

Systematic Needs Analysis of Advanced Digital Skills for Postgraduate Computing Education: The DIGITAL4Business Case

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Abstract. A 15-partner funded project, DIGITAL4Business aims to revolutionise the digital landscape in Europe, fostering strong industry partnerships to empower digital transformation organically and providing postgraduate programmes through a unique multi-academic pan European approach. This paper identifies the advanced digital skills needs and gaps across European Union countries to enable digital transformation. Validated via desk research and surveys, our results indicate that the top two advanced digital skills for companies are Cybersecurity and Cloud Computing, followed by Data Science for small and medium-sized enterprises and Artificial Intelligence (AI) for large companies, respectively. Businesses also indicate notable concerns about the digital divide, digital literacy, the potential impact of automation and job displacement, the role of regulatory frameworks, and training. Our recommendations encompass flexible and accessible education models, *ex-professo* AI & Data Science modules, stakeholder collaboration, and diversity & inclusion initiatives.

Keywords: digital transformation, advanced digital skills, needs analysis, postgraduate education, upskilling, reskilling

1 Introduction

A *needs analysis* identifies the level of skills and training requirements in a given team or organisation. Although human resources departments have long used needs analyses to link training with the results of commercial firms [22], they have only been considered relevant for the holistic development of higher education programmes until recently [16].

Advanced digital skills encompass a range of specialised competencies that go beyond basic computer literacy. While it is widely accepted that digital skills (also known as 21st-century digital skills) are structured around technical, information, communication, collaboration, critical thinking, creativity, and problem-solving [13], for them

to be deemed advanced, their underlying enablers must arguably entail progressive technologies—e.g. Artificial Intelligence (AI)—to empower individuals with a deeper understanding of digital tools, platforms, and concepts. Thus, advanced digital skills are generally referred to by their enabling technology.

Individuals equipped with advanced digital skills are in high demand, as they possess the ability to harness the power of technology and drive organisational success [2]. DIGITAL4Business is a ground-breaking 20-million Euro project with 15 academic, industry, and government partners located in 7 European countries aimed at fostering digital transformation and upskilling for Small and Medium-sized Enterprises (SMEs) and businesses in the EU27, i.e., the 27 countries of the European Union (EU). As one of the largest initiatives funded by the EU’s Digital Europe Programme, it is set to revolutionise the provision of advanced digital skills by furnishing advanced quality education at postgraduate level including an accredited European Master’s programme, micro-credentials, and industry certifications, while fostering strong academic, industry, and government partnerships to collaboratively shape the future of advanced digital skills and tackle the growing digital skills gap in Europe.

By upskilling the workforce and fostering digital innovation, DIGITAL4Business supports creating new job opportunities, increased productivity, and overall economic development. DIGITAL4Business must play a crucial role in shaping the digital transformation of Europe’s society.

This paper systematically investigates advanced digital skills needs and identifies skills gaps in the EU27 to ultimately develop and deliver quality postgraduate education to enable digital transformation for SMEs and businesses.

We have conducted extensive desk research and industry surveys, and our analysis indicates that the top two advanced digital skills for companies are Cybersecurity and Cloud, followed by Data Science for SMEs and AI for large companies, respectively.

Recognising the value of capturing a broader perspective, this research has extended its scope to include five non-EU countries (Australia, Canada, Singapore, UK and the USA), enabling the identification of common patterns, differences, and emerging trends in the global digital skills landscape.

2 Related work

Digital transformation in Europe has undergone significant achievements and strategic changes over the past two decades. The first EU digital agenda, implemented between 2010 and 2020, focused on improving access to digital goods and services, ensuring lower prices for communications, better Internet connectivity, and consumer protection. It aimed to promote digital skills, High-Performance Computing, AI, and modernise public services [19].

The second EU digital agenda, covering 2020 to 2030, is more ambitious, aiming for technological and geopolitical advancements. Key priorities include Quantum Computing, Blockchain, AI, Cybersecurity, gigabit connectivity, 5G and 6G networks, European data spaces, and setting global technology standards. Specific targets for 2030

include promoting digital skills, business adoption of digital technologies, infrastructure development, and the online availability of public services [20].

The EU has established the Digital Europe Programme with a budget of EUR 7.5 billion for 2021-2027 to support these initiatives. The program aims to fund projects in areas such as HPC/supercomputing, AI, Cybersecurity, and digital skills. Member states must also allocate at least 20% of their recovery funds to projects that digitalize their economies and societies.

