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Acquiring competencies for mastering tools that process big data - the case of AI usage skill gaps

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Abstract:
This paper delves into the critical role of Artificial Intelligence (AI) in shaping the 21st century, emphasizing its potential to revolutionize various sectors including medicine and education, while also posing significant societal and economic challenges. Amidst the backdrop of the EU's lag in AI adoption compared to the USA and Asia, this study underscores the acute skills gap as a pivotal hindrance. It introduces the AI4VET4AI project aimed at bridging this gap through a transnational European platform of Vocational Education and Training (VET) excellence. The project seeks to integrate AI-related content into VET curricula, fostering trust in AI, and aligning skills development with the Digital Education Action Plan (2021-2027). By highlighting the importance of a collaborative knowledge triangle—business, education, and research—the paper advocates for a comprehensive approach to harness AI's potential, ensuring sustainable growth and competitiveness within the EU.

Keywords: *Artificial Intelligence, skills gap, VET*

1. Introduction

The significance of Artificial Intelligence in the 21st century cannot be overstated. Experts predict that within just two decades, the impact of AI will be so profound that aspects of daily life will undergo a drastic transformation. The influence of AI is poised to challenge the very foundations of our economic and social systems. While it has the potential to create unprecedented wealth and revolutionize fields such as medicine and education, it also poses existential risks to our way of life [1]. This emphasizes the importance of the EC2020 report, which highlights the EU's concerning lag in AI adoption and development compared to the USA and Asia. A notable factor behind this discrepancy is the shortage of skilled workforce [2], [3].

The European Commission's Expert Group on AI, the European AI Alliance [4], and the coordinated plan with member states all emphasize the importance of consolidating European efforts in the AI strategy. The European Commission believes that only by doing so can the full potential of AI be harnessed to keep pace with global technological progress. Despite significant efforts, the EC's 2020 report reveals that Europe lags behind the USA and Asia in technology and AI. Eurostat data from 2020 shows that only 7% of EU enterprises with at least 10 employees used AI applications [5]. In 2023, 8% of EU enterprises uses the artificial intelligence technologies [6]. Additionally, 2% of enterprises utilized machine learning for internal big data analysis, while 1% employed natural language processing, natural language generation, or speech recognition for the same purpose. Only 2% of enterprises used chat services with chatbots or virtual agents generating natural language responses for customers. Similarly, 2% of enterprises utilized service robots with various degrees of autonomy for tasks such as cleaning, handling dangerous substances, sorting items in warehouses, and assisting customers at points of sale [5].

2. Addressing the skills gap in AI usage

In the contemporary business environment, significant generally acknowledged gap of skilled professional, perhaps a short snapshot from the past could be quite beneficial. Authors [7] are writing in this context also about Person-Organisation fit (P-O fit) concept which is gaining meaning due to changing organizational environments. In order for a candidate, which might also just came out the VET education, to fit the organization and optimally exploit his/her potentials, they identified five groups (clusters) of competencies, as follows: 1.Social competencies (Social competence, also referred to as interpersonal competence, that are defined as the ability to engage in cooperative interaction and communication with others. This cluster of competencies encompasses understanding others' thoughts, emotions, and attitudes, and therefore demonstrating empathy towards them. Recruiting individuals with strong interpersonal skills can be highly beneficial, especially in entrepreneurial contexts, as it facilitates the formation of new communication networks and access to critical resources); 2.Personal competencies (Personal competence is defined as the individual’s potential to adjust and change one's emotions, motivations, attitudes, and values in response to continuously challenging circumstances. It also refers to the ability to extend personal capabilities toward ethical actions, cultivating a self-image.); 3.Subject competence (often named in the literature as business, technical, or operational competence, are developed through professional training and experience. This cluster involves not only having technical expertise but also the ability to apply this knowledge effectively and appropriately in a timely manner); 4.Method Competencies cluster (which is defined as the ability to approach and address

