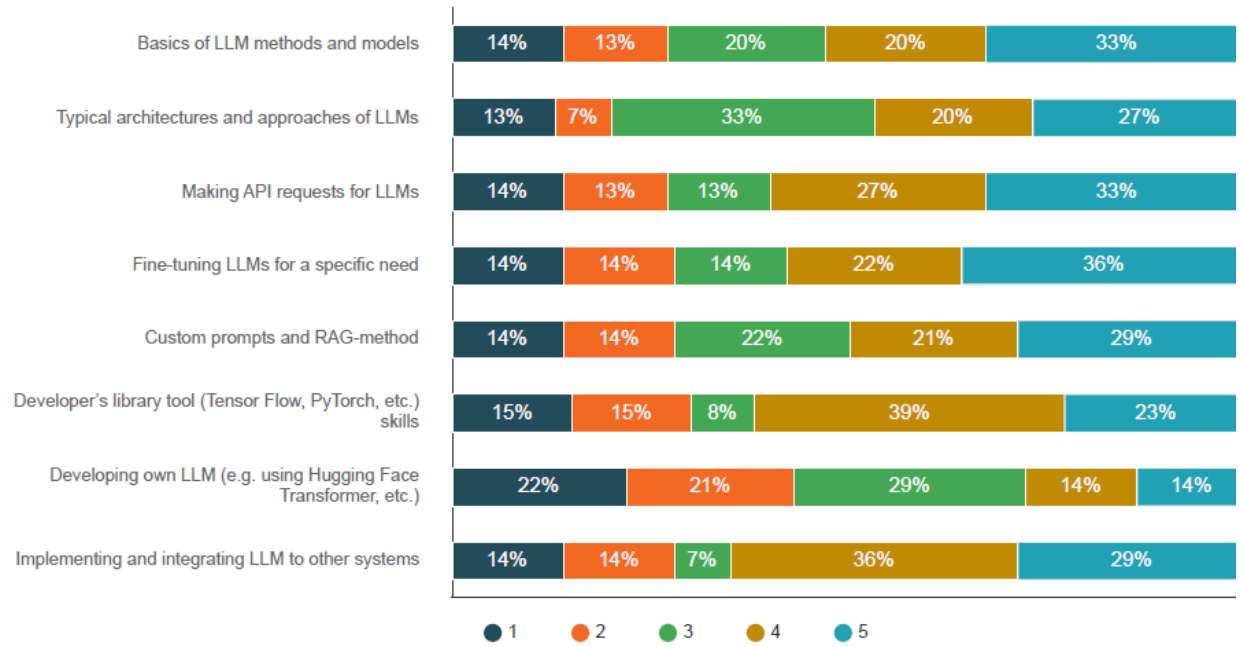

Figure 20: Specific LLM developer skills (VE)

Specific LLM developer skills both HE and VE representatives find more important regarding some skills (Basics, Making API request). Yet the major difference is that VE representatives evaluate these skills as less important. For example, developing your own LLM skill was evaluated as important.

This might be due to the fact that VE education focuses on low end training for the beginners and HE education focuses on people who might already have some kind of background in AI.

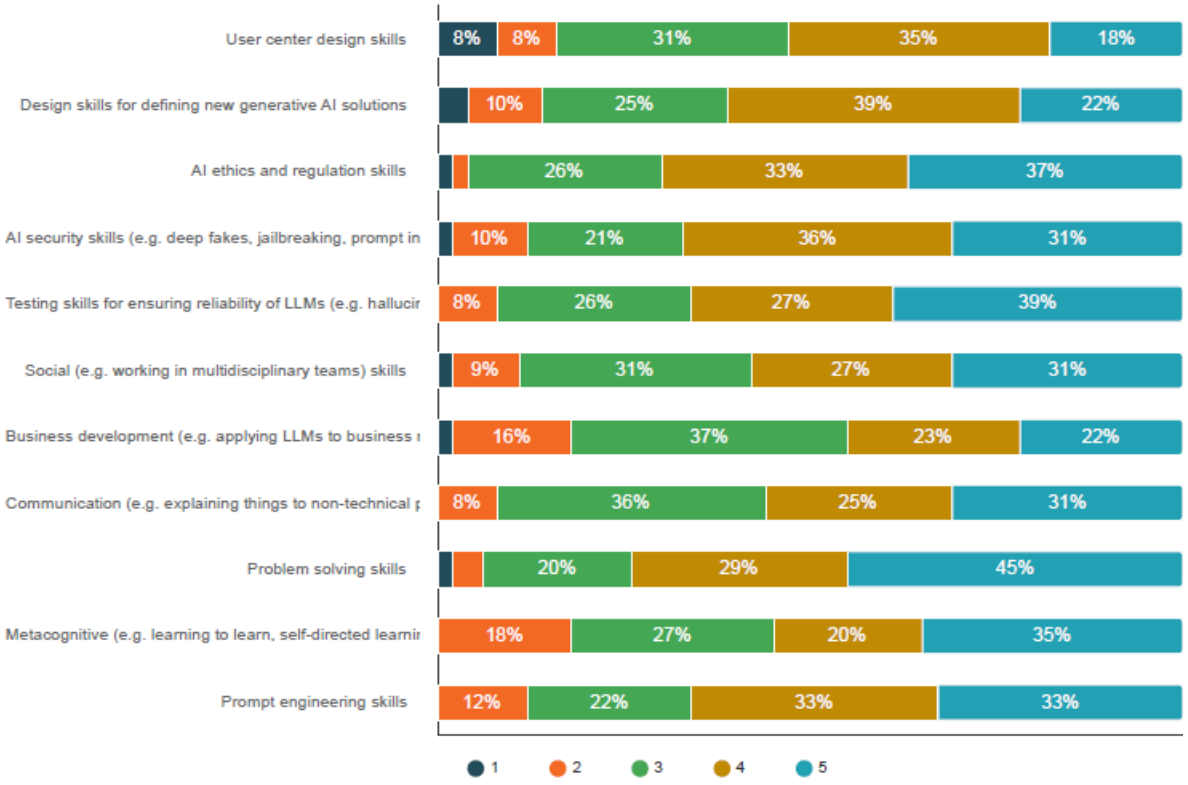

Figure 21: Other qualification skills (HE)

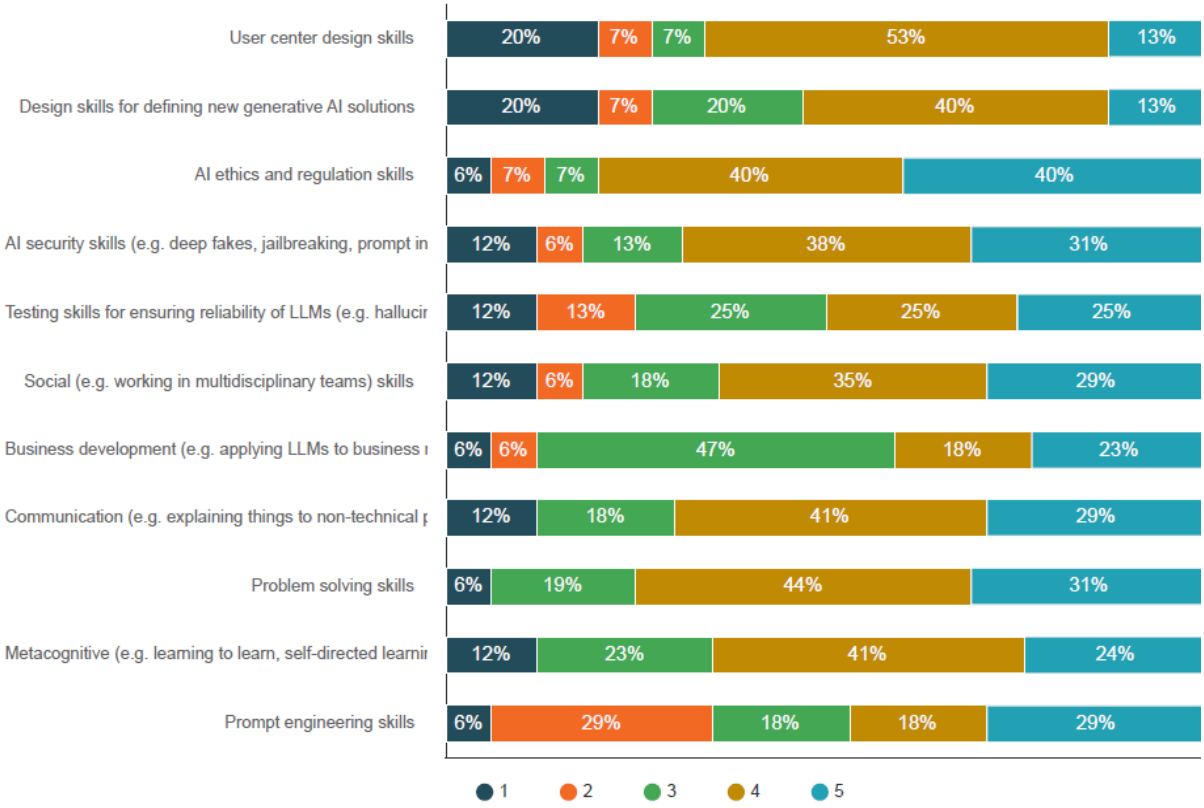

Figure 22: Other qualification skills (VE)

In other qualification skills the results were mainly the same. The biggest difference was that HE representatives see Testing and Prompt engineering skills more important than VE representatives. VE representatives saw AI ethics and regulation skills more important.

Overall, the VE representatives evaluated more skills that were not important from their perspective. Especially skills that were more technically oriented (Programming and AI Developer skills). The so-called soft skills were seen as more important from a VE perspective.

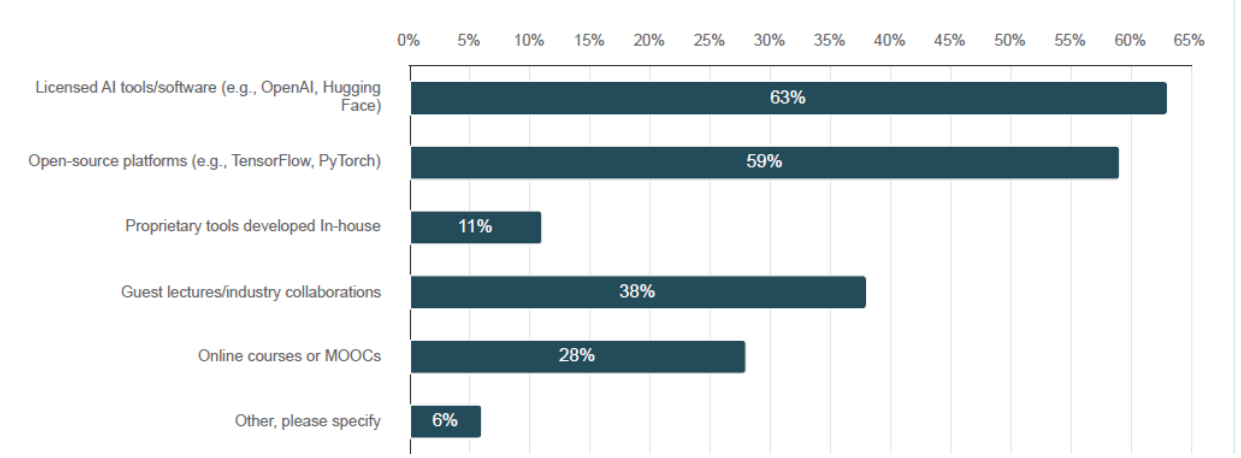

Figure 23: What resources does your institution use to support these courses or programs?

The participants found licensed and open-source platforms as most used resources and also guest lectures and industry collaborations were noted as important resources.

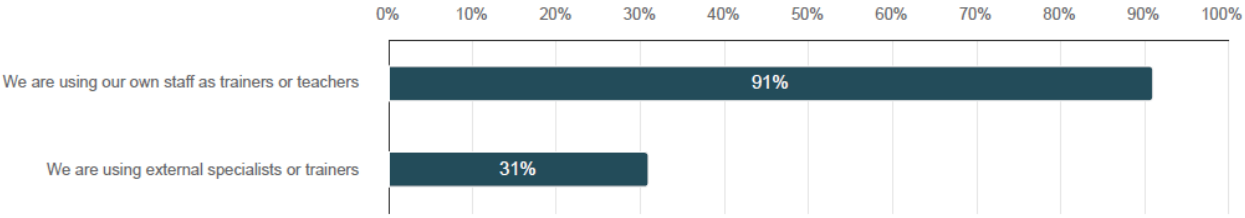

Figure 24: How have you organized generative AI Training programs and courses?

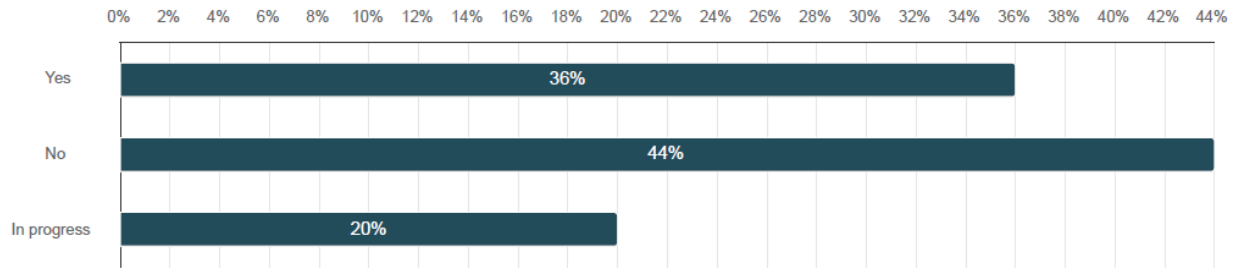

Figure 25: Does your institution collaborate with external organizations to offer generative AI training?

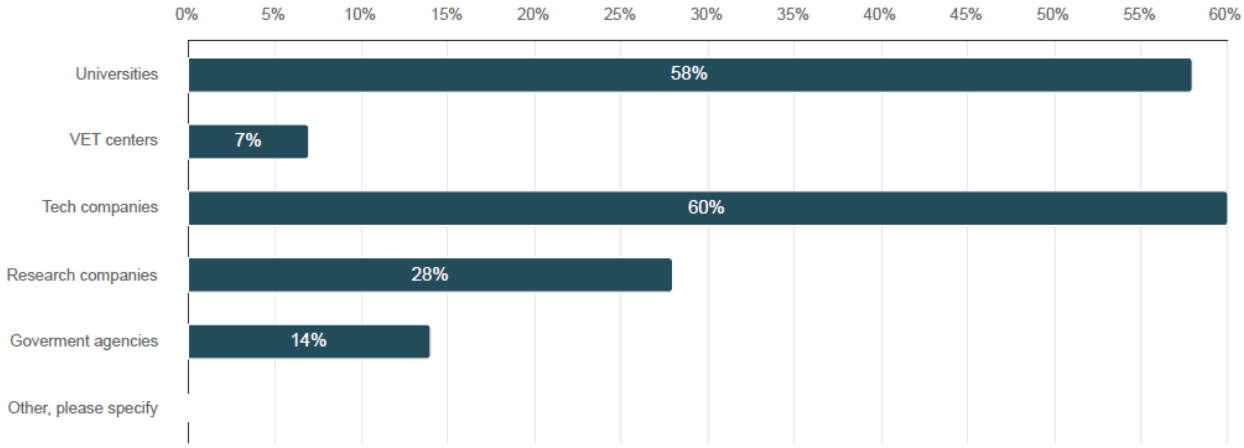

Figure 26: Specify the organizations you collaborate with?