The demand for advanced digital skills across the EU27 has arguably got the potential to drive digital transformation and reshape business models and workforce dynamics, as previously reported by the 2020 EU's Joint Research Centre [21]. Digitalisation within a country facilitates the digital transformation of its society, leading to increased adoption of basic digital skills among the population, often facilitated by the availability of digital public services [2].

However, proficiency often requires a combination of technical skills, analytical thinking, domain knowledge, and problem solving abilities, highlighting the importance of fostering collaboration and interdisciplinary education to meet skills demands [1], the growing awareness of ethical and legal implications [11], and the relevance of lifelong learning, microcredentials, and adaptability for industry [15].

Companies (and organisations in general) without professionals with advanced digital skills may find it challenging to adopt and implement new technology-intensive projects effectively, potentially leading to decreased competitiveness, and this is especially true for SMEs. The most cited benefits for SMEs reported in the literature are efficiency and effectiveness, cost reduction, productivity growth, customer satisfaction, and competitive advantage when adequately employing technologies such as social media, websites, cloud computing, and data analytics [17].

The World Economic Forum has recently reported [23] that employers estimate that 44% of the skills of workers will be disrupted over the next five years, with 60% of the workers requiring training before 2027, but only 50% have access to adequate training opportunities today. Training workers in advanced digital skills ranks third among the company skills training priorities in the next five years and will be prioritised by 42% of the surveyed companies.

In the EU27, the digital skills gap can significantly impact overall economic growth and development. Regions and countries that effectively address their skills needs and reduce the gap will likely experience stronger economic growth, primarily driven by digital industries. In contrast, areas with persistent skills gaps may experience a digital divide, where certain regions or segments of society lag behind in digital capabilities, leading to significant economic disparities [10]. Therefore, addressing the digital skills gap is vital for bridging the digital divide and promoting inclusive economic growth [4]. Nonetheless, recent research highlights that there is scarce agreement on a common taxonomy of skills [7], and most policymakers and academia should focus on those related to employability, management, career, and life skills [18, 12].

2.1 Research niche

While multi-institutional accredited Master's programmes in computing disciplines have been previously documented for Europe [3, 8, 14, 24] and the rest of the world [5], the

existence of advanced digital skills gaps emphasises the importance of implementing specialised upskilling and reskilling initiatives in the EU27. To address these gaps, European businesses and governments must arguably commit to investing in organically designed programmes that provide flexible accredited educational opportunities based on stakeholder consultations. These programmes must bridge the advanced skills gaps and equip individuals with the necessary competencies, enhancing their employability and supporting organisations in meeting their digital transformation needs. Consequently, not only does this work furnish extensive FAIR-compliant [9] desk research and surveys to document the skills needed organically, but it also brings together industry, academia, and government to achieve long-term competitiveness and growth through digital transformation and innovation.

This work therefore furnishes a systematic *Needs Analysis* to underpin the DIGITAL4Business European postgraduate education, which will focus on the practical application of Advanced Digital Skills within European Business.

Our ultimate aim is to seamlessly link four interdependent DIGITAL4Business phases: Needs Analysis, Programme Delivery, Impact Evaluation, and Financial Sustainability.

3 Method

The study employs a mixed methods approach, that is, comprehensive desk research and surveys of industry experts and professionals. Throughout the research process, **292 documents**⁵ were analysed, providing comprehensive coverage of advanced digital skills in the EU27. An additional 24 documents were reviewed at the cross-European level, typically referring to advanced digital skill needs and gaps in more than one EU country. To gain insight into the needs and gaps in advanced digital skills in Australia, Canada, Singapore, the UK, and the USA, 69 documents were examined. These documents included government reports, industry publications, academic research, media articles, and other relevant sources. The general breakdown of the reviewed publications is presented in Figure 1.

72 national and 29 European reports were identified and reviewed, offering key information and perspectives on the skill requirements and priorities set by government entities throughout the EU27. These reports served as important references for understanding the digital skills needs within each country. In addition, 61 industry publications were examined, providing industry-specific insight into the demand for advanced

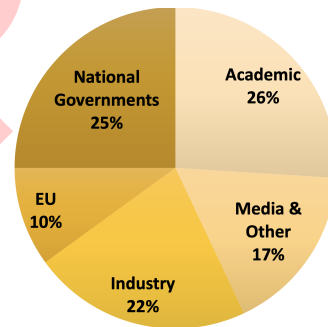


Fig. 1: Breakdown of reviewed publications for the desk research.

