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The impact of artificial intelligence (AI) on employees' skills and well-being in global labor markets: A systematic review

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Keywords: *artificial intelligence (AI); employees; skills; digital skills; upskilling; reskilling; well-being*

Abstract

Research background: This article discusses how artificial intelligence (AI) is affecting workers' personal and professional lives, because of many technological disruptions driven by the recent pandemic that are redefining global labor markets.
Purpose of the article: The objective of this paper is to develop a systematic review of the relevant literature to identify the effects of technological change, especially the adoption of AI

in organizations, on employees' skills (professional dimension) and well-being (personal dimension).
Methods: To implement the research scope, the authors relied on Khan's five-step methodology, which included a PRISMA flowchart with embedded keywords for selecting the appropriate quantitative data for the study. Firstly, 639 scientific papers published between March 2020 to March 2023 (the end of the COVID-19 pandemic according to the WHO) from Scopus and Web of Science (WoS) databases were selected. After applying the relevant procedures and techniques, 103 articles were retained, which focused on the professional dimension, while 35 papers were focused on the personal component.
Findings & value added: Evidence has been presented highlighting the difficulties associated with the ongoing requirement for upskilling or reskilling as an adaptive reaction to technological changes. The efforts to counterbalance the skill mismatch impacted employees' well-being in the challenging pandemic times. Although the emphasis on digital skills is widely accepted, our investigation shows that the topic is still not properly developed. The paper's most significant contributions are found in a thorough analysis of how AI affects workers' skills and well-being, highlighting the most representative aspects researched by academic literature due to the recent paradigm changes generated by the COVID-19 pandemic and continuous technological disruptions.

Introduction

The recent pandemic impacted dramatically the global socio-economic environment, triggering plenty of pre-existing vulnerabilities in advanced, emerging, and developing labor markets. Although employment and income loss are a major element of their overall economic losses, emerging and developing countries continue to struggle with the effects of workplace closures and weak economic activity on the labor market (ILO, 2022). Before the pandemic crisis, mankind experienced important changes in the labor market. Lately, the acceleration of remote and hybrid work has occurred, causing a significant impact on jobs due to technological disruptions. There is also a significant need for the continuous adoption of new technologies at work, an increased share of the world's workforce being exposed to new inequalities (digital skills differences, volatility in employment for workers holding precarious positions, automation and robotics impact on job destruction and job creation processes). As a result, upskilling and reskilling the workforce is of increasing importance (Eurofound, 2020; Schwab & Zahidi, 2020; Li, 2022).

The pandemic has fostered the rapid adoption of new technologies at work, as physical distancing became the norm (Soto-Acosta, 2020; Kutnjak, 2021; Mihalca *et al*., 2021; Liu *et al*., 2021; Mishchuk *et al*., 2023). The pace of adoption was unprecedented (Papagiannidis *et al*., 2020; Kolo & Zuva,

2022; Żur & Wałęga, 2023). The impact on labor markets is expected to be considerable, in terms of job destruction (robotics, automation and artificial intelligence (AI) making several types of jobs redundant and several types of job tasks irrelevant), highly routinized jobs, and job creation (newly emerging professions requiring new skills' acquisitions) (Ping & Ying, 2020; Abuselidze & Mamaladz, 2021; Korzyński *et al*., 2023).

Studies carried out by the World Economic Forum (WEF, 2021) and the Organization for Economic Co-operation and Development (OECD, 2021) on the future of work and jobs show that the technological endowment and readiness of any company directly impacts the employees' skills. Preserving job security demands the acquisition of new skills (employers need to rapidly reconfigure and develop the existing technical and non-technical skills, as well as to design and develop new skills, such as new programming languages, machine and deep learning, big data analytics, robotics, etc.). The impact of AI on employees' skills invites discussion on both reskilling, i.e., learning new skills to work in another occupation, and upskilling, the process of increasing existing abilities or adding complementary skills (Li, 2022; Habánik *et al*., 2021). Smart companies recover and strengthen their employees' contribution to the development, interpretation and improvement of AI systems (Davenport & Mittal, 2023). Companies need to invest in corporate academies, training partnerships and continuous training and re-training of existing employees (Strack *et al.*, 2021).

By 2025, 50% of all employees will have needed to re-qualify to enable the continuous adoption of innovative technologies (Schwab & Zahidi, 2020). Literature considers that upskilling and reskilling are crucial differentiators between parties that succeed and those that fail (Randstad, 2020), and are evidence of companies' commitment to employees' job prospects and work performance (OECD, 2017; ILO, 2021). The literature also pinpoints the need for reskilling in logistics and supply chain industry (Nier *et al.*, 2020; Wahab *et al.*, 2021; Woods *et al.*, 2022), in sales (Li, 2022) and in education (De Notaris, 2019; Allen, 2022). While the literature highlights the rele-vance of employee skills during the COVID-19 pandemic, their upskilling and reskilling, as well the impact of AI on skills, to the best of our knowledge, there are no papers linking the adoption of AI in organizations and its impact on both employees' skills and well-being.

Therefore, the aim of this paper is to develop and implement a systematic review of contemporary research in order to identify the implications of technological change, especially the adoption of AI, on employees' skills

(professional dimension) and well-being (personal dimension). In this regard, the authors relied on a five-step methodology (Khan *et al*., 2023), including a PRISMA flowchart with different keywords that allowed the selection of relevant scientific papers published during the later COVID-19 pandemic. From a total of 639 scientific papers from Scopus and Web of Science (WoS), after applying different inclusion and exclusion criteria, 103 articles were further analyzed regarding the professional dimension (adoption of AI in organizations and the effect on employees' skills), and 35 regarding the personal dimension (impact of AI on employees' well-being).