challenges through structured problem-solving techniques. From the other point of view, it does involve the effective application of methods to efficiently plan, prepare, organize, use time as a resources, and use knowledge appropriately. This competency cluster clearly emphasizes the systematic use of appropriate strategies to navigate tasks and achieve desired outcomes.); 5.Entrepreneurial competencies cluster (Carrying out tasks efficiently, combined with the ability to anticipate and strategically manage decisions through a balance of intuition and foresight, is essential for evaluating the costs and benefits of every choice. Entrepreneurial competence is crucial for company founders to ensure long-term success. Additionally, the concept of corporate entrepreneurship (internal entrepreneurship, spin-offs, spin-outs and other forms of corporate entrepreneurship encouragements are highlighted in the literature, which encourages employees to focus on achieving organizational objectives, learning from setbacks, and safeguarding company resources. This approach combines the entrepreneurial capabilities of individuals to the overall success of the organization.), which, in the right environments, can bring us back to the first cluster of social competencies.

Within the project AI4VET4AI, a transnational European platform of VET excellence will be established to address the current skills gap in AI. The introduction of AI has significant implications for the work and VET, requiring VET providers to prepare students for new roles and tasks, handle increased work complexity, and adapt to new forms of collaborative work with AI. To confront these changes, VET providers need to embrace digital transformation efforts.

The leverage of the triangle of knowledge (business, education, and research) will be used to maintain high standards of VET excellence while integrating AI-related content into existing VET curricula or developing new ones. The overarching goals include fostering trust in AI, promoting understanding and awareness of reliable AI development and use in accordance with EU and international standards, and introducing AI-based innovation in key sectors through skills development aligned with the Digital Education Action Plan (2021-2027) [8]. The project aims to contribute to European education and training policy, as well as the development and innovation agenda, by emphasizing intelligent, enduring, and comprehensive growth in alignment with the Europe 2020 strategy. This strategy seeks to enhance EU competitiveness and growth by prioritizing economic transitions and ambitious skills development targets. The imperative to enhance the exploration and utilization of AI, as well as the concerns regarding how AI advancements can aid in addressing critical global challenges like climate change, are internationally significant.

The field of research in this area is complex, so we limited ourselves to the following research questions:

RQ1: What are the current skill gaps at the intersection of Al related skills and VET?

RQ2: What Al skills are in increasing demand from 2020 onwards, for VET students or graduates in the labour marketplace?

RQ3: Which occupations are going to need an Al skilled, VET qualified workforce, the most in the next 10 years?

RQ4: What skills belong to the Al literacy skill set?

RQ5: Are there any country or regional differences in the Al skills gap by occupation?

RQ6: What methods can be implemented to provide ongoing and adaptive recommendations for the development of state-of-the-art Al skills curricula?

RQ7: What are the most effective methods for disseminating Al teaching materials?

To provide a focus we refined the Research Questions into three themes:

1. Al skills gap analysis: This theme is related to RQ1, RQ2, RQ3, and RQ5. These

questions aim to identify the current and future skill gaps at the intersection of Al and VET and how they vary by occupation, country, or region. The theme can help understand the demand and supply of Al skills in the labour market and the challenges and opportunities for VET students or graduates.
2. Al literacy skill set: This theme is related to RQ4. This question aims to define the skills of the Al literacy skill set, which are essential for understanding, using, and interacting with Al systems and applications. This theme helps establish a common framework and standard for Al education and training.
3. Al teaching methods: This theme is related to RQ7. This question explores the most effective methods for disseminating Al teaching materials, such as on line platforms, courses, modules, or workshops. This theme can help to improve the accessibility and quality of Al learning resources and experiences.

The basis for being able to reach the intended goal was to identify the specific needs of important industries and sectors across 10 countries and 17 NUTS2 regions represented in the consortium, in line with their existing S3 frameworks. Further on, a series of MOOCs (Massive Open Online Courses) will be developed, targeting the benefits and challenges of AI in the most promising industry sectors identified regionally. Additionally, support for VET teacher training will be provided.

