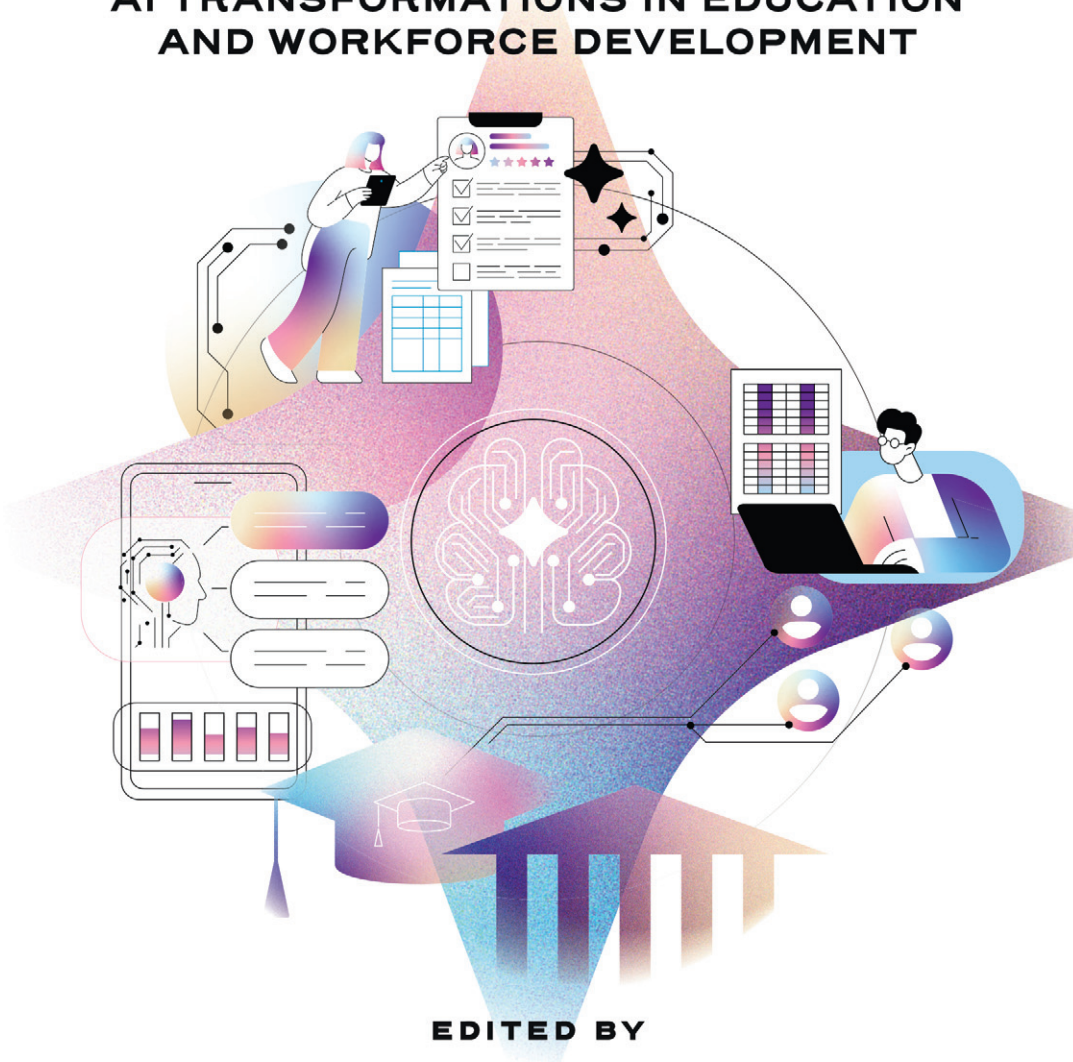
EDUCATION, FUTURE JOBS AND SMART SYSTEMS

in the Age of Artificial Intelligence

PART A

AI TRANSFORMATIONS IN EDUCATION AND WORKFORCE DEVELOPMENT



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Education, Future Jobs and Smart Systems in the Age of Artificial Intelligence, Part A

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Education, Future Jobs and Smart Systems in the Age of Artificial Intelligence, Part A: AI Transformations in Education and Workforce Development

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To
Dimitris, Hara and Katerina,
Alexandru and Maria

With love, we dedicate this volume to you. Your presence in our lives inspires us to deepen our understanding of the transformations shaping the world, to embrace its challenges and to explore the endless possibilities of the future. May your path be filled with knowledge, purpose and the passion to create a world that reflects your dreams and aspirations.

