Appendix 1. Data extraction matrix for the selected studies.

	Author, Year, Country	Study objective	Key findings	Associated technologies
1	Dimitriou et al. (2024) Greece	To elucidate the role of Human Resources in ensuring that the Metaverse evolves into a safe and inclusive working environment, and to underline the urgency of establishing a legal framework to regulate this domain.	• The metaverse is transforming workspaces. • A new strategy is required for virtual recruitment and employee training. • It is crucial to create safe virtual spaces that foster productivity. • There is an urgent need for a legal framework for ethical practices in the workplace metaverse.	Metaverse, virtual reality/immersive platforms
2	Ramachandran et al. (2023) India	To examine how the metaverse affects corporate culture and communication, by analysing existing research and conducting new, original research.	• The metaverse can transform how businesses operate • It fosters greater social interaction, cooperation and communication • It opens up new opportunities for remote working and virtual events • Beneficial impact on corporate culture and communication	Metaverse, Virtual Reality, Augmented Reality
3	Konyaliogl u, F. I. (2023) Turkey	To analyse the differences in consumer behaviour in the Metaverse environment and how it varies across sectors, products, and psychological and sociological phenomena.	• Consumer behaviour in the Metaverse varies by sector and context • It is expanding from gaming into event management, corporate marketing and real estate • Immersive consumption, content creation and decentralisation stand out • Development of behaviours with personalised dimensions • Risk of alienation from personal identities	Metaverse, Mixed Reality, virtual platforms
4	Gupta, et al. (2022) India	To elucidate an approach for developing an online 3D meeting application based on the metaverse concept in order to overcome the limitations of 2D platforms.	A multiplayer networking platform is proposed that enables meetings to be hosted, talks to be given, and offers collaborative whiteboards and multipurpose projectors, closing the remote monitoring gap.	Metaverse, Virtual Reality, Web 3.0, Holography.
5	Yadav, et al. (2025) India	To explore the integration of Adaptive AI into language education within the Metaverse, examining how AI-driven platforms and	• The combination of AI and the Metaverse enables personalised, interactive language-learning experiences. • The future of this field includes AI tutors with emotional intelligence, real-time translation tools and multilingual	Metaverse, Adaptive Artificial Intelligence, Augmented Reality (AR), Virtual

		immersive virtual environments are revolutionising language learning.	communication. • This paradigm could reshape language learning globally, fostering accessibility and intercultural understanding.	Reality (VR), Chatbots.
6	Tabassum, et al. (2025) Qatar	To explore the interdependence between Generative AI (GenAI) and the metaverse, and the unique ethical and legal challenges that emerge from their integration.	• LLMs (Large Language Models), as a component of GenAI (Generative Artificial Intelligence), are critical to facilitating real-time communication and multilingual translation in the metaverse. • The integration of GenAI and the metaverse creates unique ethical and legal challenges, such as AI bias, misinformation and data privacy issues. • Tailored ethical and legal frameworks need to be developed to manage this convergence responsibly.	Metaverse, Generative AI (GenAI), Large Language Models (LLMs), Extended Reality (XR).
7	Rafiei et al. (2025) Turkey	To address the lack of robust solutions for real-time face-to-face translation, particularly for low-resource languages, by introducing a framework that translates language and replicates nuances of voice and synchronised facial expressions.	• A framework was developed that generates translated, lip-synchronised "talking heads" in real time (with a throughput of 0.381 seconds). • The framework is linguistically agnostic and has been successfully tested in Turkish, Persian and Arabic. • The solution is ready for deployment in Metaverse and VR/AR ecosystems, enabling fluid, natural multilingual communication.	Lip Sync Models, Neural Networks, Generative Artificial Intelligence (GenAI), Computer Vision.
8	Angerbaue r et al. (2025) Germany	To examine the experiences of people with disabilities (PWD) who use inclusive avatars that represent disabilities, in order to understand how social interactions in the Metaverse affect their emotions and outcomes.	• The use of inclusive avatars by people with disabilities shapes their emotional responses through social interactions (inclusive and exclusionary). • These emotional responses directly influence their engagement, connection with the avatar, satisfaction and perception of inclusion. • Disability identity is a critical factor; a strong identity mitigates the negative emotional impact of exclusion. • The benefits of adopting inclusive avatars can outweigh the challenges.	Metaverse, Avatars, Virtual Reality.
9	Rajan et al. (2025) India	To carry out a systematic Biblioshiny-based assessment of human capital management automation systems, examining smart workforce requirements and future automation trends.	• The metaverse enhances virtual reality training, 3D simulations and self-tracking technologies. • Cloud computing simplifies simulations and collaborative mixed reality for employees. • Digital technologies (AI, the metaverse, etc.) optimise the workforce, increase corporate value and improve employee performance. • Despite advances, many companies have failed to integrate the metaverse into the workplace.	Metaverse, Artificial Intelligence (AI), Blockchain, Cloud Computing, Virtual Reality (VR), Big Data Analytics.