3. Research methodology

The research operationalization has been prepared by the team at the University of Amsterdam and Technishe Informationsbibliothek. The study was initiated through a collaborative partnership of 26 partners from 11 different countries (Croatia, Slovenia, Serbia, Austria, Germany, Greece, Italy, Spain, Netherlands, Turkey, and Ireland). The cross-border approach helped to mitigate the potential problem of the limited availability of AI-related training opportunities in underdeveloped regions, which could exacerbate the gap in innovation and development between more and less developed areas of Europe and hinder their transition to an AI-driven economy and its associated sustainable development objectives. The AI4VET4AI project assesses the influence of Artificial Intelligence on Al literacy in European Vocational Education and provides recommendations. This is achieved by conducting a skills gap analysis focusing on sector and regional variations. The effects and speed of Al on different demographics, regions, industries, and cultures are intricate and may only possibly be fully comprehended by future historians. As a result, the authors utilized multiple methodologies to corroborate their findings, employing a mixed methods approach to produce recommendations for future curricula accordingly.

The research methodology set included:
1. Skills gap survey
2. Delphi method. A discussion with experts
3. Systematic Literature Review of skills demand in the job market via Job market intelligence that, in the end, requires the analysis of a big set of on line Job advertisements
5. Systematic data review of available sources of data. Later, a number of the discovered data sources are used to support the recommendations.

The research utilized rigorous methods to establish well-informed recommendations supported by multiple sources. We made specific recommendations for AI literacy by conducting a systematic literature review, whereby ten researchers initially identified a large number of research papers and narrowed it down to 102 high-quality papers specifically related to the theme of AI literacy. One limitation we encountered was the freshness and quality of research and recommendations, which are impacted by

intense competition in advancing AI architecture and the rapid evolution of AI models trained on vast amounts of internet data. The widespread adoption of AI is rapidly affecting various industries, with implications for workers as the pace of change in these industries outstrips others.

To address the challenge of providing timely advice, we launched a systematic data review. However, the velocity of change in the field of AI limits the quality and freshness of datasets and information related to AI literacy. Adhering to a "Chain of Trust" methodology, we initially selected papers that had undergone peer review and trusted the quality of the sources cited within. Among the most valuable resources have been observatories established mainly by governance or standards bodies to monitor specific AI trends. Additionally, relevant reports generated periodically by international organizations have provided valuable insights and data sources for policymakers.

In our review, we primarily relied on Eurostat, the statistical office of the European Union, for regional data. However, we encountered limitations related to the freshness and geographical resolution of the datasets, which affected the recommendations. Our focus was on specific industries and regions, aligning with current economic data and the capacity of the Al4VET4AI consortium. The industries and regions were selected based on input from the 27 project partners and a survey of experts.

Through our methodology, we conducted a comprehensive analysis of the AI skills landscape in Europe and identified gaps between the supply and demand of AI skills, as well as best practices and recommendations for addressing them. In the next chapter, we will provide the results of the systematic literature review, offering an overview of the current state of the art in AI skills research and development.

4. First results

Based on the results of research, implemented as described in chapter 3, five sectors were selected for further analysis: (i) Professional, Scientific and Technical Activities, (ii) Wholesale and Retail Trade, (iii) Human Health and Social Work, (iv) Education and Accommodation and (v) Food Services. Further analysis was set to find converging evidence of key skills gaps. Based on the results, an annotated list of skills was prepared.

In the next step, all previous results are taken into account and the first drafts of IVET and CVET syllabuses are being created as follows:

- Accommodation and Food Services

(i) Customer Relationship Management - using AI to provide better service to customers
(ii) Using AI for Understanding Tourism Impact and Improving Sustainability

- Education

(i) Using AI for process automation in teaching and for creating personalised recommendations for learner
(ii) Human-AI Collaboration in Teaching and Learning

- Human Health and Social Work

(i) Case Study: Synthetic Patient Records how and why
(ii) Supporting Doctor - Patient Interactions with AI

- Professional, Scientific and Technical Activities (Accounting, Bookkeeping and auditing activities; tax consultancy / Advertising / Market Research and public opinion polling)

(i) Using AI for personalised advertising campaings
(ii) AI in market research (sentiment analysis, machine learning for trend prediction, ethics and privacy in AI-driven market research)

- Wholesale and Retail Trade

(i) AI in Customer Service - use of chatbots / virtual assistants and personalised suggestions
(ii) AI-Driven Inventory and Logistics Automation

All other data and obtained results are marked as internal until the end of the project, so data sharing is not allowed.