⁵ Due to page-limit constraints, the entire list of publications has not been included here but it is part of an open-access DIGITAL4Business project deliverable.

digital skills. These reports highlighted skill requirements and trends within different sectors, shedding light on skills valued by industries in the digital era. Academic publications played a significant role in providing scholarly research and analysis on advanced digital skills. 74 academic publications were analysed to collect evidence-based insights and deepen understanding of advanced digital skill needs. Furthermore, 47 media and related articles were reviewed to capture the broader discourse and public sentiment surrounding advanced digital skills. These articles provided valuable perspectives from journalists, experts, and commentators, enriching the overall analysis. In addition, 9 documents were reviewed from international sources, including the organisations such as the World Bank and OECD providing a global perspective on advanced digital skill needs and gaps.

Surveys were administered to European industry representatives from SMEs and Multinational Corporations (MNCs) to address the generalisation bias. They aimed to validate the key findings derived from the desk research, ensuring a more robust and representative analysis. These were *i*) applied to a targeted industry, academia, and government cohort; and, *ii*) issued on LinkedIn. The respondents were asked to identify the crucial digital skills for SMEs and businesses in general and rank advanced digital skills in priority order.

4 Findings

Our desk research uncovers a landscape of skills and technologies that have garnered significant attention across the EU27, identifying 18 areas listed here in alphabetic order: 1. AI; 2. Business Intelligence 3. Big Data & Analytics; 4. Cloud; 5. Cognitive Services; 6. Cloud Infrastructure DevOps; 7. Cybersecurity; 8. Data Governance; 9. Data Visualisation; 10. Digital Transformation; 11. Emerging Technologies; 12. Ethics; 13. Information Fusion; 14. Machine Learning; 15. Programming; 16. Project Management; 17. Research Methods; and 18. Statistics Fundamentals.

Our data analysis reveals a clear pattern indicating that **AI is Europe's most highly sought-after skill set**, closely followed by Data Science ⁶.

Such observation underscores the significance of these two subjects or clus-

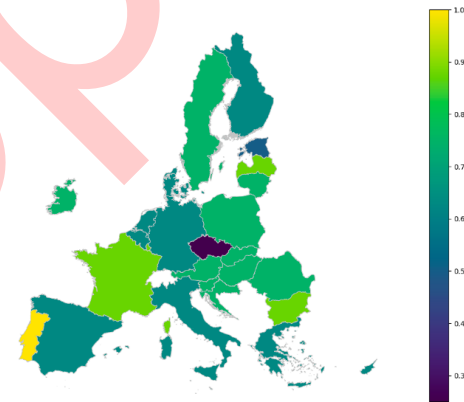


Fig. 2: EU27 heatmap depicting the coverage/need of subjects/clusters of digital skills per country. Higher coverage corresponds to warmer colours (in the yellow spectrum), lower coverage corresponds to colder colours (in the purple spectrum).

⁶ **N.B.** We consolidated the areas into 8 subjects based on the results of the desk research, bringing Data Science as one topic—comprising Big Data and Analytics, Data Visualisation, and Governance—as referenced hereafter.

ters and highlights a strong correlation between them. Machine learning emerges as a key skill too that garners widespread attention in many countries. For Belgium, Cyprus, Denmark, Estonia, France, Germany, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, and Sweden, machine learning's significance is indisputable. The focus on Data Analytics and Big Data is strong across multiple countries, with Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden assigning high importance to it. This finding suggests that organisations across Europe recognise the interdependence and complementary nature of AI and Data Science, leveraging both skill sets to drive innovation, enhance productivity, and remain competitive in their respective industries.

It is duly noted that the complete statistical analysis has not been included in this work due to space restrictions but is available upon request.

The analysis also highlights other key skill sets, such as Cybersecurity, Cloud, Blockchain, and Quantum Computing. Cybersecurity emerges as an important skill set for most European countries, with 24 out of 27 countries citing its significance at least once. The importance of Cybersecurity is evident, attributed to it by Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. Cloud Computing, recognised by Austria, Belgium, Cyprus, Estonia, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden, has emerged as a critical skillset. The demand for Blockchain and Quantum Computing skills appears to be more specific, with 19 and 8 EU27 countries, respectively, acknowledging their importance.