Most of the participants do not collaborate with external organizations and courses and programs are arranged and maintained mainly by their own staff.

Collaboration takes place with several different organizations and is not limited to a specific type of organization. Most of the collaboration takes place with tech companies and universities.

3.5 Conclusions

The aim of this study was to gain an overall view of the education and training of generative AI in Europe. The focus was on ensuring a diverse and high-quality representation by including a range of vocational institutes, universities, and training organizations from across Europe. The respondents were mainly professors and lecturers. Due to our focus on AI, most respondents were from the engineering field, where most AI education and training takes place.

The results of the research show a positive trend in European education regarding the inclusion of AI studies, with half of the organizations already providing AI education or training in some form, and every fourth respondent planning to do so in the next 1-2 years. However, there are several barriers to developing and expanding the offering of AI education, such as limited funding or resources, curriculum development challenges, and access to relevant technology and tools, among other reasons.

About half of the respondents also offer some form of generative AI education and training. Generative AI education and training is provided mainly through workshops and online courses, and half of them focus on engineering disciplines, followed by business, education, or user-centric content. Almost all teaching is done by the organization's own staff in these courses or workshops. This study shows that generative AI education and training should be expanded to cover more topics, methods, and case examples from various areas. All skills included in the survey were seen as important and relevant. Thus, more education and training are needed in this field.

The results are discussed in more detail in Chapter 5: Discussion and Recommendations.

4 Research on skills needs

This chapter presents a structured and comprehensive methodological approach for acquiring, processing, and analyzing job market data to identify current skill gaps and forecast future skills requirements in the generative AI domain across key industries. Additionally, it outlines the results derived from the application of this methodology.

The research follows a quantitative design, leveraging job postings from the LinkedIn job portal to determine the skills currently in demand within job vacancies across EU member states.

The sections that follow also describe the measures taken to ensure data quality, including the use of multiple tools to cross-reference and validate the results.

4.1 Objectives for the research

The GenAISA project aims to address the skills gap in the domain of generative AI by designing, developing, and testing both Higher Education Curricula and Vocational Education and Training (VET) programs, with a specific focus on the member states of the European Union.

As a foundation for this work, a comprehensive desk research and survey were conducted to map the current state of generative AI offerings in Europe, including academic programs, vocational training, and other educational initiatives. These findings provided valuable insights into existing education and training provisions within the domain of AI, with a particular emphasis on generative AI.

Building upon this initial research, it is essential to conduct a deeper analysis focused on identifying relevant skills, associated job roles over time, industry-specific demands, and transversal competencies. This skill gap analysis ensures that the curricula and training programs developed by GenAISA are aligned with both current and anticipated market needs in the evolving landscape of generative AI.

4.2 Methods

To fulfill the objectives of this research, a rigorous methodology was developed. This methodology consists of three distinct phases, each contributing to the overall effectiveness of the research: data collection, data processing, and data analysis and visualization. All steps in the methodology are supported by Python programming (version 3.13).

The following subcategories describe each of these stages in detail.

4.2.1. Data collection

Data collection is a critical step in the research process, as its quality directly affects all subsequent phases. The data must effectively target the subject of interest, but it should not be too restrictive; otherwise, there is a risk of losing valuable information. To balance focus

with inclusivity, a broad-based approach was adopted by defining a comprehensive list of 31 keywords related to generative AI, ensuring wide coverage of relevant information without compromising specificity. These keywords include both technical terms (e.g., *large language models*, *transformer architecture*) and application areas (e.g., *prompt engineering*, *AI content generation*). This method allows for a more open-ended search, enabling the data itself to reveal what is present in the market, rather than imposing predefined boundaries.

Once the keywords were selected and validated by the project partners, the job board from which the market data would be retrieved was chosen. The LinkedIn job portal was selected due to its real-time, rich, and representative dataset, and its status as one of the most widely used job boards globally. Using the assistance of the large language model *GPT-4o*, the generative AI keywords were translated into the appropriate languages for each EU member state, which were also defined as the geographic targets for job postings.

With these elements prepared, an in-house scraping tool was used to collect the job postings, exporting each listing as a JSON object, a structured format that is well-suited for subsequent processing. Since one of the research goals is to understand both current and evolving market needs, the partners agreed to define two distinct timeframes for the analysis. For this purpose, **the dates 31/01/2025 and 03/03/2025 were established to represent these two separate points in time**. Following data collection, an initial exploratory data analysis (EDA) was conducted to assess data quality and ensure geographic representativeness. The results across both time periods were consistent, showing similar numbers in terms of geographic distribution. The most represented countries were France, Germany, and Spain (each with over 700 postings), while the least represented were Latvia, Estonia, Slovenia, Croatia, and Cyprus (each with over 70 postings). Job posting data was obtained for 25 EU member states out of 17; Malta was excluded due to the absence of available postings, and Czechia was excluded due to a data acquisition error.

Between the two collection periods, there was a slight increase in postings from the least represented countries.

As an initial raw count, before any processing, a total of 8,704 job postings were collected for the first period, and 9,188 for the second.

4.2.2. Data processing

Once all the data was retrieved, each period was processed separately using the project's data pipeline. This pipeline consists of several layers of processing, where each targeted data type is extracted by transforming raw job descriptions into meaningful data points for analysis.

The first step involves extracting information already available in each job post's JSON object (a structured format for storing data as key-value pairs). The quality and structure of this data had previously been confirmed through Exploratory Data Analysis (EDA), which is a preliminary review to detect patterns, errors, or inconsistencies.

From each object, three elements were extracted: the URL, the job description, and the job ID. The URL was used to determine the country associated with the job posting, as it contains a country identifier (e.g., "it" for Italy, "pt" for Portugal) that can be mapped accordingly. The

job description was retained for later steps where skills, job title, and industry would be identified.

The job title already present in the JSON object was not used directly, because during EDA it was found to often require translation, normalization (standardization of format and terms), or was inconsistent or invalid. Therefore, the job title was extracted anew from the job description to reduce errors. The job ID served as a unique identifier for each post. These elements were organized into a dataframe (a table-like structure commonly used for handling large sets of data) for further processing.

The second step involved using job descriptions to extract the appropriate job titles and industries. Several sub-processes were used. To determine the industry, a predefined list of 46 industries was created, based on LinkedIn's classification and refined using support from GPT-4o, a large language model capable of understanding and generating human language, along with input from experts in education, data science, and management. This list provided a more precise view of the roles and skills in demand across different sectors. GPT-4o was then prompted to match each job description to one of these industries and to extract a suitable job title based on the content.

The third step was to extract the skills listed in the job description. This was done through a custom API (Application Programming Interface, a system that allows software components to communicate), which sent the descriptions to GPT-4o with prompts designed to identify as many relevant skills as possible.

A clear categorization system was used to guide the extraction. Skills were divided into three main groups:

- Hard skills: technical and job-specific competencies (e.g., AI/ML fundamentals, programming languages, development frameworks, cloud platforms),
- Soft skills: interpersonal and management abilities (e.g., communication, teamwork, adaptability),
- Horizontal skills: skills that apply across different industries and roles.

Each skill was further classified as either a core skill (essential and frequently listed for the role) or a non-core skill (beneficial but not mandatory).

GPT-4o was prompted to extract hard and soft skills from each job description, as well as to indicate whether each skill was core or non-core. Horizontal skills were not extracted at this stage, since identifying them requires cross-referencing skills across roles and industries, which is part of the later analysis.

Once all skills were extracted, the next step was normalization, meaning standardizing the terminology so the skills could be compared consistently across job postings. Each extracted skill was matched against the project's internal taxonomy (an organized classification system), which integrates terms from frameworks such as ESCO (European Skills, Competences, Qualifications and Occupations) and current labor market language. This alignment ensures that the skills data is compatible with recognized standards and ready for trend analysis.

The matching process used machine learning techniques. First, a sentence encoder (a model that transforms text into numerical vectors based on meaning) called all-mpnet-base-v2

converted both extracted skills and taxonomy terms into vector representations. Then, cosine similarity (a method to measure how close two vectors are in meaning) was applied to find the top 20 closest taxonomy terms for each extracted skill. A second model, a cross-encoder (which directly compares pairs of text for semantic similarity), ms-marco-MiniLM-L-6-v2, then re-ranked these 20 terms, selecting the one with the highest relevance score as the normalized skill.

This process was repeated for every extracted skill, ensuring a standardized and accurate matching with the project's taxonomy.

The final processing steps involved normalizing the job titles (using GPT-4o to return a consistent, standardized form of each title) and cleaning the dataset. Job postings missing critical information, despite three automated retrieval attempts, were removed at this stage.

After completing all processing steps, the result was two Excel datasets — one for each time period. Each dataset contained the following columns: job_id, is_core (indicating whether the skill is core or non-core), skill (the normalized taxonomy term), skill_type (hard or soft), country, and industry.

The data was now fully prepared for the analysis and visualization phase.

4.2.3. Data Analysis and Visualization

The final layer of this methodology involved preparing the processed datasets for deeper analysis and visualization. This subsection outlines the steps taken to shape the data to analyze skill and role trends across time periods, countries, and industries, and to explore how these elements relate to each other — particularly for identifying horizontal skills (skills that cut across different fields).

The first step was to merge the two datasets into a single dataset and add a column called "interval," which identified the time period associated with each job posting. Then, the frequency of each skill and job title was analyzed across both periods. These frequencies were used to determine the top 20 skills and job titles per country, per time period, and globally (aggregated across all countries).

The global counts served as a reference point to represent overall European market demand for generative AI skills and roles. They were compared to the top 20 lists for each country to assess whether countries' trends align with broader European patterns. Only core skills were included in this analysis to focus on the most critical competencies required by employers.

To assess how countries align with broader market trends, each skill and job title's presence or absence in the top 20 across both periods was classified into one of four categories:

- Constant demand: appears in both periods,
- Fading demand: appears in the first period but not the second,
- New demand: appears only in the second period,
- No demand: absent in both periods.

This classification made it easier to track how demand evolved across regions and time.

The second focus of the analysis was to explore relationships between skills and job titles. Each of the top 20 skills and job titles was cross-referenced with its top five associated skills

or titles. This step helped identify key connections between high-demand roles and important competencies and how these connections evolved over time and across different countries.

Industry dynamics were also analyzed by identifying the top three industries per period (globally) based on the volume of job postings. For each of these industries, the top 10 associated skills and job titles were examined to understand which competencies defined the sectors during each timeframe.

To explore cross-sectoral relevance, the top 20 skills were mapped to the industries where they most frequently appeared. Skills shared across multiple industries were flagged as transversal skills, providing insights into the flexibility and transferability of the workforce across sectors.

To support the interpretation of these results, several types of visualizations were used:

- Bubble charts: to display general patterns and relationships,
- Slope charts: to illustrate detailed changes between the two periods,
- Tables: to present large sets of complex detailed information.

Each visualization type was carefully selected to clearly and objectively communicate the findings.

4.3 Results

This section presents the main findings from the quantitative analysis of job postings across two collection periods, focusing on the evolution of skills and job titles demands over time, across countries and industries. Results are presented by category, divided according to skill dynamics, job title evolution, and geographic distribution, followed by the cross-relations between skills and roles, and concluding with sector-specific patterns. Each subsection provides descriptive insights based on the data, with key patterns and notable cases highlighted to support further interpretation in the conclusion section.

4.3.1 Cross-country Skill Continuity Results

To assess the consistency of key skills across countries over time, the analysis focused on the changes for skills and job roles, in terms of stability, emergence or decline between the two periods considered. This evaluation was carried out at country level, using the global top 20 most in-demand skills for each period, as described in the previous subsection.

The following figure shows the differences in mentions' percentage for the top 20 skills per period. The skill with the highest frequency is the hard skill *Python* (computer programming), which demonstrates a very stable growth rate. The skill *use-methodologies for user-centered design* has the lowest count in period 1, while in period 2, *RESTful web services* hold the lowest count. The skills *AI* (artificial intelligence) and *project management*, which rank second and third in period 1, appear very close in terms of frequency. However, in period 2, demand for *AI* increased, while *project management* declined, widening the gap between them.

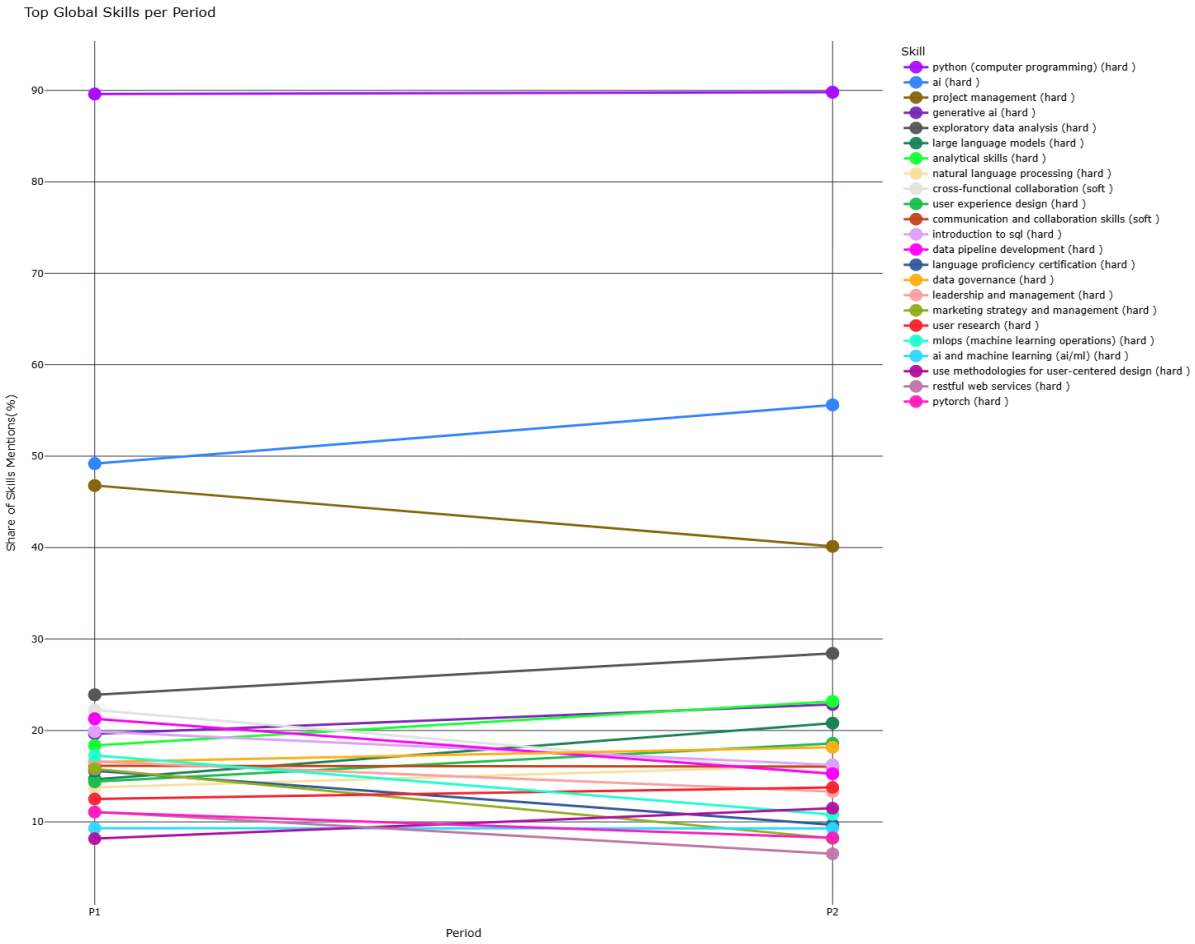

Figure 27: Top Global Skills Mentions per Period: Percentage of top 20 global skills per period

In Table 2, the *AI & Machine Learning* group includes five top skills. The skills *Generative AI*, *Large Language Models*, and *Natural Language Processing* show constant demand across the majority of countries, particularly *Generative AI*. The other two skills, *PyTorch* and *MLOps* (Machine Learning Operations), show limited constant demand, only Spain demanded *PyTorch*, and no country demanded *MLOps* in both periods. Among the countries that did demand for them, this demand appears to be declining, with only Slovakia and Austria showing new demand for *PyTorch*, and none for *MLOps*. Additionally, these two skills were not selected by most countries in either period.