The novelty of the paper lies in highlighting the changes generated by both the recent COVID-19 pandemic and the continuous technological disruptions to workers' skills and well-being under the influence of AI tools and techniques. Furthermore, it also pinpoints possible future research questions/directions underlying the impact of AI on employees' skills and well-being.

The paper is structured as follows: Section 2 presents the literature review on the relevant concepts, such as: A. The impact of artificial intelligence (AI) on the dynamics of labor supply and demand (in terms of *job creation* versus *job destruction); B.* The impact of the adoption of new technologies on *skills* with a special focus on *digital skills; C.* The need for continuous development of skills through *upskilling* and professional conversion through *reskilling; D.* Personal and professional development in correlation with *employee well-being*. Section 3 contains the research methodology, comprising the inclusion and exclusion criteria employed for applying the PRISMA method to conduct the bibliometric analysis and literature review. Section 4 presents the results, followed by discussion on the key findings. The paper ends with implications and future research perspectives.

Literature review

Overall, labor demand in relation to capital demand is determined by the rate of automation compared to the creation of new types of jobs (Graetz, 2020). The role of new technologies in the Industry 4.0 stage is crucial, as it enables the revolutionizing of manufacturing and engineering at the global level. By exploiting a combination of computer systems, the Internet, the Industrial Internet of Things (Andronie *et al*., 2021), artificial intelligence,

machine learning, hyper convergent infrastructures, deep learning, virtualization, and intelligent production systems, Industry 4.0 represents a traditional manufacturing virtual reality fusion system (Li, 2018; Li, 2020; Lazaroiu *et al*., 2022a). The debate over job creation and job destruction induced by AI is still strong, with some experts arguing that job cuts will be significant (Mitchell & Brynjolfsson, 2017; Hemin, 2018; Malik *et al*., 2021; Wach *et al*., 2023), while others stress the dominance of the job creation effect (Bruun & Duka, 2018; Bilal & Várallyai, 2019).

Some literature analyzes the concept of well-being relating to the labor market to rigorously capture the most relevant aspects of interpretation and measurement regarding the elements that define and characterize it. The ability to experience both positive and negative emotions, competence, information integration, and autonomy are all aspects of the affective, behavioral, and cognitive elements that constitute psychological well-being at work (Russell & Daniels, 2018). Affective well-being (AWB) is the most important component of psychological well-being due to the solid connections with many workplace structures, including work-family conflict (Zhou *et al.*, 2021), job satisfaction, burnout at work and projected performance (Wu *et al.*, 2018; Saman *et al.*, 2022).

In relation to AWB, "anxiety-comfort, depression-ease, boredom-enthusiasm, fatigue-vigor, and anger-fear are defined as the most important dimensions to be considered" (Daniels, 2000, p. 3). Workers' psychological well-being (PWB) may have weakened because of their shift from work to temporary or long-term unemployment, or from working on site to telecommute (Escudero-Castillo *et al.*, 2023). Having a job or being unemployed impacts significantly employees' well-being and health (Thern *et al.*, 2017), while teleworking can generate effects upon the work-life balance (Song & Gao, 2020; Bellmann & Hübler, 2020; Palumbo, 2020).

Van Horn *et al.* (2004, p. 364) considered that job-related well-being is based on five interlinking dimensions: "affective well-being includes mood and emotion, satisfaction with work, organizational commitment, emotional exhaustion, cognitive well-being (cognitive fatigue, concentration, and taking new information), social well-being (social relationships with colleagues), professional well-being (self-confidence, aspirations, and competences), and psychosomatic well-being (physical health)". These dimensions are integrated with well-being in a home-working context analysis, examining how new forms of remote working under lockdown and imposed social distancing influenced employee well-being (Kaltiainen &

Hakanen, 2023). Through stress indicators linked to burnout, depression symptoms, change in sleep patterns, and the moderate effects of factors such as age, gender, number of dependents, mental health status, work-related conflict, and leadership quality, the literature links professional and personal well-being to the quality of leadership (Platts *et al.*, 2022). The effects of the COVID-19 lockdowns, restrictions, and subsequent lifting of restrictions on the physical and psychological status of remote workers (Platts *et al.*, 2022; Pelly *et al.*, 2022) and work productivity were analyzed in relation to employee well-being, with serious implications on the physical, mental, and social state of workers (Tronco-Hernández *et al.*, 2021).

Data analysis, digital skills, advanced cognition, decision-making, and continuous learning skills are the five important competences of professionals today, making the need for upskilling clear (Akanksha *et al*., 2021). In the Industry 4.0 context, employees need to have access to a new, improved, and unique lifelong education system so that they are properly educated for future jobs (Strack *et al.*, 2021; Li, 2022). Such a system should be developed by companies and public entities and embraced by employees. Digitalization affects future jobs and skills, the answer to these challenges lying in the implementation of upskilling and reskilling training programs, that both eliminate the risk of employees facing deskilling, and enhance employees' motivation to upgrade their careers (Anshari & Hamdan, 2022).

Research methods

This article explores the influence of technological transformations on the global labor markets, and the impact of AI on employee skills (the need for upskilling and reskilling) to properly cope with the new types of jobs embedding new technologies. We also explore the impact of AI on employee welfare, more precisely how the adoption of AI impacts employee well-being based on the Van Horn (2004) five-model perspective.