A further categorisation exercise was performed to assign each of the most prominent advanced digital skills to its respective designated topic area, yielding the following Subjects/Clusters categorisation listed in order of relevance:

1. *AI*: Ethics, Machine Learning, Natural Language Processing, Chatbots/Robotics, Smart Sensors, and Digital Twins.
2. *Data Science*: Big Data & Analytics, Business Intelligence, Data Visualisation, Data Governance, and Information Fusion.
3. *Cloud*: Cloud Computing and Cloud Infrastructure/DevOps.
4. *Internet of Things (IoT)*: Sensors, IoT, and 5G/6G.
5. *Cybersecurity*: Cybersecurity and Network Security with ties to the Cloud topic.
6. *Quantum Computing*
7. *Blockchain*
8. *Programming*: Python and Automation.

By grouping these skills and concepts into specific topic categories, it allows for a clearer organisation and understanding of the various domains of advanced digital skills. Comprehensive data analysis was undertaken on the extracted data from the desk research, delving deeper into understanding the geospatial distribution of digital skills across the EU27. Additionally, the analysis revealed a robust correlation between the demand for AI and Data Science skills across most countries.

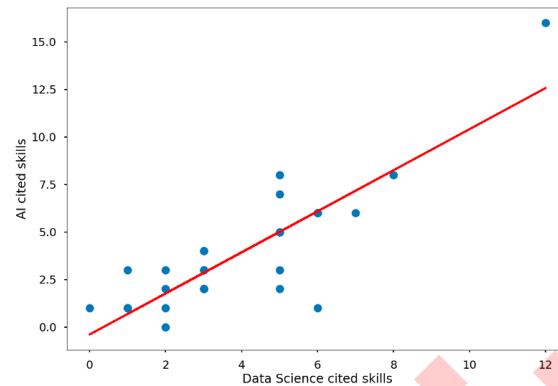


Fig. 3: Correlation between AI and Data Science Skills. It presents the absolute values of AI and Data Science skills per country. Each blue dot on the plot represents the number of times these skills were mentioned across all the documents collected during the desk research for each country.

Geo-Spatial Analysis Based on the Needs Analysis data collected and compiled for this analysis, we have studied the distribution of advanced digital skill needs across the EU27 included in the desk research. Figure 2 shows the coverage of the in-demand advanced digital skills across the EU27 included in the desk research. The coverage depicts the ratio among the number of Subject/Cluster cited at least once and the total number of Subject/Clusters in a given country. In particular, a higher coverage value indicates that most advanced digital skills are needed in those countries. The maximum possible value is 1, indicating that all the Subjects/Clusters are required in that country, although they may have different priorities. We notice that in most countries, there is significant coverage/need for advanced digital skills, with at least 5 Subjects/Clusters of skills cited at least once in each country.

Correlation Analysis As illustrated in Figure 3, a robust correlation is observed between AI and Data Science skills. This correlation indicates that these subjects are closely related and suggests the possibility of merging them into the same cluster or offering them together. Additional evidence supporting this claim arises from the acknowledgement that modern Data Science heavily relies on Machine Learning, which is an integral component of AI. The desk research collected a total of 292 documents. We manually analysed these documents and counted 136 documents cited at least once, either requirement for AI or Data Science skills. Of these documents, 76 cited the need for both AI and Data Science skills. This denotes a strong statistical correlation between the skill sets; Pearson's correlation coefficient measured 0.56. The correlation coefficient for the absolute counts is measured at 0.84, indicating a strong positive linear relationship between AI and the data science skills analysed. This implies that there is a tight clustering of data points around the best-fit line, demonstrating a consistent and predictable increase in skill needs for both AI and Data Science. As the demand for AI

skills rises, the need for Data Science skills also tends to increase relatively consistently and predictably.

4.1 DIGITAL4Business Surveys

The survey sent to the targeted industry, academia, and government cohort yielded 18 responses. The same survey published on LinkedIn yielded an additional 12 curated responses from decision makers. All survey respondents were asked to rank advanced digital skills in priority order. As presented in Table 1, our results show that both the SMEs and the MNC respondents ranked Cybersecurity in the first position, followed by Cloud with Data Science in third position for the SMEs and AI in third position for MNCs.

Additionally, there was a focus on user experience design and the importance of general digital knowledge as a foundation for new technologies. Data Science, Programming, and AI were emphasised as critical skills, and the significance of cloud technologies and strong cybersecurity frameworks were recognised. Other areas mentioned included Blockchain, Quantum Computing, and Machine Learning. In general, respondents acknowledged the importance of understanding and applying cybersecurity to their businesses in conjunction with technological advances.



Fig. 4: Transversal skills suggested by survey respondents.