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Additionally, we recognize the inspiration provided by our colleagues and students, whose curiosity and engagement continue to fuel important discussions about the evolving role of AI in shaping education and the workforce. Their enthusiasm reinforces the importance of fostering innovation and adaptability in this rapidly changing landscape.

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Chapter 1

The Transformative Impact of AI: Implications for Education, Labour and Smart Systems

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Abstract

The transformative impact of Artificial Intelligence (AI) is reshaping education, labour and smart systems, driving significant changes in skill demands and labour market dynamics. Globalization and digitalization have shifted labour markets and economies towards knowledge-intensive sectors. They need highly adaptable, digitally literate labour force. This chapter explores the evolving labour market context, where AI and automation redefine job roles, emphasizing creativity and interdisciplinary skills while automating routine tasks. AI's effects extend to education sector, highlighting the need for lifelong learning, flexible modular training and public–private collaborations to align curricula with industry needs. In an AI-driven labour market, equipping individuals with skills like critical thinking, digital literacy and problem-solving is essential. Interdisciplinary approaches in different learning context can create the skills needed for future roles. The mechanisms of reskilling and upskilling the labour force, through the lifelong learning process, are necessary responses to evolving demands in the current societies.

Keywords: Artificial Intelligence; technology; smart systems; digital transformation; education

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Introduction

Globalization has a great impact on labour markets and has changed skill demand. The increasing interconnectivity of economies generated by globalization has led to the integration of markets, enabling companies to easily operate across borders. This shift has created new job opportunities in emerging markets and intensified competition for accessing in/controlling developed economies. Under this new context, traditional manufacturing jobs have moved to regions with lower labour costs, generating a shift in developed countries towards service-oriented and knowledge-intensive sectors. Currently, as a result, employees face a higher demand for highly skilled jobs, in technology, critical thinking and cross-cultural communication. Digitalization and automation have evolved with globalization, and skill requirements are increasingly changing (Cramarenco et al., 2023). They need higher adaptability, flexibility, digital literacy, and they are more technology-based. And these aspects make lifelong learning essential for labour force readiness in an increasingly dynamic global economy.

In terms of technology, the advancements have profoundly transformed labour market dynamics and labour environment, impacting jobs content, jobs roles, jobs demands and even organizational structures. Using automation processes and Artificial Intelligence (AI), routine tasks as well as some complex tasks can be performed (Halal et al., 2016). These changes redefined and will increasingly redefine the occupational structure and will increasingly lead to redefinition of job responsibilities and, in some cases, the sunset of some jobs and responsibilities taken by humans. However, this shift is also creating new types of job that many times are focused on the demand for professionals skilled in data analysis, cybersecurity and digital innovation. Also, the rise and use of remote work technologies and collaborative digital platforms has impacted the traditional labour places, enabling flexible work arrangements and global collaboration. Adaptability for both employees and organization is a requirement if they want to succeed in the new context. While employees must adapt to new tools, digital needs and technologies, the organizations must redesign the work flow to integrate the AI and human–AI collaboration. These new changes and trends imply both opportunities and challenges, and they require continuous upskilling, adaptability and a focus on new skills to cope successfully with the new labour market context. The current challenges of the labour market and educational systems are presented in Fig. 1.1.