Focusing on the recent COVID-19 pandemic (March 2020-March 2023), a bibliometric analysis and systematic literature review was conducted to explore the effects of technology disruptions on international labor markets. In this regard, papers from the two most relevant databases were selected (Scopus and Web of Science — WoS). From an initial total of 902 papers, 337 were removed, as they were duplicates (see Figure 1). Only

papers published in English were considered, their final version having been published between March 2020 and May 2023, when the WHO announced the official end of the COVID-19 pandemic (UN, 2023).

The research focuses only on full-text English scientific papers. All selected papers addressed the following search terms: 'employees', 'artificial intelligence', and 'AI' as primary determinant filters. Two more sections relating to 'skills' and 'well-being' and their dimensions were subsequently added: for skills — 'reskilling', 'upskilling', 'digital skills', 'soft skills', 'hard skills'; and for well-being — 'cognitive well-being', 'social well-being', 'professional well-being', 'affective well-being', 'psychosomatic well-being'. In both databases, the selected criteria were linked to title, abstract and keywords.

To conduct the analysis, the PRISMA method was employed as it represents a valuable instrument for the creation of structured systematic reviews in various scientific fields. The model has three major layers: identification, screening and included reports. The analysis was also based on the five-step methodology of Khan *et al.* (2023), which entails:

- framing the question.
- identifying pertinent work/papers.
- evaluating the quality of the selected studies.
- summarizing the evidence.
- interpreting the results.

Results

Framing the question

The framed research question of the analysis was: Which professional and personal implications are induced on employees in the workplace by the adoption of AI? The impact of artificial intelligence might be analyzed by exploring the changes relating to skills (the need for upskilling and reskilling) as well as those related to employee welfare — the five dimensions of well-being according to Van Horn (2004).

Identifying the relevant work

While exploring the relevant papers regarding the impact of AI on employees, both the professional dimension (skills related) as well as the personal one (well-being related) were considered. As far as the impact on skills is concerned, the large adoption of AI-related technologies has led to a clear need to upskill the professional profile of employees (the readiness for so-called human-machine competencies (Semaan *et al.*, 2021; Jaiswal *et al.*, 2022) and/or to reskill employees in properly adopting the new job requirements (Li, 2022; Falahat *et al.*, 2023). The need for continuous learning focused on digital skills is clear, through upskilling or reskilling. The mismatch between an employee's skills and job-related skills might affect their well-being, the mismatch acting as a stressor, and leading to increased levels of dissatisfaction among employees (Brun-Schammé *et al.*, 2021; Nemțeanu *et al.*, 2022). The pressure of continuous learning for upskilling might negatively impact the well-being of employees and work-life balance (Bjursell *et al.*, 2021; Jaiswal *et al.*, 2022). Flexible lifelong learning programs, on the other hand, might ease the upskilling and reskilling processes and increase employees' satisfaction and performance at work (Bjursell *et al.*, 2021; Davidescu *et al.*, 2022).

Evaluation of the attributes of the selected studies

To evaluate the attributes of the selected papers, several inclusion and exclusion criteria were used (Table 1). To analyze the papers, VOSviewer was chosen, as it allows the build up of bibliometric networks using the final database that was developed and and utilized during the research (van Eck & Waltman, 2023). Based on indicators such as citations, bibliographic couplings, co-citation or co-authorship relationships, text extraction functionality can be used to construct and visualize a network of common occurrences of key terms extracted from the database, the networks being developed to identify existing correlations.

The most frequently employed terms formed the basis of the co-occurrence matrix (such as: artificial intelligence, AI, machine learning, employee training, affective wellbeing, artificial intelligence in human resources, motivation, health, decision-making, behavior, cognitive technologies, etc.) by studies in the field highlighting the main topics of interest (see Figure 2). When issued, the publications attracted the curiosity of

researchers interested in the subject, as evidenced by the sheer number of citations (see Figure 3). Bibliographic coupling provides a more in-depth look at the research activity of field academics and how they construct links between existing publications. It also emphasizes the study's exposure and the extent of the research community actively involved in it (see Figure 4). The matrix aimed to represent the linking networks of authors, with at least one significant connection between them (see Figure 5). The generated network is composed of nodes and links that generate a frame that depicts changes in time. By having at least five citations, the number of nodes is defined by the number of publications that cite and are cited (see Figure 6).

Out of the 15 selected articles, 11 focused on the need for reskilling as an adaptive behavior of employees related to the advancement of technologies and AI adoption in the workplace (see Table 2). Surprisingly, only four articles addressed the need for upskilling of employees out of the total of 15 investigated articles, while only one analyzed the need for reskilling as well. Despite our expectation that most articles would address digital skills, only 14 tackled these. As for the dichotomy of the hard skills/soft skills needed for performing work-related tasks, 13 articles analyzed the need for the use of hard skills, while eight focused on soft skills. When compared with PRISMA records, the resulting difference refers to our in-depth content analysis (we explored the articles beyond just the title, abstract and keywords).