Within this group, countries such as Spain, Austria, Denmark, and Germany exhibit more constant demand. Countries like Hungary, Greece, and Ireland stand out for new demand, while Latvia, Cyprus, and Italy show signs of fading demand. Lastly, among the countries that have no demand for these skills, Bulgaria, Croatia, Cyprus, and Ireland stand out for their high coverage.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Generative AI	Ireland, Latvia	Croatia, France, Luxembourg,	Austria, Belgium, Bulgaria,	Cyprus

		Slovakia	Denmark, Estonia, Finland, Germany, Greece, Hungary, Italy, Lithuania, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden	
Large Language Models	Croatia, Greece, Hungary, Luxembourg, Slovenia, Sweden	Cyprus, Estonia, Finland, Latvia, Lithuania, Slovakia	Austria, Denmark, France, Germany, Italy, Netherlands, Poland, Portugal, Romania, Spain	Ireland, Bulgaria, Belgium
Natural Language Processing	Belgium, Estonia, Greece, Hungary, Ireland, Romania	Bulgaria, Cyprus, Latvia, Lithuania, Luxembourg, Slovakia	Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Poland, Portugal, Spain, Sweden	Slovenia, Croatia
Pytorch	Austria, Slovakia	Germany, Italy, Latvia, Slovenia	Spain	Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Sweden
Mlops (Machine Learning Operations)	—	Austria, Belgium, Italy, Netherlands, Poland, Portugal, Romania, Spain	—	Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Luxembourg, Slovenia

Table 2: AI & Machine Learning hard skills group: distribution of top hard skills by period per country

Looking at Table 3, *Analytical Skills* and *Exploratory Analysis* have the most constant demand in this group. For *Analytical Skills*, only two countries, Cyprus and Slovenia show no demand, while for *Exploratory Analysis* there is no country at all marked with no demand for it. What most clearly sets these two apart in terms of coverage is the number of countries with fading demand: *Exploratory Analysis* shows fading demand only in Slovakia, whereas *Analytical Skills* has four such cases.

Data Pipeline Development and *Data Governance* show very similar demand patterns, with comparable coverage in terms of constant and new demand. However, *Data Governance* has a higher number of countries with no demand and fewer with fading demand. In contrast, *Data Pipeline Development* shows almost the reverse pattern.

From a general perspective, countries such as Belgium, Bulgaria, and France exhibit constant demand for this group of skills. Countries like Denmark, Latvia, and Luxembourg show new demand, while Greece, Estonia, and Slovakia display fading demand. Finally, Cyprus and Slovenia have higher instances of no demand.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Analytical Skills	Denmark, Luxembourg, Portugal, Spain	Greece, Hungary, Lithuania, Slovakia	Austria, Belgium, Bulgaria, Croatia, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Netherlands, Poland, Romania, Sweden	Cyprus, Slovenia
Data Governance	Denmark, Finland, Hungary, Portugal, Slovenia, Spain	Estonia, Italy, Luxembourg, Romania	Bulgaria, Croatia, Cyprus, Greece, Latvia, Lithuania	Austria, Belgium, France, Germany, Ireland, Netherlands, Poland, Slovakia, Spain, Sweden
Data Pipeline Development	Austria, Bulgaria, Ireland, Luxembourg, Sweden	Croatia, Denmark, Estonia, Finland, Germany, Greece, Slovakia	Belgium, France, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Spain	Slovenia, Italy, Hungary, Cyprus
Exploratory Data Analysis	Croatia, Germany, Latvia, Lithuania, Slovakia	Slovenia	Austria, Belgium, Bulgaria, Cyprus, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland,	---

			Portugal, Romania, Spain, Sweden	

Table 3: Data and Analysis hard skills group: distribution of top hard skills by period per country

In Table 4, the skill with the highest constant demand within the *Project & Strategy* group, across all countries, is *Project Management*. There is mostly no demand or fading demand for *Marketing Strategy and Management*, while new demand is present for some countries. Lastly, *Leadership and Management* and *Requirements Analysis and Management* show the highest number of countries with no demand, with *Leadership and Management* showing a greater number of cases for constant demand, and *Requirements Analysis and Management* a higher count of new demand.

Generally speaking, within this group of skills, countries such as Cyprus, France and Luxembourg show higher constant demand, while Slovakia and Spain have higher levels of new demand. Greece, Austria and Croatia show higher levels of fading demand for most skills and Austria, Croatia and Denmark show the most presence in the no demand category.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Leadership and Management	Hungary, Portugal, Slovakia, Spain	Belgium, Latvia, Lithuania	Bulgaria, Cyprus, Finland, France, Ireland, Italy, Luxembourg, Sweden	Austria, Croatia, Denmark, Estonia, Germany, Greece, Netherlands, Poland, Romania, Slovenia
Marketing Strategy and Management	Belgium, Cyprus, Ireland, Luxembourg, Slovakia, Spain	Bulgaria, Denmark, Hungary, Netherlands, Poland, Slovenia, Sweden	Austria, France, Germany	Croatia, Estonia, Finland, Greece, Italy, Latvia, Lithuania, Portugal, Romania
Project Management	—	—	Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania,	—

			Slovakia, Slovenia, Spain, Sweden	
Requirements Analysis and Management	Croatia, Finland, France, Italy, Lithuania, Romania, Slovenia	Hungary, Ireland, Latvia, Sweden	Cyprus, Estonia, Luxembourg	Austria, Belgium, Bulgaria, Denmark, Germany, Greece, Netherlands, Poland, Portugal, Slovakia, Spain

Table 4: Project & Strategy hard skills group: distribution of top hard skills by period per country

In Table 5, *Use Methodologies for User-Centered Design* and *User Research* show a similar level of no demand coverage, with *User Research* having the highest number of cases in the entire group. In contrast, *User Experience Design* has significantly lower no demand coverage, shares a low level of fading demand with the other two, and holds the highest count of *constant demand* in the group. Additionally, *Use Methodologies for User-Centered Design* shows the highest level of *new demand* across all skills in this group.

When focusing on country level, there is a clear higher constant demand for skills in this group for Ireland, Germany and Greece, while Belgium, Bulgaria and Italy having a bigger presence in the new demand category. When it comes to no demand, Latvia, Luxembourg and Slovenia are the most represented countries, while Austria, Finland and Sweden are the most represented in the no demand category.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Use Methodologies for User-Centered Design	Belgium, Bulgaria, Estonia, Lithuania, Netherlands, Portugal, Slovakia, Sweden	Cyprus, Spain	Germany, Hungary, Ireland	Austria, Croatia, Denmark, Finland, France, Greece, Italy, Latvia, Luxembourg, Poland, Romania, Slovenia
User Experience Design	Bulgaria, Croatia, Italy, Lithuania, Romania, Slovakia, Spain	Austria, Finland, Hungary, Sweden	Belgium, Cyprus, Denmark, France, Germany, Greece, Ireland, Netherlands, Poland, Portugal	Estonia, Latvia, Luxembourg, Slovenia
User Research	Belgium, Italy, Portugal,	Bulgaria, Denmark	Finland, Greece, Ireland,	Austria, Croatia, Cyprus, Estonia,

	Romania		Netherlands, Poland	France, Germany, Hungary, Latvia, Lithuania, Luxembourg, Slovakia, Slovenia, Spain, Sweden

Table 5: UX & Design hard skills group: distribution of top hard skills by period per country.

Looking atT 6, *Python (computer programming)* is the one skill in this group, with a constant demand across countries and periods, showing the most consistency in demand and importance. On the opposite side there is Restful Web Services, showing constant demand for only one country, Austria, and more importantly showing the highest number of countries with no demand for this skill.

Within this group, countries such as Austria, Belgium, and France show higher levels of constant demand. New demand is particularly notable in Belgium and Finland, while Lithuania shows signs of fading demand. Countries like Croatia, Romania, and Slovakia have higher instances of no demand.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Introduction to SQL	Bulgaria, Cyprus, Finland, Greece, Hungary, Italy, Poland	Austria, Estonia, Lithuania	Belgium, France, Germany, Luxembourg, Netherlands, Portugal, Spain, Sweden	Croatia, Denmark, Ireland, Latvia, Romania, Slovakia, Slovenia
Python Computer Programming	—	—	Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden	—
Restful Web Services	Belgium, Denmark, Finland,	France, Italy, Latvia, Lithuania, Luxembourg,	Austria	Bulgaria, Croatia, Cyprus, Estonia, Greece, Hungary,

	Germany, Ireland, Sweden	Spain		Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia

Table 6: Programming and Technical Implementation hard skills group: distribution of top hard skills by period per country.

Table 7 presents the last group of hard skills, which only include one skill at this stage, *Language Proficiency and Certification*; Although the majority of countries can be found in the fading demand category, there is fairly good representation in the constant demand category, as well as a very small number of countries showing no demand as well as new demand.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Language Proficiency and Certification	Austria, Slovenia, Spain	Bulgaria, Croatia, Cyprus, Estonia, Finland, France, Greece, Hungary, Ireland, Slovakia, Sweden	Belgium, Denmark, Lithuania, Netherlands, Poland, Portugal, Romania	Germany, Italy, Latvia, Luxembourg

Table 7: Language & Certification hard skill group: distribution of top hard skills by period per country

Finally, Table 8 presents the distribution of soft skills in demand. Generally speaking, both soft skills show the highest representation in the constant demand category, while also showing some level of new demand. *Communication and Collaboration Skills* also show a high degree of fading demand, compared to *Cross-Functional Collaboration Skills*, which also shows the highest presence in the no demand category.

For this group, countries such as Germany, France, and Greece show constant demand, selecting both skills. Countries like Lithuania and Portugal display new demand, selecting one of the two skills individually. Bulgaria and Denmark show fading demand, selecting both skills, while Slovenia is the only country with no demand for either skill.

Skill	New Demand	Fading Demand	Constant Demand	No Demand
Communication and Collaboration Skills	Austria, Croatia, Cyprus, Finland, Latvia, Lithuania, Slovakia	Bulgaria, Denmark, Estonia, Ireland, Netherlands, Portugal, Romania, Spain	Belgium, France, Germany, Greece, Hungary, Luxembourg, Poland, Sweden	Italy, Slovenia
Cross-Functional Collaboration	Estonia, Hungary, Portugal	Bulgaria, Denmark, Italy,	Belgium, Cyprus, Finland, France,	Austria, Croatia, Latvia, Lithuania,

		Poland, Sweden	Germany, Greece, Ireland, Luxembourg, Netherlands, Romania, Slovakia, Spain	Slovenia

Table 8: Soft skills group: distribution of top soft skills by period per country

4.3.2 Cross-country Roles Continuity Results

This subsection focuses on the level of consistency shown by key job roles over time and across countries. The categories applied to differentiate the demand for job roles are the same used previously, new demand, constant demand, fading demand, and no demand.As in the previous subsection, this analysis was conducted at country level, using the top 20 most in-demand roles for each period. Figure 28 shows the distribution, in percentage of points, of these top global roles, per period.

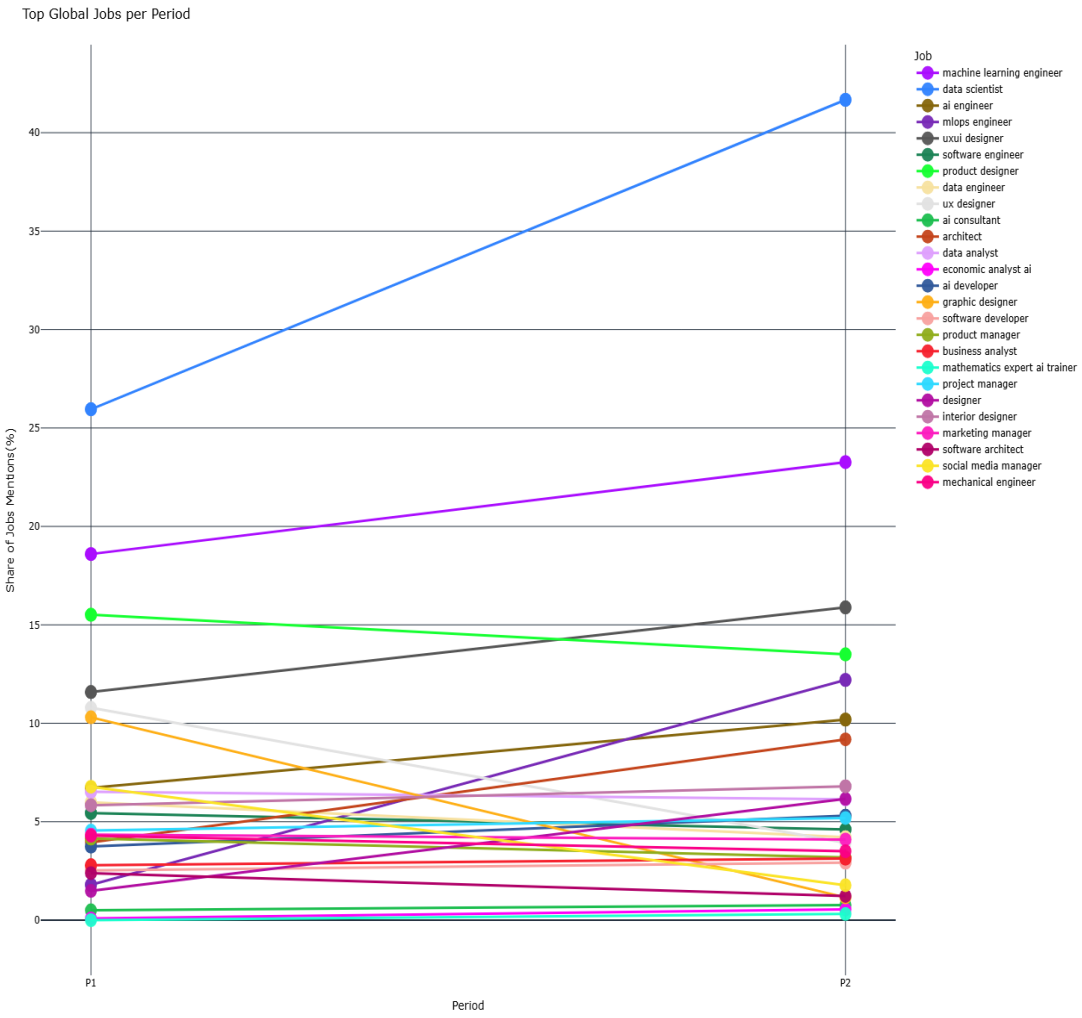

Figure 28: Top Global Jobs Mentions per Period: percentage of top 20 global skills per period

In Figure 28, The job with the highest frequency for both periods is *Data Scientist*, which demonstrates the most significant growth rate between the periods. *Machine Learning Engineer* is the second most identified role in both timelines, and it shows a slightly lower but notable growth rate between periods. *AI Consultant* shows the smallest presence in period 1, followed by *Mathematics Expert AI trainer* in period 2, which was not included at all among the top job roles in period 1.