Table 1: Ranking Advanced Digital Skills for SMEs and MNCs.

Position	SMEs	MNCs
1st	Cybersecurity	Cybersecurity
2nd	Cloud	Cloud
3rd	Data Science	AI
4th	AI	Data Science
5th	IoT (joint position)	Programming
5th	Programming (joint position)	IoT
7th	Blockchain	Blockchain
8th	Quantum Computing	Quantum Computing

Survey respondents were asked to identify the digital skills that are crucial for SMEs and businesses in general. Besides the previously mentioned skills, digital marketing and social media expertise were highlighted as essential for online brand promotion and customer engagement. Due to the ever-changing digital landscape, lifelong learning is emphasised as necessary, with adaptability and continuous learning seen as vital for long-term success. As shown in Figure 4, the surveys also revealed the importance of complementary transversal skills such as critical and innovative thinking, teamwork, communication, self-discipline, and self-motivation. In response to the question, “Are

there any insights or issues related to Advanced Digital Skills you would like to share?" the respondents touched on several important aspects. Notable concerns include the digital divide, digital literacy, the potential impact of automation and job displacement, the role of regulatory frameworks, and training.

In general, the responses underscore the importance of digital awareness, understanding, and skill development in various contexts, including business, education, and social development, and the results of the survey align with the results of the desk analysis and further support the key advanced digital skills that the DIGITAL4Business project must focus on.

4.2 Comparing EU27 with Findings Globally

The comprehensive assessment of the in-demand advanced digital skills in the EU countries provided a solid basis for comparing them with five selected international countries (i.e., Australia, Canada, Singapore, UK, and USA), revealing both commonalities and distinct skill requirements. The results indicated noteworthy similarities between the in-demand advanced digital skills of the EU countries and those sought after in the five global countries, along with a few differences. Although there was a high demand for advanced digital skills in both the EU and globally, specific skill preferences varied across regions. The findings of this research have significant implications for policymakers, educators, and industry leaders, emphasizing the importance of adopting a targeted approach to skills development that considers national and global demands.

4.3 Demand, Challenges & Unique Factors in Advanced Digital Skill Needs

The analysis of the demand for advanced digital skills across the EU27 revealed similarities whilst also highlighting differences in the level of demand. These variations can be attributed to several factors.

Firstly, disparities in economic development and technological advancement play a significant role. Countries with more advanced digital infrastructure and a higher concentration of technology-driven industries exhibit a greater demand for advanced digital skills such as AI, IoT, Blockchain, Data Science, Cloud Computing, and Cybersecurity. Notable examples include France, Germany, Italy, Sweden, the Netherlands, Finland, Denmark, and Ireland. Differences in national policies, priorities, and investments in digital transformation initiatives also contribute to the divergence in skill needs between countries. These factors collectively shape the unique landscape of advanced digital skills requirements in each EU27 country.

Another factor highlighted in the desk research is evidence that large enterprises are more likely to embrace new technologies compared to SMEs. This discrepancy in adoption rates of SMEs can be attributed to various factors, including lower financial resources, organisational capacity, and their reduced ability to navigate the complexities of technological implementation [6]. For example, Cloud has emerged as a game-changer for enterprises, offering scalable and cost-effective data storage, processing, and software delivery solutions. Large European enterprises are leading the way in cloud adoption, benefiting from enhanced operational efficiency and agility. However, SMEs have a lower adoption rate, indicating the existence of barriers such as limited

awareness, concerns about data security, and a lack of resources to facilitate the transition.

Another example of this is given by Big Data Analytics which has revolutionised the way enterprises extract insights and make data-driven decisions. The current landscape shows that large enterprises have a more significant presence in Big Data processing, while SMEs lag behind. This discrepancy can be attributed to the complexity of implementing Big Data Analytics, the availability of skilled personnel, and the initial investment required. Looking at big data adoption internationally, we observe diverse patterns across countries. In Malta, nearly a third of enterprises analyse big data, indicating a relatively high adoption rate. The Netherlands and Denmark follow closely behind with adoption rates of 27%. However, countries like Romania, Slovakia, Cyprus, and Bulgaria have much lower adoption rates, ranging from 5% to 6%. These disparities reflect differences in digital readiness, infrastructure, and the availability of skilled professionals.