According to Van Laar *et al.* (2020), there have been several developments relating to skill frameworks and definitions, focusing on analysis of the limits and mismatches in digital skills, and on the design of sound interventions to upgrade and develop skills such as digital skills, digital knowledge, electronic skills, and Internet skills. Nevertheless, there has recently been a shift in emphasis from discovering ways of exploiting information and communication technologies to ensuring safety in cyberspace and understanding the competing realities (Tinmaz *et al.*, 2022). A comprehensive review of the relevant literature regarding the recent development of digital skills revealed that there are seven fundamental, and five contextual skills (Van Laar *et al.*, 2017). Among the technical skills are "Technical, Information Management, Communication, Teamwork, Creativity, Critical Thinking and Problem-Solving", while among the contextual ones are "ethical awareness, cultural awareness, flexibility, self-discipline and lifelong learning" (Van Laar *et al.*, 2017, p. 1).

To analyze further the digital skills, we considered Livingstone *et al.'s* (2022) model, which depicts the following four dimensions (see Table 3):

1. "Technical and operational skills" ('Tech') — the capacity to use ICTs and technical features of a variety of devices, platforms, and apps, from basic knowledge to more advanced ones, like configuration administration or programming.
2. "Information navigation and processing skills" ('Info') — the capacity to identify, select and evaluate online information sources.
3. "Communication and interaction skills" ('Comm') — the capacity to critically assess the effects of interpersonally facilitated communication and interactions with peers while engaging with people and building networks using a variety of digital media and technology elements.
4. "Content creation and production skills" ('Create') — Ability to develop (high-quality) digital materials and understanding of how they are published, produced, and impact society.

We looked at the four components of technical, informational, communicational, and creative in the chosen articles to get a better idea of the value of digital abilities. The results are limited in that only two publications studying three of the four components could be found (see Table 4), while the bulk (9 out of 11) concentrated on the technical aspects of digital skills, and five out of 11 on information processing and navigation abilities. The talent for producing and creating content was only examined in one article. We might contend that since academics tend to overlook the intricacy of digital abilities, more extensive research is required.

The literature examines how interpersonal emotion control affects employees' affective well-being, pointing out that the perceived stress associated with AI augmentation works as a competing mediator by attaining the goal of interpersonal emotion regulation with the use of technology, and may have positive repercussions on service employees' emotional well-being (Henkel *et al.*, 2020; Arpat *et al.*, 2021). Safety and health have an unbreakable connection and have become essential to the functioning business community and anthropology. Machine learning is becoming an instrument that is utilized to supplement and increase physicians' cognitive capacities (Abdullah & Sofyan, 2023).

Studies (Henkel *et al*., 2020; Sagar *et al*., 2022) have also looked at how AI affects workers' perceptions of its utility in meeting basic psychological needs and maintaining mental health. The findings show that general mental aptitude affects the level of perceived usefulness of AI and determines

whether it is regarded favorably or not. This viewpoint has a different effect on how satisfied or thwarted employees are by their basic psychological needs, as well as indirectly on their mental health. Whether employees meet or reject basic psychological requirements to improve their psychological health is influenced by their general mental capacity, which also influences the perceived value of AI, either in positive terms or in negative ones (Lăzăroiu *et al.*, 2022b). A new model illustrates how perceptions of artificial intelligence-based technology indirectly affect psychological wellness at work (Stamate *et al.*, 2021).

The workplace environment might impact positively or negatively people's physical, intellectual, or emotional well-being (Kanchibhotla *et al.*, 2021). The working context impacts the mental and physical condition of employees, as well as their level of occupational stress. During the COVID-19 pandemic, meditation impacted positively the emotional state, contributing to mental well-being (Sagar *et al.*, 2022).

Focusing on employee well-being enables companies to maintain a good working relationship. A company's employment relationship with its employees involves mutual beliefs, attitudes, expectations, and informal duties. Organizations address employees' needs by implementing organizational policies that promote employee well-being and respond by fostering favorable behaviors, motivations and attitudes that improve the company's performance (Ercantan & Eyupoglu, 2022; Pap *et al.*, 2022a).

Technology and artificial intelligence may increase the efficiency and rewards of those who remain employed, but may also lead to contradictory effects on the well-being of employees and the security of employment. Technology should not allow us to "dehumanize" or "control" our lives but could replace the basic interactions necessary for people's psychological well-being and the development of skills. According to the World Health Organization, well-being is defined as the state of existence, along with material, intellectual, mental, emotional, and physical success, which creates purpose and meaning for individuals. "Psychological well-being" refers to a combination of positive performance between individuals, including interpersonal interactions and self-referencing behaviors such as self-confidence and individual development (Martela & Sheldon, 2019; Khogali & Mekid, 2022; Nemțeanu *et al.*, 2021).

Yet again, in the matter of employee well-being, the most significant link corresponds to employee attitude. It should be noted that skill requirements, talent matching, and employee attitude have the greatest im-

pact on company success and employee well-being, respectively (Pap *et al.*, 2022a). One might argue that because academics often miss the complexities of the well-being concept, more extensive investigation needs to be conducted in relation to psychosomatic well-being.

Discussion

AI has been significantly contributing "to both routine and non-routine tasks such as information selection and sorting, memorization, non-cognitive speed, and deductive reasoning" (Morandini *et al.*, 2023, p. 48). These transformations became more visible in the accelerated process of digitalization during the pandemic (OECD, 2021). Some of the most important aspects in improving company performance and well-being are skill requirements and skill matching, as well as the voice of employees (Pap *et al.*, 2022b). The Economist and World Economic Forum specialists stressed that employers who do not engage with new tasks based on improved skills may be confronted, if not with 'great resignations', then with 'quiet quitting' practices. The estimations are quite worrying, one in five employees being willing to resign in 2022 (WEF, 2022).