The roles *Interior Designer* and *Mechanical Engineer* were initially flagged as top roles. However, their relevance raised concerns, as they are not typically associated with generative AI and lacked a clear connection to AI-related tasks. Upon further investigation, some job postings for these roles did include one or more AI-related skills, while others did not provide a clear reason for their inclusion. Due to this uncertainty, these roles were excluded from the trend analysis. Nevertheless, they will be referenced again in the Conclusions section, as their occasional inclusion of AI skills may still be of significance.

Role	New Demand	Fading Demand	Constant Demand	No Demand
AI Consultant	Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Italy, Lithuania, Netherlands, Poland, Portugal, Romania, Sweden	---	Latvia, Spain	Croatia, Cyprus, Estonia, Hungary, Ireland, Luxembourg, Slovakia, Slovenia
AI Developer	Austria, Bulgaria, Poland, Portugal, Spain	Finland, Greece, Latvia	Germany, Italy, Sweden	Belgium, Croatia, Cyprus, Denmark, Estonia, France, Hungary, Ireland, Lithuania, Luxembourg, Netherlands, Romania, Slovakia, Slovenia
AI Engineer	Bulgaria, Estonia, Greece, Slovenia	Denmark, Finland	Austria, Belgium, Croatia, Cyprus, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Spain, Sweden	Slovakia

Machine Learning Engineer	---	---	Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden	---
MLops Engineer	Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, Germany, Ireland, Italy, Lithuania, Netherlands, Portugal, Slovakia, Slovenia	---	France, Poland, Romania, Spain, Sweden	Austria, Cyprus, Greece, Hungary, Latvia, Luxembourg
Economic Analyst AI	Belgium, Bulgaria, Finland, France, Germany, Greece, Ireland, Luxembourg, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden	---	---	Austria, Croatia, Cyprus, Denmark, Estonia, Hungary, Italy, Latvia, Lithuania, Netherlands, Spain
Mathematics Expert AI Trainer	Finland, Germany, Ireland, Portugal, Romania, Spain	---	---	Austria, Belgium, Bulgaria, Croatia, Lithuania, Luxembourg, Netherlands, Poland, Slovakia, Slovenia, Sweden

Table 9: AI & Machine Learning roles group: distribution of top roles by period per country

Table 9 shows *Machine Learning Engineer* as the most widely covered of all roles across both periods, with every country showing demand for it. *AI Consultant*, *MLOps Engineer*, and *Economic Analyst AI* all show no fading demand and high levels of new demand, with *MLOps Engineer* also having very low coverage for no demand. *AI Engineer* has the second highest level of constant demand, with minimal presence in the other demand categories, while only Slovakia shows no demand for it. Lastly, *AI Developer* has the second highest coverage of no demand and limited representation in other categories; a pattern similar to *Mathematics*

Expert AI Trainer, which shows no instances of constant or fading demand and the highest overall no demand coverage.

In terms of geographic demand coverage for the entire group, constant demand is mostly seen in Spain and Sweden, new demand in Bulgaria and Portugal, fading demand in Finland, and no demand is primarily found in Cyprus and Hungary.

Role	New Demand	Fading Demand	Constant Demand	No Demand
UX Designer	Greece	Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, France, Hungary, Ireland, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovakia, Spain, Sweden	Bulgaria, Finland, Germany, Italy	Latvia, Netherlands, Slovenia
UX/UI Designer	Croatia, Slovenia, Sweden	Cyprus, Ireland, Luxembourg	Austria, Belgium, Bulgaria, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Spain	Finland, Slovakia
Designer	Cyprus, Denmark, Germany, Italy, Lithuania, Portugal, Slovenia, Sweden	—	—	Austria, Belgium, Bulgaria, Croatia, Estonia, Finland, France, Greece, Hungary, Ireland, Latvia, Luxembourg, Netherlands, Poland, Romania, Slovakia, Spain
Graphic Designer	—	Austria, Denmark, Estonia, Germany, Greece, Ireland, Italy, Lithuania,	—	Belgium, Bulgaria, Croatia, Cyprus, Finland, France, Hungary, Latvia, Luxembourg, Netherlands,

		Poland, Romania, Spain		Portugal, Slovakia, Slovenia, Sweden

Table 10: UI/UX & Design roles group: distribution of top roles by period per country

As shown by Table 10, *UX/UI Designer* has by far the highest coverage of constant demand, with only a few countries falling into the other demand categories. Only Finland and Slovakia show no demand for this role in either period. In contrast, *UX Designer* and *Graphic Designer* show high levels of fading demand, with *Graphic Designer* also having one of the highest levels of no demand. *Designer* has the greatest no demand coverage within the group; however, it also shows the highest level of new demand across the group.

In this skills group, constant demand has the highest representation for countries such as Bulgaria, Germany, and Italy. New demand is most notable in Greece, Slovenia, and Sweden. Fading demand is observed in Ireland and Romania, while no demand is most evident in Finland, the Netherlands, and Slovakia.

Role	New Demand	Fading Demand	Constant Demand	No Demand
Software Architect	Finland, Poland	Austria, Belgium, Bulgaria, Latvia, Portugal, Slovakia	Denmark, Germany	Croatia, Cyprus, Estonia, France, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Romania, Slovenia, Spain, Sweden
Software Developer	Lithuania, Poland	Belgium, Cyprus, Estonia, Finland, Germany, Greece, Italy, Luxembourg, Portugal	Austria, Denmark, Hungary	Bulgaria, Croatia, France, Ireland, Latvia, Netherlands, Romania, Slovakia, Slovenia, Spain, Sweden
Software Engineer	Finland, Italy	Belgium, Bulgaria, Cyprus, France, Ireland, Latvia, Netherlands, Slovenia, Sweden	Austria, Croatia, Denmark, Estonia, Hungary, Lithuania, Poland, Portugal, Slovakia	Germany, Greece, Luxembourg, Romania, Spain

Table 11: Software and Development roles group: distribution of top roles by period per country

According to Table 11, *Software Engineer* has the highest coverage of constant demand within the group and the lowest coverage of no demand. However, it also shows one of the highest levels of fading demand, sharing similar coverage with *Software Developer*. All roles in this group exhibit very low levels of new demand.

In this skill group, constant demand is primarily represented by Denmark, new demand by Finland and Poland, fading demand by Belgium, and no demand by Romania and Spain.

Role	New Demand	Fading Demand	Constant Demand	No Demand
Business Analyst	Croatia, Italy	Greece, Lithuania, Luxembourg, Portugal, Slovakia	Belgium, France, Hungary, Ireland, Poland, Spain	Austria, Bulgaria, Cyprus, Denmark, Estonia, Finland, Germany, Latvia, Netherlands, Romania, Slovenia, Sweden
Data Analyst	Cyprus, Luxembourg, Netherlands, Slovakia	Germany, Greece, Italy, Portugal	Belgium, France, Hungary, Lithuania, Poland, Romania, Spain	Austria, Bulgaria, Croatia, Denmark, Estonia, Finland, Ireland, Latvia, Slovenia, Sweden
Data Engineer	Latvia, Romania	Belgium, Cyprus, Finland, Greece, Italy, Luxembourg, Portugal, Slovenia, Spain	Austria, Bulgaria, Denmark, France, Hungary, Lithuania, Netherlands, Poland, Slovakia, Sweden	Croatia, Estonia, Germany, Ireland
Data Scientist	---	Slovenia	Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden	---

Table 12: Data & Analytics roles group: distribution of top roles by period per country

Table 12 shows *Data Scientist* as having the highest level of constant demand among the other job roles in the same group, with only Slovenia showing low demand and no countries falling into the other demand categories. It is the only role in the group with no recorded instances of new or no demand. *Business Analyst* and *Data Analyst* share the highest levels of no demand within the group, as well as the highest coverage for new demand. *Data Engineer* shows the highest level of fading demand of all roles in this group, while also having the second lowest level of no demand.

In terms of geographic coverage, countries such as France, Hungary, and Poland show constant demand for most of the roles. New demand is most prominent in Croatia, Cyprus, and the Netherlands. Fading demand is highest in Greece and Portugal, while Estonia shows the greatest number of roles with no demand.

Role	New Demand	Fading Demand	Constant Demand	No Demand
Product Designer	Belgium, Finland, Latvia	Germany, Italy, Netherlands, Romania, Sweden	Bulgaria, Croatia, Cyprus, Denmark, Estonia, France, Greece, Hungary, Ireland, Lithuania, Poland, Portugal, Spain	Austria, Luxembourg, Slovakia, Slovenia
Product Manager	Cyprus, Estonia, Finland, Greece, Ireland, Latvia, Lithuania, Portugal, Slovenia, Spain	Austria, Denmark, Germany, Netherlands, Romania	Croatia, France	Belgium, Bulgaria, Hungary, Italy, Luxembourg, Poland, Slovakia, Sweden
Project Manager	Belgium, France, Germany, Ireland, Romania	Spain	---	Austria, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Slovenia, Sweden

Table 13: Product & Project roles group: distribution of top roles by period per country

Table 13 shows *Product Designer* as the role with the highest level of constant demand. However, it also shows, together with *Product Manager,* the highest coverage for fading demand. *Product Manager* also shows the highest level of new demand within the group, the highest coverage for no demand, (with only Spain showing fading demand), and no countries showing constant demand. Despite this, this role still shows a notable level of new demand. Within this group, constant demand is most frequently represented by Croatia and France. New demand is most prominent in Belgium, Finland, Ireland, and Latvia. Fading demand is more common in Germany, the Netherlands, and Romania, while Luxembourg and Slovakia show the highest levels of no demand.

Role	New Demand	Fading Demand	Constant Demand	No Demand
Marketing Manager	Lithuania	Austria, Netherlands, Portugal, Romania, Slovakia, Spain	Belgium	Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Poland, Slovenia, Sweden
Social Media Manager	---	Belgium, Estonia, Germany, Hungary, Latvia, Lithuania, Spain	---	Austria, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden

Table 14: Marketing & Social Media roles group: distribution of top roles by period per country

In Table 14, both roles show very similar demand coverage, with the highest levels falling under fading demand and no demand.

In terms of geographic demand coverage for the group as a whole, constant demand is recorded only in Belgium. New demand appears only in Lithuania. Fading demand is observed in Spain for both roles, while countries such as Bulgaria, Croatia, France, and Greece show no demand for either of them.

4.3.3 Sector-Specific and Cross-Sector Skill Trends

In order to assess both sector-specific skill requirements and transversal competencies, the distribution of core skills was analyzed across industries and both time periods considered.

Period	Industry	Postings Counts
1	Information Technology	3951
2	Information Technology	3608
1	Finance	455
2	Finance	428
1	Advertising & Marketing	377
2	Consulting	333

Table 15: The Top 3 most demanded per industries per period

Table 15 shows a clear picture for the 4 industries represented: information technology is the industry standing out with the highest number of job posts, identified in both periods considered, followed by *Finance*, *Advertising & Marketing* and *Consulting*. To better understand

market demands, the top 10 skills were selected for each of these leading industries in both periods considered, and are represented in the following graphs.

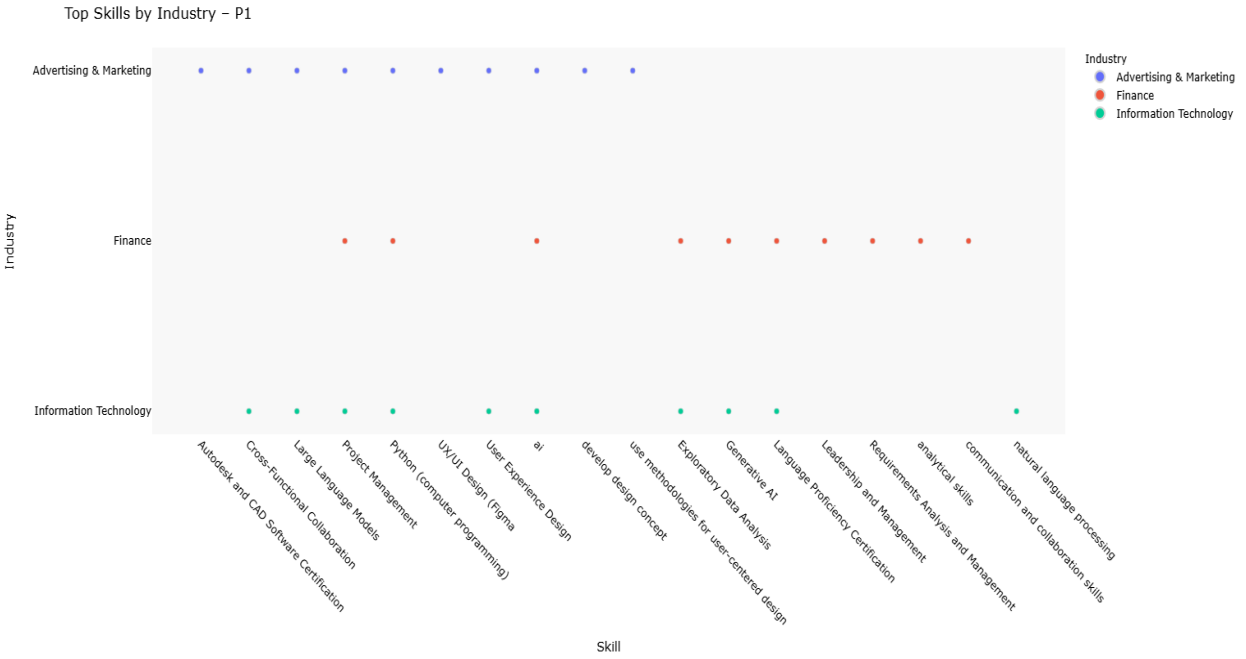

Figure 29: Top skills 10 skills per Industry for period 1:

Figure 29 presents all the unique skills associated with the top three industries identified for period 1. The graph highlights both skills that are considered exclusive to a specific industry—such as *Natural Language Processing* for *Information Technology* or *Analytical Skills* for *Finance*—and those considered transferable across sectors. These transferable skills appear in multiple industries, such as *Generative AI*, which is present in both *Information Technology* and *Finance*, or *Python (computer programming)*, which is shared across all three industries.