The rapid technological change and globalization have intensified the demand for lifelong learning and adaptability for the labour force. As traditional jobs have changed or became obsolete, employees need to acquire new skills and competencies and to change their jobs and even the type of the jobs many times throughout their careers. Lifelong learning has become essential for staying relevant on the labour market in different fields that are intensely influenced by innovation, such as technology, healthcare, education and finance. In all fields, with a higher intensity in the mentioned ones, new tools and practices regularly redefine best and traditional practices.

Fig. 1.1. Key Challenges Impacting the Future of Jobs and Education. *Source:* Authors.

In the current societies, adaptability is considered as a core competency, allowing individuals to adjust to new work environments, adopt new technologies and respond to shifts in tasks. This need for a continuous education and flexibility has led to the expansion of online learning platforms, certification programmes and corporate training initiatives, designed to support employees in adjusting skills on an ongoing basis. This is a very important aspect that should be taken into account in order to reduce the risk of social exclusion and increasing social inequality.

State of the Art on Labour Market and Education in Our Times

Current trends in the labour market are dominated by the shift driven by the rapid technological advancements, adoption of AI and automation technologies. Machines and algorithms are used to replace the routine and data-intensive tasks, and as a result, businesses are restructuring their labour force, leading to the decline of some traditional tasks and creating demand for new, highly skilled and technological skilled jobs. Jobs involving repetitive tasks, such as manufacturing and data processing, are particularly susceptible to automation, while jobs requiring creativity, critical thinking and interpersonal skills are gaining importance. These changes create space for a new and increasing need for employees who can work alongside AI and use the benefits of AI, manage and use digital tools effectively, and adapt to rapidly evolving job demands and tasks. Some authors (Rigley et al., 2024), referring to the impact of AI across industries, highlight the challenging effects on both employers and individuals looking for a job. Employers face difficulties in finding when they recruit for AI roles, and graduates have difficulties to find employment as result of a skills gap or skills misalignment.

The available papers offer limited insight into the future of work and the impact of generative AI. While some documents introduce broad research themes such as productivity, human potential and future technologies, they do not provide specific findings related to AI and employment. Others briefly mention studies on generative AI and labour markets, but often lack detailed content or concrete data. Many abstracts primarily consist of organizational information or report titles rather than substantive research results. As a result, it is difficult to draw meaningful conclusions or provide a comprehensive summary regarding the influence of generative AI on the future of work.

AI is focused on creating systems capable of performing tasks that typically require human intelligence, for example, recognizing speech, understanding language, making decisions based on previous experience and examples and even solving complex problems by using complex algorithms (Fathi et al., 2024). AI is significantly impacting future employment patterns, reshaping job tasks and skills across economies. While AI may automate routine tasks and potentially displace certain types of jobs, it also creates new opportunities, particularly in

management, development and ethical governance (Tabbassum et al., 2024). The IT sector is highly challenged by the rise of AI development, as a result of the transformations in cybersecurity, software development and infrastructure management roles. However, AI is viewed as having complementing roles rather than replacing human labour. To successfully address the challenges, there is a need of all involved actors in the business and education environment (policymakers, industry leaders, education institutions) (Subudhi, 2024).

The current labour market is characterized by the shift in skills demand, increased impact of AI and importance of digital literacy, as summarized in Fig. 1.2.

Mean and Mochel (2023) highlight also the labour market transformations due to AI and automation, the need for interdisciplinary AI skills and adaptability, and a higher number of jobs experiencing higher risks of automation based on task granularity and interaction requirements. This evolution calls for targeted educational programmes to develop digital proficiency and interdisciplinary competencies, preparing the labour force to adapt to AI roles and the rapidly changing job landscape (Rusandi et al., 2023).

The EY (2023) report on tech skills transformation highlights the critical need for technical skills integration across all job roles to future-proof labour forces. It identifies three main findings: the universal demand for tech skills, increased complexity of tech skill requirements and the importance of real-time skills visibility within organizations. Companies are responding by developing skill taxonomies and benchmarks to optimize the use and management of human talent (Giraud et al., 2023). These strategies aim to address tech skills gaps, improve organizational agility and adapt to a rapidly changing tech environment, ensuring efficiency and competitiveness.