Employee satisfaction and corporate performance are two interconnected concepts. To evaluate skill use and skill approaches, skill requirements and skill match, continuous education, and skill improvement, "direct employee participation" and "indirect employee participation" are required (Pap *et al.*, 2022b). Machine learning approaches can improve company success. Organizations should use AI-related features as a prerequisite for strategically improving various company outcomes (Perifanis & Kitsios, 2023) when tackling innovation and teamwork (Fredström *et al.*, 2022), to create environments that assist employees to develop both their existing skills as well as new ones, while preserving and enhancing their sense of security, inclusion, and well-being (Jiang *et al.*, 2022).

The recent pandemic transformed organizational expectations that have frequently surpassed typical working hours and efforts due to the specificities of the new remote working context. This has generated unquestionable effects and led to studies investigating the role of techno-stressors such as technological overload, technological invasion, and technological complexity on both individual well-being and organizational performance and health, and in opposition to two important well-being outcomes, behavior-

al stress and work-family conflict (Molino *et al.*, 2020). Subjective well-being was positively triggered during the lockdowns, while extensive restrictions relating to the pandemic negatively impacted well-being (Foa *et al.*, 2020). We are also aware of AI's participation in the worldwide race to develop vaccines, test innovative vaccines, develop medical treatments, monitor patients (telemedicine played a crucial role in this), organize the logistics of vaccine distribution, and more (Piccialli *et al.*, 2021). Those efforts impacted the well-being and general health status, so the positive impact of AI on health services is undeniable (Dicuonzo *et al.*, 2023).

When discussing the professional dimension of AI impact on employees, the focus is related to skills (screening the skills level of employees means choosing either upskilling or reskilling strategies to cope with existing skills mismatch). Technological transformation requires continuous transformation of digital skills — from the technical component of digital skills to information and communication (Nagy *et al.*, 2023), and a focus on the creativity component as well as the cyber security one (Pelau *et al.*, 2021).

The consequences of current labor market reforms that have reduced job protection may have exacerbated income and well-being inequality among workers (Simonetti *et al.*, 2022). The OECD examined the primary pathways by which economic growth and well-being complement and reinforce one another, with a focus on 1) Health Care; 2) Social Protection and Redistribution; 3) Education and Skills; and 4) Gender Equality (OECD, 2019).

Research has revealed a broader understanding of the relationship between work and life, determining the reciprocal connections between six dimensions of well-being: life satisfaction, happiness, meaning, purpose, mental health, interpersonal relations as well as professional ones, considering the overlapping effects of each factor between work and life. The research interests include the evaluation of a wide range of phenomena, including psychological well-being, physical and psychological working conditions, occupational safety and health, work stress, work autonomy, work resources, conflict between work and family, etc. (Weziak-Bialowolska *et al.*, 2021).

Employee well-being, work stress and work-life balance are all topics that scholars, legislators and managers have tried to analyze and discern, aiming to understand the correlations and implications determined by the changes that occurred during the pandemic period. Furthermore, a better understanding of the positive and negative influences of employee well-

being is needed, while organizations are expected to proactively address the potential changes in employee performance (Pagán-Castaño *et al.*, 2020) through sound decision-making, oriented towards staff needs (ensuring access to tailored training, therapy programs (Platts *et al.*, 2022), etc. Moreover, the development and dynamics of AI tools (Valaskova *et al.*, 2022) induced by the organizational transformations during the pandemic demand more flexibility and adaptation of employees to the new environment.

The effect of AI is recognizable under normal conditions, but is amplified during pandemics such as COVID-19. The literature looks at employee well-being from several perspectives: personal, familial, work-life balance (Magnavita *et al.*, 2020) and organizational (Sonnentag *et al.*, 2023). Management efforts to support employee well-being revealed both the stressors in the professional context and the psychological/ emotional reactions of employees (Saleem *et al.*, 2021; Saxena *et al.*, 2020). These are indicators based on subjective measurements of job stress and well-being. They seek to alter the psychological work climate by modifying certain components of an organization, such as frameworks, procedures, guidelines, atmosphere, programs, responsibilities, and obligations, among others (Weziak-Bialowolska *et al.*, 2020).

Analysis of the investigated literature highlights the relevant associations between the well-being of employees during the pandemic period and the perceived stress that was found to regulate the interlinkages between organizational responsiveness, work-family conflict, and personal well-being (Vks *et al.*, 2022), but not the adaptability. Other than organizational responses, which have no direct impact on health, research shows that organizational responses, family conflict and adaptability have a direct impact on perceived stress and well-being (Al-Jubari *et al.*, 2022). Future research might concentrate on obtaining dependable responses to queries regarding skills and/or wellbeing (see Table 5).

One of the challenges of the post-pandemic context is related to both the public and private entity's ability to preserve and develop skills acquired throughout the unexpected COVID-19 pandemic. The public sector adoption of new technologies led to new skills acquisitions (Mittal, 2020), even though the process was not the same in all public sectors and in all regions in the EU–28 (Chinn *et al.*, 2020). Potential sources for this differentiation are represented by existing technological endowment, technological readiness, investment, and financial allocation (Mazzucato & Kattel, 2020), etc.,

the public sector being "responsible not only for fixing markets but also for shaping and co-creating them" (Laplane and Mazzucato, 2020, p. 1). For the private sector, the pandemic context was perceived as both a matter of survival and a source of new development opportunities (Hai *et al.*, 2021). Digitalization should be maintained in the "New Normal" by both the public and private sectors and should be constantly adapted to the transformational nature of the social and economic environment. Long-term assistance should be provided for skills such as AI sound development (fostering an agile working environment and preserving resilience behaviors), cloud computing, cyber security, online-network task performance, and access to shared knowledge. Universities, as learning hubs, must collaborate with other higher education institutions, industry clusters, and public and private sector organizations (Li, 2022).