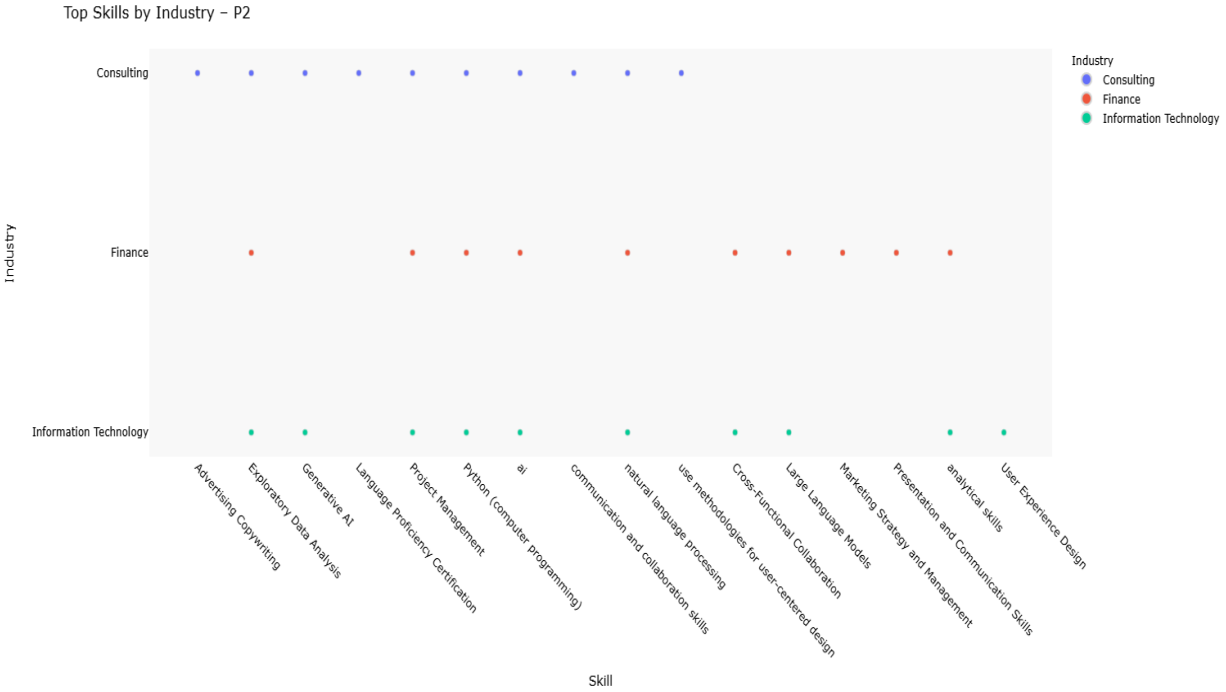

Figure 30: Top skills 10 skills per industry for period 2

Figure 30 shows all the unique skills associated with the top three industries identified for period 2. As in the previous graph, both skills considered exclusive to a particular industry and transferable across sectors are highlighted—such as *User Experience Design* for *Information Technology* or *Communication and Collaboration Skills* for *Consulting*. Examples of transferable skills include *Cross-Functional Collaboration*, which appears in both *Information Technology* and *Finance*, and *Project Management*, which is shared across all three industries.

This graph also allows for trend identification by comparing the two periods. A closer look reveals that many skills (13 out of 18) remained consistent between periods: Only three new skills were introduced in period 2, *Advertising Copywriting*, *Marketing Strategy & Management*, and *Presentation and Communication Skills*.

Another relevant observation is that although many skills appear in both periods, the industries associated with them have changed. For example, the skill *Natural Language Processing,* previously seen only within *Information Technology*, is now also present within *Finance* and *Consulting*. Similarly, the skill *Generative AI*, which was previously associated with *Information Technology* and *Finance*, is now included within the *Information Technology* and *Consulting sectors*.

To gain additional insights into the distribution of skills within each industry,the level of presence (count and percentage) of skills in demand across the two periods was calculated. The table below presents the results of this analysis.

Skill	Advertising & Marketing	Consulting	Finance	Information Technology
Advertising Copywriting	0	3%	0	0

Autodesk and CAD Software Certification	4%	0	0	0
Cross-Functional Collaboration	3.4%	0	1.4%	1%
Exploratory Data Analysis	3%	5%	2%	2%
Generative AI	0	4%	1.4%	2.3%
Language Proficiency Certification	0	3%	1.2%	1.3%
Large Language Models	3%	4%	1.4%	2%
Leadership and Management	3%	0	1.5%	0
Marketing Strategy and Management	0	0	1.5%	0
Microservices Architecture	0	3.3%	0	0
Presentation and Communication Skills	0	0	1.7%	0
Project Management	9%	5%	3%	3%
Python (computer programming)	9%	12%	6%	7%
Requirements Analysis and Management	0	0	1.2%	0
UX/UI Design (Figma	3%	0	0	0
User Experience Design	4%	0	0	1.4%
User Research	2.4%	0	0	0
ai	6.2%	7%	3%	4%

ai and Machine Learning (AI/ML)	0	3%	0	0
analytical skills	0	3%	2%	1.3%
communication and collaboration skills	2.4%	3%	2%	0
develop design concept	3%	0	0	0
natural language processing	0	4%	2%	2%
use methodologies for user-centered design	3.3%	3%	0	0

Table 16: Average percentage for each top skill for both periods per Industry:

Specifically, Table 16 shows the percentage of distribution for each previously identified skill across both periods. These numbers reveal how prominent each skill is within each industry. For example, *Python (programming language)*, although previously identified as a top skill across all industries with a higher absolute frequency in *Information Technology*, shows a higher value in the *Consulting* industry.

In addition to identifying the top skills for the leading industries in each period, it is also relevant to look at the data from the industry perspective. By selecting the top three industries associated with each top skill that appears in more than one industry it is possible to identify the most frequent *transversal skills* and the three industries most commonly linked to each of them.

The figure below shows the results for this analysis.

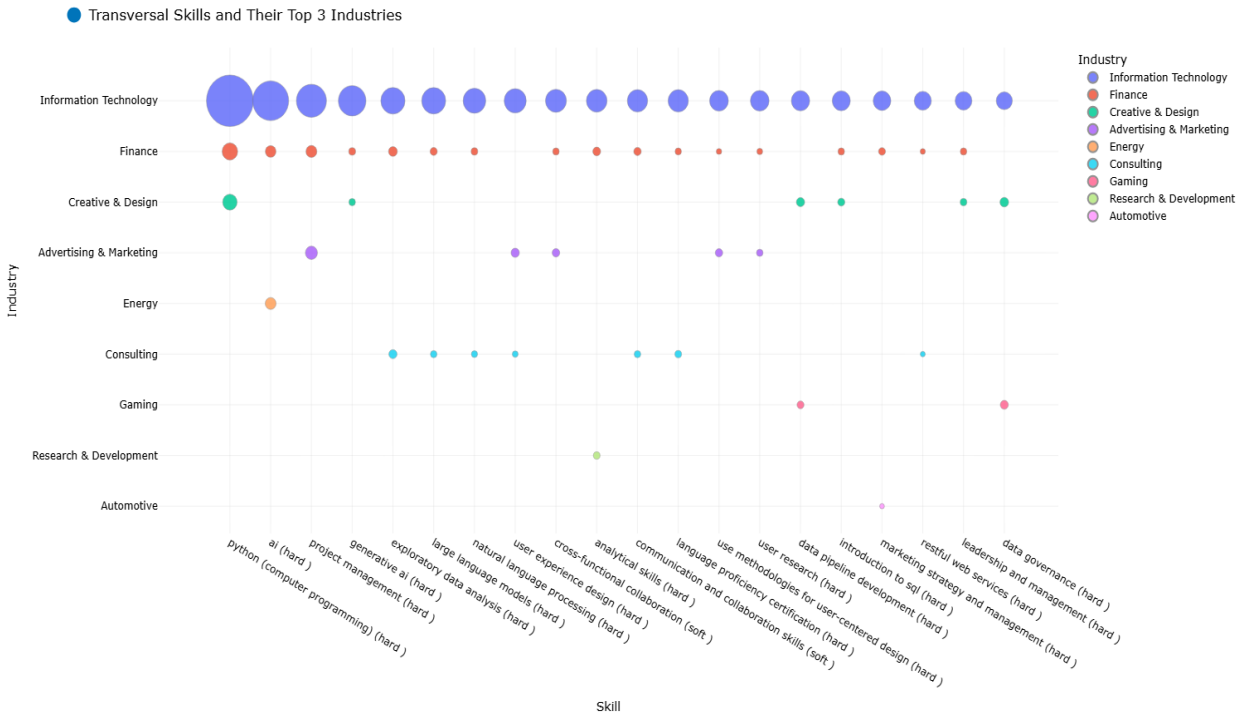

Figure 31: Transversal Skills and their Top 3 Industries: most frequent transversal skills and the 3 most frequent industries per skill.

As shown in Figure 31, in addition to the three previously identified top industries, five other industries were found to be strongly associated with top *transversal skills*: *Creative & Design*, *Energy*, *Gaming*, *Research & Development*, and *Automotive*. For example, the skill *Python (computer programming)* is now also associated with *Creative & Design*; the skill *AI* is identifiable within the *Energy* industry; and *Data Pipeline Development* appears within both *Gaming* and *Creative & Design*.

4.3.4 Cross-Role Skill Trends

This section will focus on gaining insights into the relationships between roles and skills, by selecting the top global items for both, according to those already identified in subsections 4.2.3 and 4.2.4. Their most closely related roles or skills were then identified based on the frequency of co-occurrence. The following plots present the results obtained using these filters.

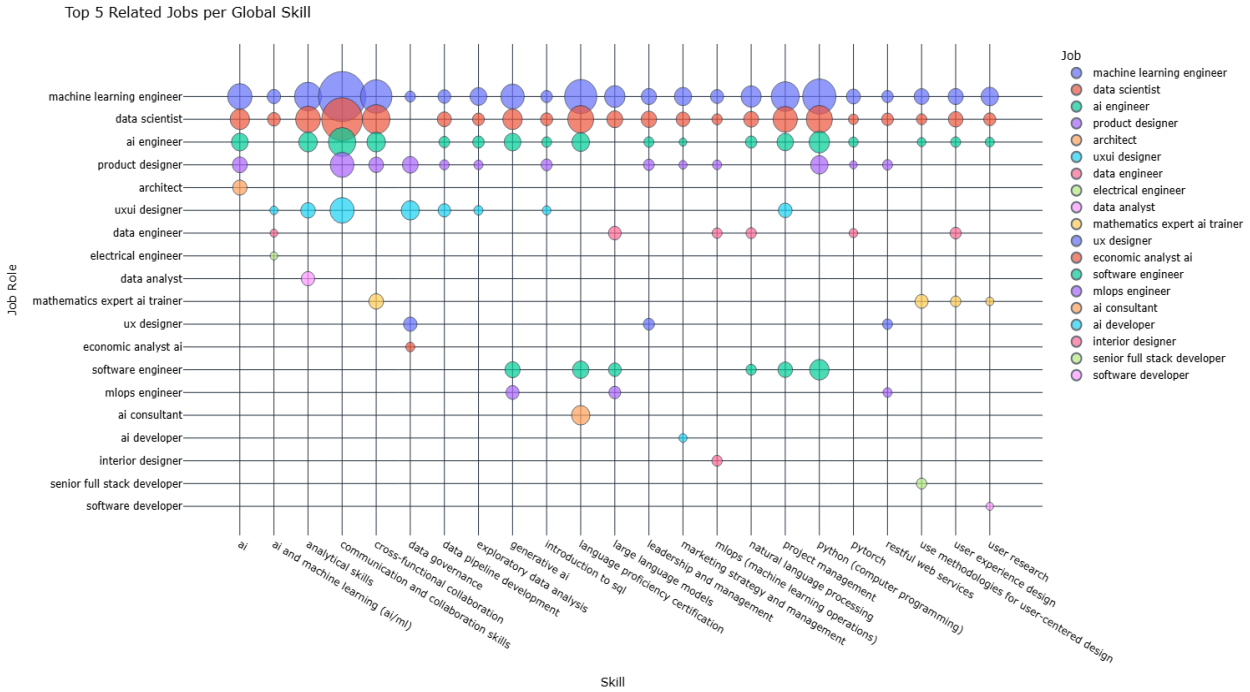

Figure 32: Top Job Roles Associated with Global Skills: each skill is in x axis, whilst the corresponding job is in the y axis represented by a different bubble color. The size of the bubble represents the frequency of co-occurrence.

As seen in Figure 32, several job roles are shown to be associated with the same skill. For example, the roles *Machine Learning Engineer*, *Data Scientist*, *AI Engineer*, *Data Engineer*, *Product Designer*, and *UX/UI Designer* are all highly associated with *Communication and Collaboration Skills*. The plot also reveals which roles are shared across different top skills. The same roles, *Machine Learning Engineer*, *Data Scientist*, *AI Engineer*, *Data Engineer*, and *Product Designer*, appear repeatedly across multiple top global skills.

Additionally, it is possible to identify which skills are shared between specific roles. For example, *Machine Learning Engineer* shares nearly all of its associated skills with *Data Scientist* and *Data Engineer* but shares only the skill *MLOps (Machine Learning Operations)* with *Senior Full Stack Developer*.

To better understand which skills are commonly shared between different roles, a different perspective was also used, analysing the top skills associated with the global top job roles. The results of this analysis are shown in Figure 33.