Ellingrud et al. (2023) discuss the profound changes expected in the US labour market by 2030 due to automation and generative AI. They highlight a shift towards higher-wage jobs and increased demand for roles in healthcare, STEM and transportation. However, lower-wage routine jobs in food services, customer service and office support are expected to decline as automation expands. They emphasize the need for large-scale labour force development, focusing on reskilling and inclusive hiring practices, as workers in lower-wage roles face greater risks of displacement. Effective training and broader hiring approaches are critical for adapting to an AI-driven economy.

The joint US-EU report (COMM, 2024) on AI's impact explores AI adoption, its economic benefits and the labour market challenges. The AI transformative potential in productivity and job creation across sectors is recognized as well as its potential risks of job displacement, exacerbated inequality and biases in AI-driven hiring and monitoring. To manage these issues, the report calls for inclusive policies that exploit AI's benefits while protecting workers from adverse effects, emphasizing the need for strong policy frameworks to support a balanced AI-driven labour market transformation.

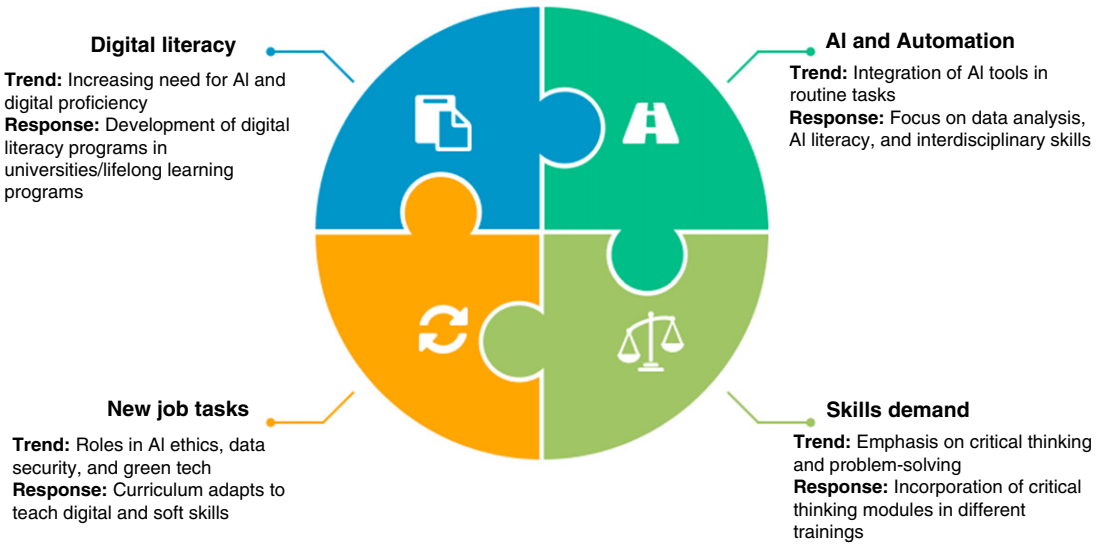

Fig. 1.2. Labour Market Evolution. *Source:* Authors.

Strategic Propositions for New Skills and Jobs to Emerge

The strategies for successful future labour markets should promote new skills and job opportunities in response to the evolving impact of AI, automation and digital technologies, by focusing on upskilling, interdisciplinary training and the development of digital competencies (KPMG, 2024). In this way, the labour force will be prepared for the new evolving roles, by increased adaptability, continuous learning, digital and AI literacy – aspects that are crucial for individual and organization to succeed in the technology-based labour markets. Strategic recommendations emphasize building AI-specific skills, encourage adaptability and implement policies to support labour force transitions. This approach aims to balance AI's disruptive potential with the benefits of increased productivity and innovation.