The research focus should not only discuss whether AI-related skills are needed or not, as the continuous development of new technologies (Andronie *et al.*, 2023a) is an essential part of the socio-economic environment and should better explore how both existing and newly emerging digital skills support the job creation processes. The adoption of digital technologies demands new skills development, through reskilling and upskilling. The newly acquired skills should lead to the use of these new technologies in a more confident, critical, collaborative, and creative manner (Jashari *et al.*, 2021). New professions are emerging all the time, and the transformative processes on the labor markets (Andronie *et al.*, 2023b) might lead to the generation of new jobs (Nübler, 2016; Eberhard *et al.*, 2017; Lane and Saint-Martin, 2021) in the long run. Therefore, we might do well to focus on the process of creative destruction of jobs, followed by continuous creation of better and newer jobs.

An extended analysis of the controversies relating to the job creation versus job destruction processes has highlighted that both are impacted by the adoption of new technologies. The research has also revealed how the medium and low skilled workers performing routinized tasks are especially impacted by AI (they might lose their jobs if they reject reskilling), and how the highly skilled workers should embrace upskilling, through lifelong learning programs (Dosi *et al.*, 2021).

While analysing the dualism of job creation-job destruction in a low-income country (Ghana), it was found that the summative destruction is higher in the short run, but job creation is higher in the long run (Asravor *et al.*, 2023). Cross-European research revealed that the difference between

countries in terms of job creation versus job destruction are explained by the country-specific characteristics of ICT investment (non-machine versus machine-based) and the existing skill endowment of the labour force (Marques Santos *et al.*, 2023).

The impact of new technologies on the labour market was also analysed for Eastern and Central European countries (ECE). For instance, research on the automotive industry during the COVID-19 pandemic has found that the pandemic contributed significantly to the development of the already existing trends of digitalization, thus challenging companies to invest in upskilling programs for their employees (Pelle & Tabaji, 2021). On the other hand, the extended use of digital technologies can support the enhancement of employees' digital competencies, and challenge employers to properly address these needs (Horobet *et al.*, 2021). Lacová *et al.* (2022) pinpointed that employers' commitment to ease the workers' adaptation to new technologies is more easily implemented if employers cultivate digital literacy and resilience among their staff.

Doran *et al.* (2022) revealed the significant role of digitization in increasing the performance of banking services and the need to continuously invest in employees' skills in designing new digital products or ways to expand existing ones on a larger scale. Literature (Marcu, 2021; Grenčíková *et al.*, 2021) analysing the job structure within Industry 4.0. revealed significant job destruction (irrelevant jobs being displaced) and job creation developments (new positions created through upskilling of the existing labor force).

Conclusions

The recent pandemic induced an accelerated process of automation and digitalization of work tasks, with AI playing a major role in the transformation of job routines and procedures. AI has impacted both employees' professional and personal life. Upskilling and reskilling have become the norm for the organizational environment as a coping mechanism to address the skill mismatch. The focus on digital skills development (especially the technical side of it) might be accompanied by training programs that address employee well-being (cognitive well-being, social well-being, professional well-being, affective well-being, psychosomatic well-being).

Despite the conviction that digital skills are largely addressed by researchers in extensive analysis of AI impact on employees' professional and personal life, the resulting reports proved the opposite. Since academics tend to overlook the intricacy of digital abilities, more extensive research is required in the future, as AI is expected to generate more disruptive transformations on the labor market, from job requirements, work procedures, tasks design, to assessment techniques, etc. It was found that the complexity of the well-being concept was not adequately addressed in the well-being model that we examined, necessitating further research into psychosomatic well-being, for which no pertinent items were discovered, while weak relationships with other elements, such as cognitive, professional, and affective well-being, were established.

From a managerial perspective, the paper also highlights some relevant best practices for policy makers. Among them, one can count the adoption of sound national strategies for continuous development of professional skills, the financial support for lifelong learning programs focusing on digital skills, the fiscal stimuli for employers investing in employees' professional development, grants support for the design and implementation of flexible education and training programs that will allow development/new skills acquisition and international partnerships for fostering mobility programs for employees.

The professional and personal aspects of employees' lives must be addressed by organizations, particularly learning organizations, by integrating the most recent AI developments in an adequate, responsible, and coherent manner. Stakeholders in the labor market (decision-makers, employers, supporting organizations, and employees) should proactively confront the changes brought on by new technology by adopting appropriate rules, putting them into practice, and closely monitoring developments.

In the post-pandemic context several already emerging trends should be preserved, such as: flexible forms of employment, for instance teleworking, remote working, e-work, hybrid work, etc. (Vyas, 2022; Babapour *et al.*, 2022; Lipták *et al.*, 2023); tailored well-being programs for employees (Laker & Roulet, 2021; Mantello & Ho, 2023); creative, affordable, accessible training programs for new skills acquisitions (Li, 2022; Patino & Naffi, 2023); and continuous development of digitalization in both the private and public sectors (Vyas, 2022; Rapanta *et al.*, 2021).