The provision of efficient digital infrastructures plays a crucial role in this digitalisation process and is a key focus for several EU27 countries, as evidenced by the desk research. Countries such as Romania, Luxembourg, Lithuania, Latvia, the Czech Republic, and Bulgaria, among others, have prioritised rolling out digital infrastructures and subsequently expanding their e-government digital services. These initiatives reflect the commitment of these countries to improve their digital landscapes and to promote widespread digitalization within their societies. Moreover, countries prioritising specific digital domains, such as AI or Cybersecurity, tend to witness a higher demand for the corresponding skills.

Additionally, differences in educational systems and training frameworks among the EU27 contribute to variations in the availability and quality of digital education and skill development programs. These disparities directly impact the supply of skilled professionals in advanced digital domains. The emphasis on specific digital areas and the effectiveness of educational initiatives significantly shape the skill landscape, professional expertise and demand for specific advanced digital skills within each country.

5 Recommendations

Flexible and Accessible Education Models Our research has shown a demand for advanced digital skills in the areas of AI, Data Science, Cloud, IoT, Cybersecurity, Quantum Computing, Blockchain, and Programming in the EU27. Bridging this gap requires promoting flexible and accessible education and training models that cater to individuals of all backgrounds and career stages. This can be achieved through initiatives such as online courses, micro-credentials, and lifelong learning. In addition, fostering international cooperation between academic institutions can provide a platform for flexible and accessible education and training, particularly aimed at SMEs. Such cooperation can help promote knowledge exchange on digital skill development, enabling SMEs to learn from best practices implemented in other countries and to collaborate on joint initiatives, research projects, and standardisation efforts.

Ex-professo AI and Data Science Modules Based on the correlation between AI and Data Science, we consider that both areas of learning should be taught in modules designed *ex professo*—ie in the capacity of an expert—to fulfill commercial needs.

Stakeholder Collaboration It is necessary to foster collaboration among policymakers, educational institutions, businesses, industry associations, and SME networks and to work together to promote flexible and accessible education and training models that meet the unique needs of all learners, particularly SMEs. Highlighting the importance of lifelong learning and providing resources that enable SMEs to continually up-skill their workforce are also very important. This is in line with the views expressed in the Digital Skills Gap white paper [2, p. 74], “digital competence development necessitates an “all-government” strategy that encompasses digital competence development in areas such as employment, the labour market, education and training, social services, and economic growth. Governments, industry, education and training providers must collaborate and share information about current and future needs for digital talent.”

Diversity and Inclusion Initiatives It is also necessary to be mindful of diversity and inclusion in digital skill development programmes. It is essential to provide equal opportunities for training and educational resources to individuals of diverse backgrounds, such as women, minorities, and individuals with disabilities. In addition, promoting diversity in hiring practices can lead to innovation and bring different perspectives to the digital workforce.

6 Conclusions

The research findings have significant implications for policymakers, educators, and industry leaders. Adopting a targeted approach to skills development that considers national and European demands is crucial. This includes promoting flexible and accessible education and training models and micro-credentialing to cater to individuals of all backgrounds and career stages.

Collaboration among policymakers, educational institutions, businesses, industry associations, and SME networks is essential to promote accessible and flexible education and training models. Lifelong learning should be emphasised, and resources should be provided to enable SMEs to upskill their workforce continuously. It is also essential to prioritise diversity and inclusion in digital skill development programs to provide equal opportunities for individuals from all backgrounds.

Although this research has provided valuable information on digital skills needs and gaps in the EU27, areas still warrant further exploration. Future research could focus on specific digital skill requirements and gaps within different industries or sectors. Furthermore, research on the effectiveness of different upskilling and reskilling initiatives in addressing the digital skills gap would benefit policymakers and educators.

In conclusion, advanced digital skills are essential for individuals and organisations to thrive in the digital age. The DIGITAL4Business project is at the forefront of revolutionising digital transformation and upskilling in Europe. By addressing the digital skills gap and fostering collaboration between industry and academia, the project aims

to shape the future of advanced digital skills in Europe and promote economic growth and innovation. To stay competitive in the digital age, individuals must continuously update their skills and embrace lifelong learning. Policymakers, educators, and industry leaders must work together to provide flexible and accessible education and training opportunities that meet the diverse needs of learners. By doing so, we can ensure that individuals and organisations are equipped with the advanced digital skills necessary to succeed in the digital landscape.

Overall, our research findings underscore the transformative potential of AI, Data Science, Cloud, IoT, Cybersecurity, Quantum Computing, Blockchain, and Programming. They highlight the need for individuals, organisations, and society to adapt, collaborate, and embrace lifelong learning to fully leverage the benefits of these emerging technologies while addressing the associated challenges.

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