In the future labour markets, the advancements in AI and digital transformation, merged with the increasing need for sustainable business and practice, will lead to new job categories to address specific sector's needs. AI is automating routine tasks, potentially replacing roles in manufacturing and customer service, while creating new positions in AI development, data science and digital ethics (Unuriode et al., 2024). New job categories need interdisciplinary skills, ethical considerations and innovation, and we summarized their focus as follows:

(1) AI and machine learning

- Relevant sectors: Technology, finance, healthcare and manufacturing.
- Challenges: Addressing AI ethics, data quality and rapid skill evolution.

(2) Cybersecurity and digital privacy

- Relevant sectors: government, finance, healthcare and e-commerce.
- Challenges: Managing cybersecurity threats, data privacy and compliance.

(3) Green technology and sustainability

- Relevant sectors: Energy, urban planning and agriculture.
- Challenges: Advancing sustainable technologies and adapting to environmental regulations.

(4) Human–AI collaboration facilitators

- Relevant sectors: Customer service, operations, education and healthcare.
- Challenges: Training on AI tools, balancing human–AI roles and maintaining empathy.

(5) Digital transformation and automation

- Relevant sectors: Logistics, manufacturing, retail, government and education.
- Challenges: Leading automation integration, training staff and managing interdisciplinary collaboration.

(6) Digital content and virtual experience

- Relevant sectors: Media, retail, education and real estate.
- Challenges: Creating immersive experiences, leveraging virtual reality/augmented reality (VR/AR) and content innovation.

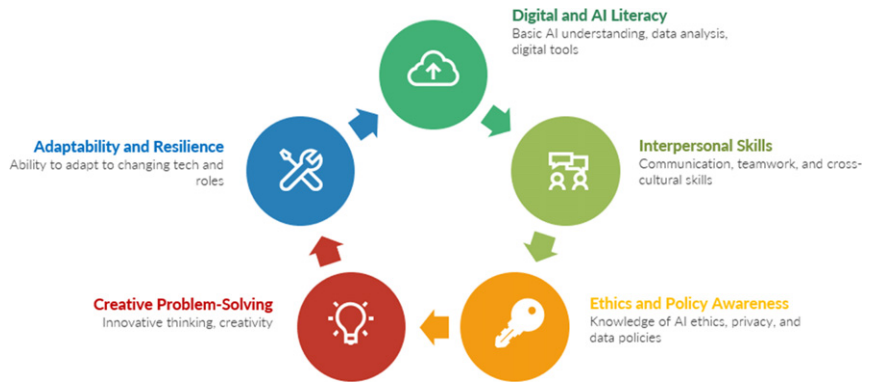

Fig. 1.3. Strategic Skills for the AI-Driven Future. *Source:* Authors.

In an AI-driven labour market, equipping individuals with skills like critical thinking, digital literacy and problem-solving is essential (Koechling et al., 2023; Spector & Ma, 2019). These are the strategic skills for the AI-driven future (Fig. 1.3). In this context, integrating AI literacy into education can ensure early exposure, supporting individuals' adaptability (Benvenuti et al., 2023). Also, interdisciplinary approaches in different learning context can create the skills needed for future roles. The mechanisms of reskilling and upskilling the labour force, through the lifelong learning process, are necessary responses to evolving demands in the current societies. Also, partnerships between industry and educational institutions play a crucial role in aligning curriculum with real-world job requirements, educating a labour force ready to activate in a dynamic, technology-oriented environment.

Continuous learning opportunities should exploit all the advancements in education systems and learning tools. They should consider online courses along with traditional physical training, adapted to industry-specific needs. These learning opportunities need to be considered from both the government and business sector. By implementing flexible, modular training programmes, companies can help employees acquire the new needed skills alongside AI tools. These will help them to adapt to new technologies and transition into emerging roles. Public sector involvement, particularly educational institutions, is essential for creating standardized frameworks for reskilling, offering accessible programmes and developing curricula that align with industry needs, providing skilled graduates ready for an AI-integrated economy. Government and industry collaborations, as well as accessible certifications and micro-credentials, further support labour force adaptability, ensuring that workers remain resilient in the face of rapid technological advancements.

Conclusion

The high impact of AI on labour markets and education, where automation and digitalization are reshaping job roles, skill demands and learning requirements, is