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Annex

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
– Final version scientific articles in English – Methodology-based studies using qualitative, quantitative, or mixed methods. – Studies that access and evaluate employees and artificial intelligence. – Peer Reviewed journal articles	– Final version of non-English scientific articles – Studies that do not use methodology; qualitative, quantitative, or mixed method. – Studies that do not evaluate employees and artificial intelligence. – Articles that were not published in 2020 and 2021, 2022, 2023. – No journal nor peer reviewed articles

Table 2. Papers focused on the impact of AI on employees' professional life (skills)

Papers	P1= Re-skilling	P2= Up-skilling	P3= Digital skills	P4=Hard skills	P5=Soft skills
Kar *et al.* (2021)	x		x	x	x
Morandini *et al.* (2023)	x	x			
Suhasini *et al.* (2020)	x	x			
Polychronidou *et al.* (2022)	x	x			
Jaiswal *et al.* (2022)	x	x			
Chuang (2022)	x				
Li *et al.* (2023)	x				
Lee and Chang (2020)	x				
Morozevich *et al.* (2022)			x	x	x
Woods *et al.* (2022)			x	x	x
Zhang and Pan (2022)			x	x	x
Abina *et al.* (2022)	x		x	x	
Hussain *et al.* (2023)	x				
Henderikx and Stoffers, (2022)	x		x	x	x
Carlisle *et al.* (2023)			x	x	x
Kateryna *et al.* (2020)			x	x	x
Joamets and Chochia (2020)			x	x	
Ulfert *et al.* (2022)			x	x	
Jamwal *et al.* (2022)			x	x	
Doellgast *et al.* (2023)			x		x
James *et al.* (2021)			x	x	
Chatterjee *et al.* (2022)			x	x	

Note: P1: Reskilling (learning new skills to work in another occupation or training people to work in another occupation); P2: Upskilling (the process of increasing existing abilities or adding complementary skills); P3: digital skills (use of digital devices, communication applications, and networks to access and manage information; P4: hard skills (programming, data analysis, cyber-security, etc.); P5: soft skills (communication, data search, problem solving, collaborative work, etc.)

Table 3. Livingstone *et al.* (2022) model of digital skills

Papers	P1= Tech	P2=Info	P3=Comm	P4=Create
Carlisle *et al.* (2023)	x	x	x	
Kateryna *et al.* (2020)	x		x	x
Kar *et al.* (2022)	x			
Joamets and Chochia (2020)	x			
Ulfert *et al.* (2022)	x	x		
Jamwal *et al.* (2022)	x	x		
Doellgast *et al.* (2023)			x	
Morandini *et al.* (2023)			x	
Polychronidou *et al.* (2022)	x	x		
James *et al.* (2021)	x	x		
Chatterjee *et al.* (2022)	x			

Note: P1: Technical and operational skills; P2: Information navigation and processing skills; P3: Communication and interaction skills; P4: Content creation and production skills.

Table 4. Van Horn's model of well-being

Authors	F1	F2	F3	F4	F5
Henkel *et al.* (2020)				x	
Abdullah and Sofyan (2023)	x				
Stamate *et al.* (2021)	x				
Sagar *et al.* (2022)	x	x		x	
Swarajya *et al.* (2021)		x			
Pap *et al.* (2022a)		x	x		
Colquitt *et al.* (2023)		x			
Oravec (2022)		x			
Khogali and Mekid (2022)		x			
Asokan *et al.* (2022)		x			
Mortazavi *et al.* (2020)		x			
Pap *et al.* (2022b)		x	x		

Note: F1: cognitive well-being; F2: social well-being; F3: professional well-being; F4: affective well-being; F5: psychosomatic well-being.

The fifth feature of Van Horn's paradigm, psychosomatic well-being, was not covered in any of the studies that were examined. Therefore, it should be the subject of future research to provide a thorough examination of well-being.

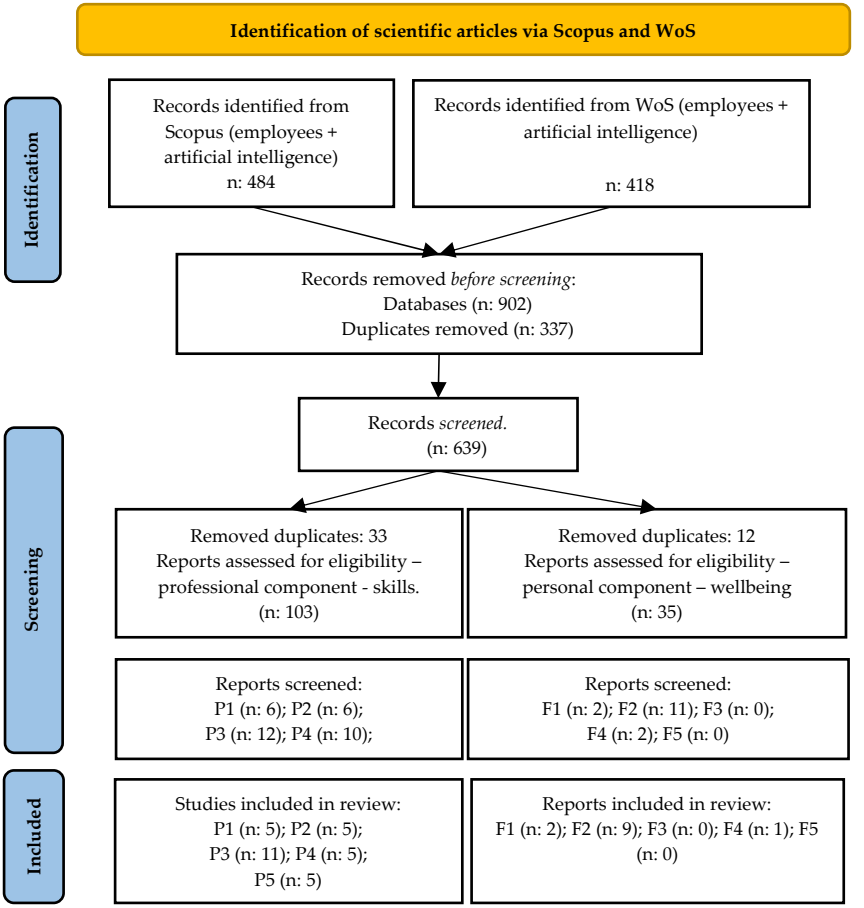
Table 5. Possible future research question/directions