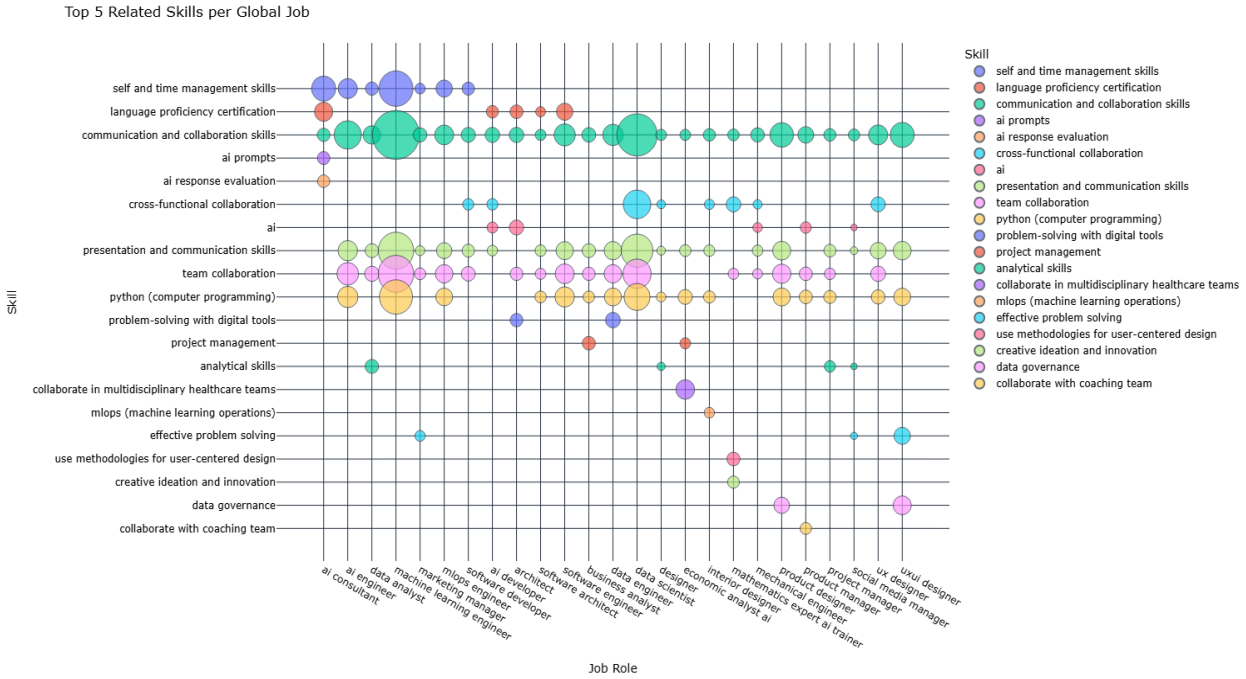

Figure 33: Top Skills Associated with Global Roles: each job is in x axis, whilst the corresponding skill is in the y axis represented by a different bubble color. The size of the bubble represents the frequency of co-occurrence.

Figure 33 shows that *Communication and Collaboration Skills*, *Presentation and Communication Skills*, *Team Collaboration*, and *Python (computer programming)* not only show similar levels of coverage but are also the most widely distributed skills across the identified top global roles. Additionally, the chart highlights the top skills associated with each of these roles, along with the relative weight or importance of each skill. For example, for the role *Machine Learning Engineer*, the skills *Python (computer programming)*, *Team Collaboration*, *Presentation and Communication Skills*, *Communication and Collaboration Skills*, and *Self and Time Management Skills* are considered highly relevant, as they frequently co-occur in this role. Some unexpected relations can be observed, for example, for the role *Project Manager*, the skill *Project Management* is not considered a top skill for it but, skills like Python (computer programming), Analytical Skills, Team Collaboration, etc., are.

4.4 Conclusions

The objective of this research was to identify the most in-demand skills and job roles related to generative AI across EU member states, in order to support the design of higher education and vocational training programs relevant to real market needs. To achieve this, a comprehensive and multi-layered methodology was deployed, the use of a large language model (GPT-4o) for extracting, categorizing, and semantically aligning skill data with ESCO standards, alongside transformer-based models and a rich taxonomy on 15621 job postings.

The statistical analysis conducted revealed several key findings across skills, job roles, geographic distribution, and industry-specific trends, providing a rich overview of the current generative AI job market in the EU.

Development of Skills in Demand across time

The analysis of the top global skills allowed to gain insights into the European market trends in terms of skills mostly identified and the level of demand for these. Only the top skills were included in the analysis , which means that they only represent a percentage of the whole market, counting for a total of 5670 unique core skills. This points to the richness and diversity of the generative AI market.

Across all periods and countries considered ,the hard skill *Python (Computer Programming),* stood out as the most consistently in-demand technical skill, with universal constant demand reported from all EU countries with available data. This skill has also shown the most versatility, with a presence across a wide range of technical job roles, such as *Machine Learning Engineer* but also non-technical ones such as *Product Manager*. Another prominent and versatile skill, *Project Management,* also showed a universal constant demand from all EU countries. Among other highly demanded skills, there are hard skills such as *Analytical Skills, User Experience Design, Natural Language Processing, Exploratory Data Analysis* and *Introduction to SQL*. Among soft skills, *Cross-Functional Collaboration* shows the highest coverage as a skill most consistently in demand. Skills that showed a distinctive new demand, such as *Data Governance, Requirements Analysis and Management* and *Use Methodologies for User-Centered Design* combined with a lot of cases of no demand can be an indicator of a shift in their status.

The analysis also shows a possible shift in the relevance of skills such as *Pytorch, MLops, User Research* and *Marketing Strategy and Management,* which are becoming less in demand. Soft skills like *Communication and Collaboration Skills* and *Cross-functional collaboration* were frequent in job postings and showed a high constant demand, especially considering Communication and Collaboration Skills. Additionally, other soft skills like *Presentation and Communication Skills* and *Team Collaboration* showed the strongest co-occurrence and coverage when considered together with both technical and non-technical top roles. This highlights the growing importance of interpersonal and team-oriented competencies even within highly technical domains. Additionally, the skill *Project Management's* demand also comes from roles that aren't management roles like *Software Engineer*. In fact, the role *Project Manager* didn't take this skill in its top 5 skills. This means that the type of responsibilities that typically belong to some roles are being transferred to other less typical ones, which reinforces the previous statement of the focus not simply being on technical skills.

Geographic Skills Demand Variation

An integrated analysis of skill demand patterns reveals pronounced differences in how EU countries are integrating generative AI competencies into their labor markets. Countries such as France, Germany, Poland, Netherlands, and Belgium consistently exhibit high levels of *constant demand* across several major skill groups, particularly in *AI & Machine Learning*, *Data & Analysis*, *Programming & Technical Implementation*, and *Soft Skills*. These patterns reflect a mature ecosystem where generative AI-related skills are broadly and consistently integrated into the workforce.

In contrast, countries such as Slovenia, Croatia, Latvia, and Estonia show some of the highest levels of *no demand*, particularly within *AI & Machine Learning*, *Project & Strategy*, and *UX & Design*. These domains represent both foundational and interdisciplinary areas, and the lack

of demand suggests a possible limited or delayed integration of generative AI within these labor markets.

New demand is strongest in countries such as Portugal, Hungary, Lithuania, Slovakia, and Belgium, where increasing engagement with skills related to *UX & Design*, *Project & Strategy*, and *Data & Analysis* is observed. These trends indicate diversification in the types of AI competencies sought, pointing to broader implementation across functional areas and increased relevance of cross-disciplinary capabilities.

Meanwhile, Austria and Italy display more transitional demand profiles, showing some *constant demand* for key technical domains like *AI & Machine Learning* and *Data & Analysis*, but also a relatively high presence of *fading* or *no demand* in *Soft Skills*, *UX & Design*, and *Project & Strategy*. This imbalance may reflect sector-specific discrepancies or early-stage diversification efforts.

Finally, countries such as Spain, Romania, and Greece appear to be in a more balanced position, where both *constant* and *new demand* coexist across various skill groups. These markets reflect steady technical integration alongside growing emphasis on user-oriented and strategic competencies.

Altogether, the EU generative AI skills landscape is highly asymmetrical, with national labor markets evolving at different speeds and in varied directions. Understanding this fragmentation is essential for designing effective education and training strategies that respond to both existing strengths and emerging gaps at country and industry sector levels.

Development of Roles in Demand across time

An analysis of role-level demand across top most frequent generative AI-related occupations reveals a clear distinction between widely adopted core roles and others that are still emerging, fluctuating, or absent from many labor markets. At the center of the AI workforce are roles such as *Machine Learning Engineer* and *Data Scientist*, which exhibit near-universal demand across time periods and countries These roles show consistent inclusion in job posting trends and generally speaking, no fading or absence signals, indicating their crucial role in the generative AI ecosystem.

Other roles with relatively high and stable demand include *AI Engineer, UX/UI Designer*, and to a lesser extent, *AI Consultant* and *Product Designer*. These positions reflect the increasing integration of technical expertise with user-centered design and strategic thinking. Their consistency suggests a growing need for professionals who can bridge the gap between core development and application-focused deployment of generative AI systems.

Interestingly, most of the roles above, *Machine Learning Engineer, Data Scientist, AI Engineer* and *Product Designer* have most of those skills in common, in terms of their distribution across top global skills in the market **.**

Specialized technical roles such as *AI Consultant, MLops Engineer*, and *Mathematics Expert AI Trainer* show high levels of *no demand* coverage and minimal instances of constant demand, suggesting they are either too niche for widespread adoption or not yet well-integrated into conventional job frameworks, which can be explained by their levels of *new demand*. Similarly, roles like *Marketing Manager* and *Social Media Manager* appear largely absent or

decreasing in demand , indicating a possible limited applicability within the generative AI job market currently.

Within the software development domain, roles such as *Software Engineer* and *Software Architect* display varying degrees of demand consistency, with some signs of fading or decline. This may reflect shifting job title conventions or a narrowing focus on AI-specialized roles that blend traditional software engineering with machine learning expertise.

Overall, the demand for generative AI-related roles reveals a maturing core of stabilized, high-demand positions, alongside a broader set of roles that remain fluid, fragmented, or in the early stages of recognition. These patterns point to an evolving labor market still negotiating how best to structure and define roles within the rapidly growing domain of generative AI.

Geographic Roles Demand Variation

Demand for generative AI roles across EU countries reveals clear distinctions when examined by type and job category.

Poland, France, and Spain exhibit high levels of *constant* demand across multiple job groups, particularly in *AI & Machine Learning, Software & Development*, and *Data & Analytics*. These countries show consistent presence across both job group-specific and overall role data, reflecting stable and ongoing integration of technical AI roles into their labor markets.

In contrast, *new* demand is most prominent in Finland, Portugal, and Lithuania, with appearances across several job groups including *Product & Project, UX/UI & Design,* and *Marketing & Media*. This indicates active expansion of AI-related capabilities into cross-functional and user-centered domains, beyond core technical positions.

Countries such as Slovenia, Luxembourg, Cyprus, and Croatia are characterized by widespread *no demand* across groups. The absence of demand is not limited to strategic or creative roles but also extends to foundational technical job groups, pointing to minimal generative AI adoption in these labor markets.

Fading demand is most consistently observed in Portugal, Austria, Germany, and Spain. This can be observed, for example, in roles related to *Product & Project, UX/UI & Design*, and *Marketing & Media*. These countries show signals of decreasing demand within organizational and applied AI roles, even where technical demand remains more established.

Together, these patterns highlight significant variation in how generative AI roles are being adopted across Europe. While some countries are expanding and sustaining demand across diverse job categories, others remain limited in scope or show weakening signals in key areas. Recognizing these dynamics is essential for aligning workforce development efforts with the specific strengths and gaps of each national context.

Industry and Cross-Sectoral Insights

The analysis of sector-specific and transversal skill demand reveals both stability and gradual shifts in how generative AI-related competencies are integrated across industries. A central observation is the sustained dominance of the *Information Technology* sector, which recorded the highest number of job postings in both periods. *Finance* also maintained a steady presence, while *Advertising & Marketing*, initially among the top industries in period 1, was replaced by *Consulting* in period 2, suggesting rotational prominence among adjacent service

sectors. This shift could indicate that organizations are looking for strategic advice on how to implement AI solutions, not just the technical know-how.

Despite industry variation, 13 out of the 18 top skills identified in period 1 remained present in period 2, demonstrating a stable core of high-demand competencies. However, the association between these skills and industries shifted. For instance, *Natural Language Processing*, originally exclusive to *Information Technology*, was later selected by *Finance* and *Consulting*, reflecting its growing cross-functional relevance. Similarly, *Generative AI*, initially linked to *Information Technology* and *Finance*, transitioned to being selected by *Information Technology* and *Consulting*, further illustrating changes in how industries embed key AI technologies.

The emergence of new skills in period 2, *Marketing Strategy & Management*, *Presentation and Communication Skills*, and *Advertising Copywriting*, highlights an evolving need for strategic and communicative capabilities, particularly in knowledge- and service-oriented sectors. These skills appeared almost exclusively in *Consulting* and *Finance*, indicating a possible sectoral rebalancing toward user engagement, market adaptation, and internal coordination.

The skill frequency percentage, from table 14, further quantifies the relevance of core competencies. *Python (computer programming)* appeared across all industries, but while its absolute frequency is highest in *Information Technology*, its relative weight peaked in *Consulting* (12%), indicating that, in this sector, a good quantity of jobs postings have a higher demand for this skill. Similarly, *Project Management* showed strong relative presence in both *Advertising & Marketing* (9%) and *Consulting* (5%), and *AI* had notable presence in *Consulting* (7%) and *Advertising & Marketing* (6.2%), confirming the broadening of AI deployment across domains.

Figure 4 further expands the view of *transversal skills*, identifying not only their shared presence across dominant sectors but also their diffusion into emerging ones. Five new industries, *Creative & Design*, *Energy*, *Gaming*, *Research & Development*, and *Automotive*, appeared in the skills landscape, linked to skills like *Python*, *AI*, *Data Pipeline Development* and *Data Governance*. For example, *AI* is now associated with the *Energy* sector, *Data Pipeline Development* with *Gaming* and *Creative & Design*, and *Python* with nearly all sectors reviewed.

Additionally, it is worth remembering that the roles *Interior Designer* and *Mechanical Engineer*, flagged as part the top 20 Global roles, even if not typical generative AI roles, most of their job postings do have one or another AI skill, such as 3D visualization tools, AI tools for mechanical hardware development, etc. This is a sign that the sector of generative AI is indeed in expansion already being relevant for roles of fields that aren't typically related to generative AI.

These findings point to a maturing AI labor ecosystem. While core technical skills maintain stable demand across periods, their Industry embedding is becoming more dynamic, revealing a system in which foundational knowledge meets evolving application contexts. This reinforces the need for workforce development strategies that are not only responsive to dominant skill trends but also agile enough to prepare professionals for deployment across increasingly diverse and interdisciplinary domains.

5 Discussion and recommendations

5.1 State of the art analysis

The survey covered 14 different countries (N=96) in Europe. The respondents represented higher education (57%), vocational education (32%), training centers (6%), and other organizations. Over half of them had more than 1,000 students, with 24% having over 10,000 students in their organization. Lecturers (48%) were the largest group among respondents, followed by professors (20%). Engineering was the largest field (49%), followed by education (27%) and business professions (6%).