5. Where do we go from here

Based on the findings, the project will facilitate the creation of VET innovation hubs, where VET learners can acquire skills in using AI to enhance their problem-solving abilities. As AI's introduction to the labour market emphasizes the importance of VET learners' social competences and personal skills, our project addresses a range of target groups.

• VET learners (developing AI-related competences and skills)
• VET teachers (including teaching of AI-related content in their courses and broadening the scope of their teaching)
• HEI students and teachers (forming partnerships with VET organisations for the purpose of exchanging knowledge and innovation practices)
• sectoral representatives (gaining partners who will contribute to closing AI skills gap)
• Innovative startups, SMEs and other business organisations (acquiring the much needed talent pool of experts)
• Policy makers (on regional and national level, including them in a more focused way on how VET Centres of Excellence can contribute to regional smart specialisation strategies)

The goal of AI4VET4AI is to contribute to the digital transformation of the EU labour market by introducing new innovative teaching content and methods to VET curricula in 11 European countries and 18 EU NUTS2 regions. This initiative aims to support the development of AI-skilled workers. Starting with a comprehensive analysis of the most promising sectors for AI deployment in our 17 regions, we collaborate closely with enterprises and their cluster organizations to develop 14 MOOCs and TT materials that can be easily integrated into VET programs (IVET and CVET). Additionally, we are establishing 11 innovative AI VET campuses and 7 VET innovation AI incubators to provide VET learners with opportunities to enhance their creativity and entrepreneurial skills. Through project activities, we foster close collaboration among partners and raise awareness of the potential of AI in our regions among stakeholders from the public and private sectors, as well as civil society. This enables us to build a collective and active platform comprising EU citizens and institutions who are interested, well-informed, and motivated to support further AI development. Ultimately, this forms the basis of our ambitious CoVE (Centre of vocational excellence), which aims to attract a wide array of institutions (HEIs, VETs, companies, agencies, and individuals) in its quest to create a sustainable, inclusive, and equitable AI-powered future for all.

6. References:

[1] ‘AI4VET4AI project’, AI4Vet4AI. Accessed: Sep. 16, 2024. [Online]. Available: https://www.ai4vet4ai.eu/
[2] European Commission, ‘Artificial Intelligence: first quantitative study of its kind finds uptake by businesses across Europe is on the rise | Shaping Europe’s digital future’. Accessed: Sep. 16, 2024. [Online]. Available: https://digital-strategy.ec.europa.eu/en/news/artificial-intelligence-first-quantitative-study-its-

kind-finds-uptake-businesses-across-europe
[3] European Commission, ‘White Paper on Artificial Intelligence – a European approach to excellence and trust | Shaping Europe’s digital future’. Accessed: Sep. 16, 2024. [Online]. Available: https://digital-strategy.ec.europa.eu/en/consultations/white-paper-artificial-intelligence-european-approach-excellence-and-trust
[4] European Commission, ‘The European AI Alliance | Shaping Europe’s digital future’. Accessed: Sep. 17, 2024. [Online]. Available: https://digital-strategy.ec.europa.eu/en/policies/european-ai-alliance
[5] Eurostat, ‘Artificial intelligence in EU enterprises’. Accessed: Sep. 16, 2024. [Online]. Available: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210413-1
[6] Eurostat, ‘Use of artificial intelligence in enterprises’. Accessed: Sep. 16, 2024. [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Use_of_artificial_intelligence_in_enterprises
[7] Zu Knyphausen-Aufseß, D., & Vormann, C. (2009). Personnel selection criteria in IT ventures: A policy-capturing analysis. Zeitschrift Für Betriebswirtschaft, 79(2), 213–234. doi:10.1007/s11573-008-0207-8
[8] European Commission, ‘Digital Education Action Plan (2021-2027) - European Education Area’. Accessed: Sep. 17, 2024. [Online]. Available: https://education.ec.europa.eu/focus-topics/digital-education/action-plan

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