Impact of AI	**On Skills**	– How have AI tools in the labor market been impacted by the pandemic? – How may AI affect how well employees acquire their skills? – Has the pandemic altered the AI capacity of employees? If so, what specifics are there? – What long-term effects will the pandemic have on employees' capacity in the post-pandemic era, and how can businesses change to meet these emerging patterns and demands? – How might organizations prevent continuous learning fatigue among employees, because of the upskilling and reskilling demands?

Table 5. Continued

Impact of AI	**On Wellbeing**	– What are the key variables affecting employee well-being? – What impact did AI have on employee well-being during the pandemic? – What elements, in relation to advancements in AI, affect employee well-being in the post-pandemic era? – How much do employees' perceptions of AI development in the post-pandemic age affect their physical and emotional health? – In the post-pandemic period, what impact does AI have on employee well-being and opportunities for performance improvement?

Figure 1. Prisma flow chart: The impact of AI on employees: professional and personal dimensions



Note: P1: reskilling; P2: upskilling; P3: digital skills; P4: soft skills; P5: hard skills; F1: cognitive well-being; F2: social well-being; F3: professional well-being; F4: affective well-being; F5: psychosomatic well-being.

Figure 2. VOSviewer design of the impact of AI on employees: professional and personal dimensions regarding co-occurrence – key words

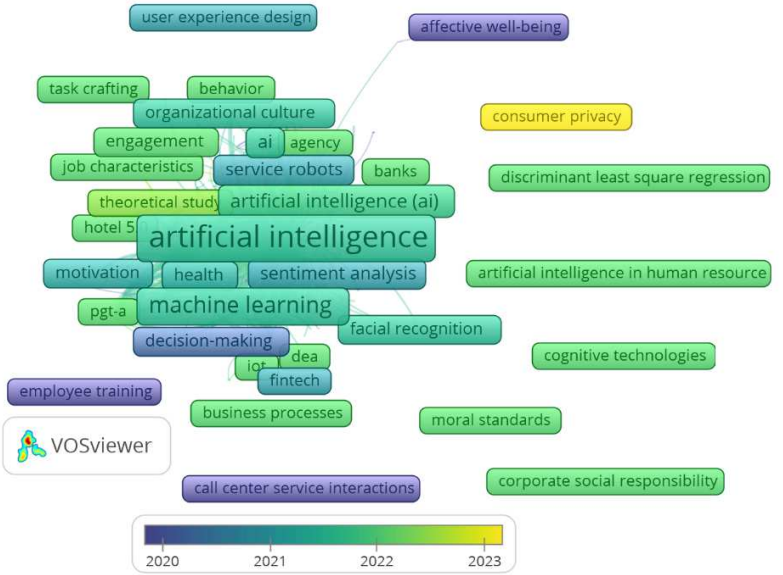


Figure 3. VOSviewer design of the impact of AI on employees: professional and personal dimensions regarding citation

Figure 4. VOSviewer design of the impact of AI on employees: professional and personal dimensions regarding bibliographic coupling

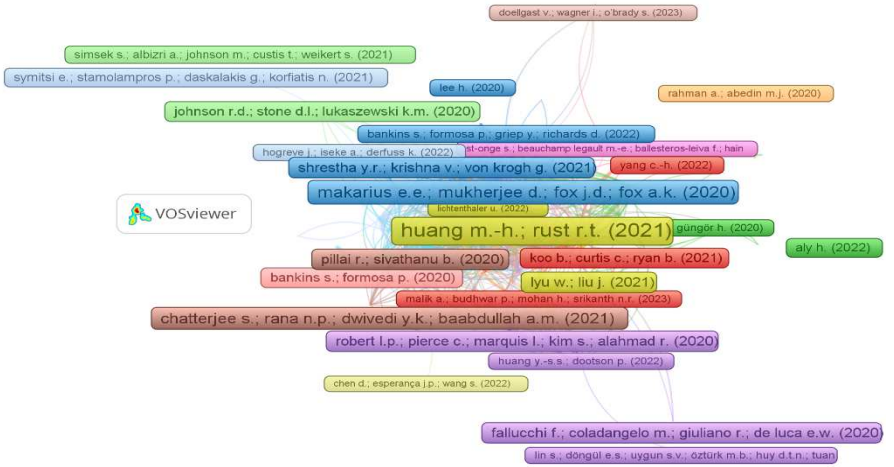


Figure 5. VOSviewer design of the impact of AI on employees: professional and personal dimensions regarding co-authorship

Figure 6. VOSviewer design of the impact of AI on employees: professional and personal dimensions co-citation – minimum 5 citations