AI education appears to be a part of European education, as 63% of organizations are offering AI education or training in some form, and 24% are planning to do so in the next 1-2 years. The reasons for not yet offering AI education ranged from limited funding or resources (32%) to curriculum development challenges (41%), access to relevant technology and tools (38%), and other reasons.

An interesting finding from the perspective of this project is that 49% of respondents are offering courses or training on generative AI, and 19% are planning to do so soon. However, the most common methods to offer generative AI education are workshops and seminars (47%) and online courses (35%). Generative AI courses or training are organized by their own staff (91%). The most common content in those courses includes engineering (54%), business (28%), education-oriented courses (43%), user-centric courses (33%), and others (14%).

These results show a growing institutional commitment to generative AI education. When viewed alongside labor market data, a more detailed picture emerges of how well these offerings align with actual workforce needs. An analysis of 15,621 job postings across the EU highlights strong demand for skills such as Python (Computer Programming), Project Management, User Experience Design, and Natural Language Processing. These skills correspond with the general content areas mentioned in the survey.

Equally notable is the prominence of soft skills like Communication, Cross-Functional Collaboration, and Team Collaboration, which are frequently cited in job postings. These skills are especially relevant for project-based learning environments and indicate a growing emphasis on interpersonal competencies even in technical domains.

However, the labor market also reveals a broader and more complex demand for interdisciplinary skillsets, hybrid roles, and sector-specific applications that extend beyond what is currently reported in the most common educational formats. For example, Project Management is a top skill in roles like Software Engineer but does not appear in the top five skills for Project Manager roles, suggesting a shift of managerial functions into traditionally technical domains. Similarly, skills such as User Experience Design, Requirements Analysis, and Data Governance show growing but uneven demand, pointing to emerging interdisciplinary expectations.

Generative AI competencies are also being embedded in roles not traditionally associated with AI. For instance, Interior Designer and Mechanical Engineer both appear among the top global roles, with job postings listing skills like 3D visualization and AI tools for hardware

development. These examples demonstrate that generative AI is expanding beyond core tech professions into diverse industry sectors.

These patterns suggest that while education and training offerings are expanding, they may not yet fully reflect the evolving structure of labor market needs. Preparing learners for these new and hybrid roles requires continued curricular adaptation, not only in terms of content, but also in how programs support skill integration across disciplines and professional contexts.

5.2 Gap analysis comparing training offerings and needed skills

Survey and Desk Research Findings

An essential finding in this survey is that about half of the education organizations or training centers are offering generative AI courses or training, and many organizations are planning to do so in the next 1-2 years. Additionally, all content areas or skill requirements included in the survey were deemed relevant and important by the respondents.

According to desk research, large organizations are actively developing generative AI course offerings, while universities are following more slowly. Naturally, large tech organizations are promoting their own business interests by offering education related to generative AI, as it boosts market growth. Some of the enterprise-led courses are paid courses, which limits their public offering. There are still many AI-related courses, such as traditional machine learning courses, where elements of generative AI have been embedded as a learning module. These courses tend to provide an orientation to generative AI rather than more specific and detailed content about different dimensions, technologies, applications, models, and development and management practices of generative AI.

The Need for Specialized Generative AI Training

We conclude that there is still a significant need for specific generative AI course offerings across Europe. Generative AI adoption and development are expanding in all sectors, with new solutions such as AI agents, customized large language models, and their new applications and technologies being actively created and developed across Europe. Additionally, generative AI is a vast field that includes various targeted and sector-specific applications, ranging from text, speech, video, image, and code generation to regulation and development processes, practices, and methods within multidisciplinary teams.

Future generative AI professionals, whether they are engineers, developers, designers or IT consultants, should have competencies related to technical proficiency, programming, critical thinking and evaluation, ethical and social responsibility, generic and specific LLM developments, and other qualification-enhancing skills. The other qualification-enhancing skills range from business understanding to design and management skills and applied ethics and regulation (AI and Data Acts). These content areas include more detailed skills, which are presented in more detail in the results section of this document.

In sum, this survey shows that generative AI is a very large and important field in education, and much more specific course offerings are needed, from technical to design and business understanding. Generative AI is a moving and expanding target for educators. This requires agile course and training development since its technologies, applications, use cases and usage experiences are developing rapidly.

Skills Needs Analysis

In alignment with the above, a skills needs analysis based on 15,621 generative AI-related job postings across the EU further reinforces the complexity and breadth of demand that emerging education programs must address. A total of 5,670 unique core skills were identified, highlighting the diversity of applications and the need for fine-grained, targeted training strategies.

Key Findings from the Job Market Analysis

Python (Computer Programming) stands out with universal constant demand across all countries and periods. The analysis confirms its relevance not only in core technical roles like Machine Learning Engineer but also in strategic or hybrid positions such as Product Manager, illustrating its cross-functional importance. Likewise, Project Management, earlier noted for its role in technical occupations, appears frequently in listings for Software Engineer, indicating a redistribution of traditional coordination responsibilities into development roles.

Soft skills such as Cross-Functional Collaboration, Communication, and Team Collaboration remain among the most frequently listed across both technical and non-technical job categories. Their strong co-occurrence patterns reinforce their embedded role within collaborative, team-oriented AI environments.

The analysis also provides a deeper view of shifting demand patterns. Data Governance, Requirements Analysis, and User-Centered Design Methods show signs of new but uneven uptake across EU countries, suggesting early-stage or sector-specific relevance. Conversely, the demand for certain technical skills, such as PyTorch, MLOps, and Marketing Strategy and Management, appears to be declining, potentially reflecting shifts in preferred tools or changing role definitions.

In terms of geographic variation, clear asymmetries persist. Countries such as France, Germany, Poland, and Belgium show high levels of stable demand across major skill groups. In contrast, Slovenia, Croatia, Latvia, and Estonia register higher rates of no demand, particularly in foundational and interdisciplinary areas such as AI & Machine Learning, UX & Design, and Project & Strategy. Meanwhile, Portugal, Hungary, Lithuania, and Slovakia display strong signals of new demand in skills related to Data & Analysis, UX & Design, and Strategic Roles, pointing to expanding cross-sectoral adoption.

At the occupational level, earlier observations about core roles are reinforced. Machine Learning Engineer and Data Scientist are the most consistently in-demand positions across countries and timeframes. These are followed by roles like AI Engineer, UX/UI Designer, and Product Designer, which also show strong demand and overlapping top skill requirements, suggesting common competency clusters.

Notably, the skills analysis confirms that generative AI is expanding into roles not traditionally associated with AI. Occupations such as Interior Designer and Mechanical Engineer are now listing AI-related skills, like 3D visualization tools or AI-assisted hardware development, within job postings. This reinforces the broader integration of generative AI into fields like Creative & Design, Engineering, Gaming, and Automotive.

Final Conclusion: Urgent Need for Agile, Aligned Education Programs

Altogether, while the survey and desk research pointed to the need for more specific and agile training programs, the job market data underscores how urgently those programs must be aligned with real labor needs. Beyond increasing the number of generative AI courses, effective education must respond to the regional, sectoral, and functional dynamics of demand. This means building curricula that integrate technical, strategic, and collaborative skill development across traditional disciplinary boundaries, preparing learners for a fast-evolving AI labor market in Europe.

ANNEX

1. Data collection

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
Google	Beginner: Introduction to Generative AI Learning Path	https://www.cloudskillsboost.google/paths/118	This learning path provides an overview of generative AI concepts, from the fundamentals of large language models to responsible AI principles.	Holistic program for beginners	F
Microsoft	Generative Ai for beginners	https://microsoft.github.io/generative-ai-for-beginners/#/	Learn the fundamentals of building Generative AI applications with our 21-lesson comprehensive course by Microsoft Cloud Advocates.	Holistic program for beginners, maybe too technical, but few lessons can be used as reference.	F
Microsoft	Fundamentals of Generative AI	https://learn.microsoft.com/en-us/training/modules/fundamentals-generative-ai/	Just Gen AI basics, short introduction to Gen AI and Copilot.		F
Udacity	AI Programming with Python Nanodegree	https://www.udacity.com/course/ai-programming-python-nanodegree--nd089			F
Coursera	AI For Everyone by Andrew Ng	https://www.coursera.org/learn/ai-for-everyone	4 modules, contains basics, how to build AI projects and AI in company, AI and society		F
Coursera	Machine Learning by Andrew Ng	https://www.coursera.org/learn/machine-learning	Build & train supervised machine learning models for prediction & binary classification tasks, including linear regression & logistic regression	More like analyst course	F

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
DataCamp	Introduction to Deep Learning with PyTorch	https://www.datacamp.com/courses/deep-learning-with-pytorch	Deep learning is everywhere: in smartphone cameras, voice assistants, and self-driving cars. It has even helped discover protein structures and beat humans at the game of Go. Discover this powerful technology and learn how to leverage it using PyTorch, one of the most popular deep learning libraries.	Not for the beginners	F
DataCamp	Machine Learning for Everyone	https://www.datacamp.com/courses/machine-learning-for-everyone	You will explore basic yet essential concepts to start your machine learning journey, using hands-on exercises to cement your knowledge. This includes developing an understanding beyond the jargon and learning how this exciting technology powers everything from self-driving cars to your personal Amazon shopping suggestions	Not for the beginners	F
Udemy	Generative AI for Beginners	https://www.udemy.com/course/generative-ai-for-beginners-b/?couponCode=ST2MT110724BNEW	Detailed Understanding of Generative AI Key Concepts - LLM, Embeddings, Prompt Engineering, Fine Tuning Industry use cases and ideas that can be implemented Hands-on experience, creating a chatbot Future trends and how to stay relevant in post-GenAI world	Holistic program for beginners	F

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
LinkedIn Learning	Introduction to Prompt Engineering for Generative AI (2023)	https://www.linkedin.com/learning/introduction-to-prompt-engineering-for-generative-ai-2023	Subscription needed. For beginners looking to learn more about Natural Language Processing (NLP) capabilities or a developer wanting to get started with modern NLP APIs, this course offers a great introduction		P
FutureLearn	Artificial Intelligence Program	https://www.futurelearn.com/courses/how-to-get-into-ai	Kickstart your AI career by mastering essential technical skills. Learn how AI can grow your professional opportunities.		P
IBM	Generative AI Fundamentals Specialization, incl. the following courses: Introduction and Applications; Prompt Engineering Basics;Foundation Models and Platforms; Generative AI: Impact, Considerations, and Ethical Issues; Business Transformation and Career Growth	https://www.coursera.org/specializations/generative-ai-for-everyone	Explain the fundamental concepts, capabilities, models, tools, applications, and platforms of generative AI foundation models. Apply powerful prompt engineering techniques to write effective prompts and generate desired outcomes from AI models. Discuss the limitations of generative AI and explain the ethical concerns and considerations for the responsible use of generative AI. Recognize the ability of generative AI to enhance your career and help implement improvements at your workplace.		P
Professio	Artificial intelligence as a business enhancer	https://professio.fi/product/tekoaly-liiketoiminnan-tehostajana/	Gen AI capabilities in driving business and how organizations can adopt Gen AI Tools.	Gen AI capabilities in driving business and how organizations can adopt Gen AI Tools.	P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
Koulutus.fi/Rastor	The basics of artificial intelligence and its use in business	https://www.koulutus.fi/koulutukset/rastor-instituutti/tekoalyn-perusteet-ja-hyodyntaminen-liiketoiminnassa-1842141	AI capabilities in driving business and how organizations can adopt AI Tools.	This is for business persons who are looking after AI transformation and what kind of business benefits it could provide to companies.	P
EIT Digital Professional School	Generative AI Essentials	https://professionalschool.eitdigital.eu/generative-ai-essentials	Gen AI capabilities in driving business and how organizations can adopt Gen AI Tools.	Contains 4 sessions A Year of Progression: Unlocking Generative AI's Application and Impact - Introduction to GEN AI Project Management Reimagined: AI's role in project planning and execution Marketing Transformation: Moving Ideas into Strategies through Generative AI Exercising Vigilance: Exploring the Landscape of AI-Enabled Cyber Threats	P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
Udacity	Various Generative AI Courses	https://www.udacity.com/catalog/generative-ai-courses	AI Training program. Contains courses for different level users.	Business and technical applications and courses. Varies from beginner to advanced.	P
Semos Education	AI Development Basics	https://semosedu.com/product/genaibiz-%d0%b8%d1%81%d0%bf%d0%b8%d1%82-gaz-110?campaign_id=444660ba-aa54-ef11-bfe3-00224882147b	Course is designed to bridge the gap between generative AI and business excellence. The course aims to demystify generative AI, demonstrating its relevance to real-world business goals and its application in content creation.	More business solution approach. Targeted at business leaders, consultants, and decision-makers.	P
Coursera	Generative AI with Large Language Models	https://www.coursera.org/learn/generative-ai-with-llms	Gain knowledge, practical skills, and a functional understanding of how generative AI works. AWS environment used.	Provides good content about large language models	F
European School Education	AI – The A to Z for Educators	https://school-education.ec.europa.eu/en/professional-development/courses/artificial-intelligence-ai-z-educators	course for beginners designed to provide educators with a comprehensive understanding of artificial intelligence (AI) and its applications in education	AI in education. Starts from the basics and moving on to how to enable AI in educational work (creating lesson, activities etc)	P
OpenClassrooms	Destination AI: Introduction to Artificial Intelligence	https://openclassrooms.com/en/courses/7078811-destination-ai-introduction-	AI definition, Social impact of AI, Describe the Inner Workings of an Artificial Intelligence Project	Holistic program for beginners	F

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
		to-artificial-intelligence			
Codecademy	Learn AI and Machine Learning	https://www.codecademy.com/catalog/subject/artificial-intelligence	Wide selection of courses starting from Gen AI basics for different platforms to Building a machine Learning skill path	Really simple course with case samples. Uses use cases for teaching.	F/P
Skillshare	Creative Applications of Generative AI	https://www.skillshare.com/browse/artificial-intelligence	Selection of different kinds of courses based on AI-led themes. Lots of short sessions (1-3 hours)	For Quick and dirty type of training. Could be useful if you are looking trainings from certain them (Prompting, Picture editing, Design)	P
IBM Skills	AI and Machine Learning Fundamentals	https://www.ibm.com/training/artificial-intelligence	Multiple programs for different kinds of professionals and business roles.	Training focusing on Watson.IX. https://www.coursera.org/learn/generative-ai-for-executives-business-leaders could be usefull while developing the MOOC for business.	F/P
NVIDIA Deep Learning Institute	AI and Deep Learning	https://www.nvidia.com/en-us/deep-learning-ai/education/	Training paths for AI developers and administrators. Technical and detailed courses	Individual and instructed learning. AI Infrastructure and Operations	P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
				Fundamental course might be useful	
AI For Everyone	Introductory AI Concepts	https://www.coursera.org/learn/ai-for-everyone	Contains modules What is AI, Building AI Projects, Building AI in your company and AI and society	course is largely non-technical, engineers can also take this course to learn the business aspects of AI	F
Stanford Online	Artificial Intelligence for business professionals	https://online.stanford.edu/artificial-intelligence/ai-business-professionals	courses give non-technical professionals the knowledge they need to make informed decisions about utilizing AI in their businesses, products, and operations.	The most expensive courses. AI-Driven Leadership: Strategies for the Future course might contain good material and references from business side	P
Udemy	Generative AI for Beginners	https://www.udemy.com/course/generative-ai-for-beginners-b/?couponCode=LETSLEARNNOW	Generative AI Made Easy: Start Your Generative AI Journey, Learn ChatGPT, LLM, Prompt engineering, Create GenAI Chatbot	Basic training containing key terminology, concepts and use cases from business sectors	P
EDIH Adria	Opportunity for business transformation with generative AI	https://edihadria.eu/en/prilika-za-poslovnu-transformaciju-generativnim-ai-em/	Introductory course for employees to understand the potential of Gen AI for progress in business.	In-person training. Course content is not available online.	Not specified

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
EDIH Adria	Application of generative AI in everyday business	https://edihadria.eu/en/primjena-generativne-ai-u-svakodnevnom-poslovanju/	Familiarize students with the concept of generative AI, its capabilities, challenges and impact on society and explain how AI can optimize business processes, solve challenges and transform businesses.	In-person training. Course content is not available online.	Not specified
sustAIn.brussels	ChatGPT & Next Generation Assistants	https://www.vaia.be/en/courses/training-track-chatgpt-next-generation-assistants	The course aims at explaining the nuts and bolts of the new generation of chatbots such asChatGPT, what they can be used for, and what are their limits.	Starts with an overview of reference chatbots (both closed and open source, ChatGPT and Mistral for example), common use cases (writing, summarizing, brainstorming, ...), and some of the main limits of these tools (bias, hallucinations, ...). The course will then dive gradually into more advanced use cases, addressing along the way more subtle issues, both ethical and technical.	F/P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
StackFuel GmbH	ChatGPT & Co: The Basics of Generative AI	https://digital-skills-jobs.europa.eu/en/opportunities/training/chatgpt-co-basics-generative-ai-levelup	This introductory training on generative AI offers a foundational understanding of how AI models like ChatGPT function and how they can be effectively utilised in the context of a work environment. Its aim is to familiarise participants with essential concepts, best practices for prompting, and practical applications in areas like marketing. Additionally, it addresses the ethical and legal considerations involved in using generative AI.	Introductory training on generative AI	F
National College of Ireland	Digital4Business - Generative AI module	https://digital-skills-jobs.europa.eu/en/opportunities/training/digital4business-generative-ai-module	The module provides a practical introduction to generative AI and its broad range of transformative applications. Using state-of-the-art models, it encompasses text, image, audio, video, and data generation	The Generative AI module is part of the DIGITAL4Business European Master's programme, a €20m EU-funded project	P
IMD - International Institute for Management Development	Generative AI for Business Sprint	https://www.imd.org/sprint/generative-ai/	Demystify generative AI and explore its application in business through multiple real-world examples. Learn about the practical aspects of implementing AI and how to avoid the most common traps of implementation. Explore ChatGPT, ethics-attribution/plagiarism and IP ownership/copyright infringement.	Sprint format	P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
The Knowledge Academy	Generative AI Certification Training	https://www.theknowledgeacademy.com/be/courses/artificial-intelligence-tools-training/generative-ai-certification-training-course/	This intensive 1-day Generative AI Training Course is meant to bring delegates with no prior knowledge of Generative AI to a baseline level of understanding and practical competencies.	Although there are no formal prerequisites for attending this course, the content is not completely suited for learners with no tech background	P
Digieduhack	Tailored AI Training Path	https://digieduhack.com/solutions/tailored-ai-training-path	A modular AI training path for marketing managers, focusing on strategic insights for senior leaders & hands-on tool use for juniors, with ongoing support & pilot projects to build confidence. role-specific, practical, and ROI-focused.		F
Monolith	Monolith AI Training	https://www.monolithai.com/services/ai-training	AI training by engineers, for engineers	Tailored AI Training program. Build understanding and alignment across your engineering department with a curated set of technical online training classes. Choose the topics most relevant to your organisation, and get your team up to speed.	P

Company	Course Name	URL	Description	Comments	Free (F) / Paid (P)
Furia	AI Training for Company	http://furia.fi/en/ai-training/	Basic courses for beginners and tailored solutions for company purposes	Mixed level courses. Custom courses available.	P
GenAITrainings	GenAI Essentials for Beginners and Everyone	https://genai-training.com/wp-content/uploads/2024/10/GenAI-Essentials-for-Beginners-and-Everyone-Course-Outline.docx.pdf	In this course, you will learn the principles, techniques, and the best practices for designing effective prompts. This course introduces the basics of prompt engineering and progresses to advanced prompt techniques. You will also learn how to guard against prompt misuse and to mitigate when interacting with FMs.	Basics and intermediate course. Course structure could be useful best practise sample for GenAisa project	P

2. Survey Questions

Question type: Choice
1. Please, select the country your organization is based on
Austria
Belgium
Bulgaria
Croatia
Rebublic of Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Norway
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
Other. please specify
Question type: Choice
2. Please, select your organization type
Higher Education
Vocational Education
Other educational institution
Training center
Association, society
Other public sector organization
Other, please specify
Question type: Choice
3. How many students does your organization have?

1-100
101-500
501-1000
1001-5000
5001-10000
More than 10000
Question type: Choice
4. Which educational group do you belong to?
Professor
Lecturer/teachers
Management
Administration
Specialist
Other
Question type: Choice
5. Which discipline are you working for?
Engineering
Business
Education
Social sciences
Natural sciences
Other
Question type: Choice
6. Do you offer to your students education or training on AI?
Yes
No
No, but we plan to do it in the next 1-2 years
I do not know
Question type: Multiple choice
7. If not, are there specific reasons your institution hasn't offered such programs? (Check all that apply)
Limited funding/resources
Access to relevant technology and tools
Curriculum development challenges
Recruiting qualified instructors
Keeping up with rapid advancements in AI
Student demand
Other, please specify
Question type: Choice
8. Do you have courses or training programs about generative AI? (Generative AI is an artificial intelligence technology that can create new content, such as text, images, music, or code)?

Yes
No
No, but we plan to do it in the next 1-2 years
I do not know
Question type: Multiple choice
 9. If yes, what type of generative AI training programs do you offer? (Check all that apply)
VET courses
Undergraduate courses
Postgraduate courses
Short-term certification programs
Workshops/Seminars
Online courses
Technological/Engineering oriented training programs
Business orientated training programs
Education oriented training programs
Other, please specify
Question type: Multiple choice
10. How have you organized generative AI training programs or courses? Please, select one or more.
We are using our own staff as trainers or teachers
We are using external specialists or trainers
Question type: Multiple choice
11. What types of course content does your organisation offer related to generative AI? Select one or more
Engineering oriented courses, such as technologies, development or security
Business oriented courses, such as how to apply them to business needs
Education oriented courses, such as how to apply them to learning or educational needs
User centric courses, such as how to use or apply Generative AI tools
Other, please describe below
Question type: Multiple choicematrix
12. What technical level do these courses target?
Beginner
Intermediate
Advanced
Mixed levels
Engineering oriented courses
Business oriented courses

Education oriented courses
User centric courses
Other, please describe below
Question type: Open-ended question
13. What types of MOOC courses are you offering for generative AI?
Question type: Open-ended question
14. Please, insert Internet-links to course descriptions if possible
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Technical proficiency
1
2
3
4
5
Understanding AI Models: Basic knowledge of how generative models (e.g., GPT, DALL-E) work, including language processing, training data, and model limitations.
Data Privacy Management: Awareness of data privacy regulations (e.g., GDPR) and methods for handling sensitive or private data responsibly.
Tool Familiarity: Experience with AI tools and platforms, especially those for generative AI, as well as familiarity with various file formats and export options for outputs.
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Critical thinking and evaluation skills
1
2
3
4
5
Verification & Fact-Checking: Cross-referencing AI-generated outputs with reliable sources to confirm accuracy and avoid spreading misinformation.
Bias Detection: Recognizing and mitigating inherent biases within models, as AI may reflect or amplify existing biases in training data
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Ethical and social responsibility

1
2
3
4
5
Informed Consent and Transparency: Being transparent when using AI-generated content, especially if it impacts decision-making or public communication.
Fairness & Inclusivity: Ensuring generative AI does not perpetuate stereotypes, harm underrepresented groups, or infringe on human rights.
Intellectual Property (IP) Awareness: Being mindful of copyright, fair use, and IP rights, especially when generating content that may resemble existing works.
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Programming skills
1
2
3
4
5
Python programming skills
C++ programming skills
Other, please specify
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Generic AI developer skills
1
2
3
4
5
Natural language processing (NLP) skills
Machine learning methods skills
Deep learning methods skills
Neural network development skills
Cloud service (e.g. AWS, Google, MS Azure) development skills
Statistical and data analytics skills
Data base (SQL, NoSQL, etc.) skills
Mathematical (e.g. probability theory, linear algebra) skills
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Specific LLM developer skills

1
2
3
4
5
Basics of LLM methods and models
Typical architectures and approaches of LLMs
Making API requests for LLMs
Fine-tuning LLMs for a specific need
Custom prompts and RAG-method
Developer's library tool (Tensor Flow, PyTorch, etc.) skills
Developing own LLM (e.g. using Hugging Face Transformer, etc.)
Implementing and integrating LLM to other systems
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Other qualification-enhancing skills
1
2
3
4
5
User center design skills
Design skills for defining new generative AI solutions
AI ethics and regulation skills
AI security skills (e.g. deep fakes, jailbreaking, prompt injection, etc.)
Testing skills for ensuring reliability of LLMs (e.g. hallucination)
Social (e.g. working in multidisciplinary teams) skills
Business development (e.g. applying LLMs to business needs) skills
Communication (e.g. explaining things to non-technical people) skills
Problem solving skills
Metacognitive (e.g. learning to learn, self-directed learning) skills
Prompt engineering skills
Question type: Free text
16. What skills do you prefer while educating engineers for generative AI in vocational schools? Likert scale 1 not at all - 5 very important
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Technical proficiency

1
2
3
4
5
Understanding AI Models: Basic knowledge of how generative models (e.g., GPT, DALL-E) work, including language processing, training data, and model limitations.
Data Privacy Management: Awareness of data privacy regulations (e.g., GDPR) and methods for handling sensitive or private data responsibly.
Tool Familiarity: Experience with AI tools and platforms, especially those for generative AI, as well as familiarity with various file formats and export options for outputs.
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Critical thinking and evaluation skills
1
2
3
4
5
Verification & Fact-Checking: Cross-referencing AI-generated outputs with reliable sources to confirm accuracy and avoid spreading misinformation
Bias Detection: Recognizing and mitigating inherent biases within models, as AI may reflect or amplify existing biases in training data.
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Ethical and social responsibility
1
2
3
4
5
Informed Consent and Transparency: Being transparent when using AI-generated content, especially if it impacts decision-making or public communication.
Fairness & Inclusivity: Ensuring generative AI does not perpetuate stereotypes, harm underrepresented groups, or infringe on human rights.
Intellectual Property (IP) Awareness: Being mindful of copyright, fair use, and IP rights, especially when generating content that may resemble existing works.

Question type: Matrix (Likert scale 1 not at all - 5 very important)
Programming skills
1
2
3
4
5
Python programming skills
C++ programming skills
Other, please specify
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Generic AI developer skills
1
2
3
4
5
Natural language processing (NLP) skills
Machine learning methods skills
Deep learning methods skills
Neural network development skills
Cloud service (e.g. AWS, Google, MS Azure) development skills
Statistical and data analytics skills
Data base (SQL, NoSQL, etc.) skills
Mathematical (e.g. probability theory, linear algebra) skills
Question type: Matrix (Likert scale 1 not at all - 5 very important)
Specific LLM developer skills
1
2
3
4
5
Basics of LLM methods and models
Typical architectures and approaches of LLMs
Making API requests for LLMs
Fine-tuning LLMs for a specific need
Custom prompts and RAG-method
Developer's library tool (Tensor Flow, PyTorch, etc.) skills
Developing own LLM (e.g. using Hugging Face Transformer, etc.)
Implementing and integrating LLM to other systems

Question type: Matrix (Likert scale 1 not at all - 5 very important)
Other qualification-enhancing skills
1
2
3
4
5
User center design skills
Design skills for defining new generative AI solutions
AI ethics and regulation skills
AI security skills (e.g. deep fakes, jailbreaking, prompt injection, etc.)
Testing skills for ensuring reliability of LLMs (e.g. hallucination)
Social (e.g. working in multidisciplinary teams) skills
Business development (e.g. applying LLMs to business needs) skills
Communication (e.g. explaining things to non-technical people) skills
Problem solving skills
Metacognitive (e.g. learning to learn, self-directed learning) skills
Prompt engineering skills
Question type: Multiple choice
17. What resources does your institution use to support these courses or programs? (Check all that apply)
Licensed AI tools/software (e.g., OpenAI, Hugging Face)
Open-source platforms (e.g., TensorFlow, PyTorch)
Proprietary tools developed In-house
Guest lectures/industry collaborations
Online courses or MOOCs
Other, please specify
Question type: Choice
18. Does your institution collaborate with external organizations to offer generative AI training?
Yes
No
In progress
Question type: Multiple choice
19. If yes, please specify the types of organizations
Universities
VET centers
Tech companies

Research companies
Goverment agencies
Other, please specify
Question type: Open-ended question
What else?
Question type: Open-ended question
If you like to receive news from this GENAISA-project, please insert your email here.

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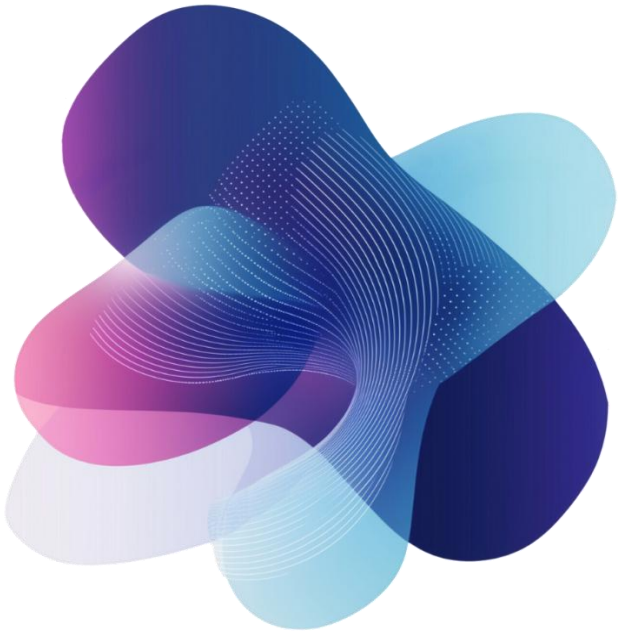

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