10	Raman et al. (2025) India	To explore the role of metaverse technologies in shaping cognitive, emotional and social processes, and to synthesise insights from existing research by applying the TCCM framework (Theory, Context, Characteristics, Methodology).	• It identifies seven thematic clusters, including "VR for behavioral skills and training" and "VR and AR in learning and development". • Theories such as Flow Theory and the Technology Acceptance Model are fundamental to understanding adoption and engagement in these environments. • Equitable design and inclusive access are critical priorities, especially in workplace training. • Long-term studies are needed on the psychological and social implications of sustained metaverse use.	Metaverse, Virtual Reality (VR), Augmented Reality (AR).
11	Kondratev a et al. (2025) France	To analyse perceptions of the advantages and limitations of avatars in the professional use of the metaverse.	• The context of professional use defines the constraints on avatar creation. • Users showed a conservative approach when designing their avatars, giving rise to a typology of three behaviours: "approver", "reluctant" and "opponent". • Avatars are conceptualised as "professional digital twins" shaped by social norms.	Metaverse, Avatars, Haptic Technologie s.
12	Jebbor et al. (2025) Morocco	To assess the role of digital twins and the metaverse in improving sustainable circular processes across different sectors, by consolidating literature from more than 150 studies.	• The metaverse contributes to virtual collaboration, process simulation and workplace training. • Digital twins optimise resource consumption and minimise waste through monitoring and predictive analytics. • There are gaps in the literature on non-industry-specific applications and AI enablers for improving prediction. • Barriers to scaling these technologies are identified.	Metaverse, Digital Twins, Artificial Intelligence (AI), Immersive Technologie s
13	Wang et al. (2025) USA	To transform traditional, instruction-based construction safety training into an immersive, interactive and engaging learning experience through a metaverse game, focusing on hazard identification.	• A pilot system called "Construction Guardian" was developed, which simulates the risk of falls on a real project. • The virtual recreation of a real-life project improves participants' sense of situational awareness. • The system allows workers to immerse themselves in realistic scenarios before setting foot on the real worksite, and monitors each participant's performance during training.	Metaverse, Virtual Reality (VR), Unreal Engine 5, Building Information Modelling (BIM), Gamification .
14	Ramasamy , et al. (2025) India	To develop an AI-based CPR training system that provides accuracy, real-time feedback and interactive engagement to trainees, improving	• The system integrates a metaverse-based tutorial that reproduces realistic CPR scenarios and guides the user step by step. • It uses IoT sensors on a practice manikin and ML algorithms to measure variables and provide real-time feedback. • Experimental evaluations showed a	Metaverse, Artificial Intelligence (AI), Internet of Things (IoT), Machine

		emergency preparedness.	70% improvement in compression accuracy and 98% accuracy in recording primary indices. • The system significantly increases skills retention and user engagement.	Learning, Sensors.
15	Aluri, A. (2025) USA	To identify and measure "privacy trust assurance" as a critical factor in the adoption of wearable Augmented Reality (AR) applications among hospitality industry professionals.	• "AR privacy trust assurance" significantly influences professionals' intention to adopt the technology in the workplace. • The motivational constructs of "flow experience" and "emotional involvement" directly and indirectly impact adoption. • Wearable AR is used to improve operational efficiency and to provide immersive training, communication and collaboration. • The integration of GenAI into these technologies makes research on privacy and trust even more crucial.	Wearable Augmented Reality (AR), Metaverse, Generative Artificial Intelligence (GenAI).
16	Yadav et al. (2025) India	To explore how virtual workspaces are transforming the global labour market, creating new employment opportunities and contributing to sustainable growth and the achievement of Sustainable Development Goal 8 (Decent Work).	• Virtual workspaces create new job roles, including positions in training, onboarding and technical support. • They foster the gig economy, offering opportunities for freelance and short-term projects. • Technologies such as Microsoft Mesh provide immersive mixed reality experiences that foster a cohesive and innovative working culture. • They contribute to sustainable economic growth by reducing the need for physical infrastructure and harnessing a diverse global workforce.	Virtual Workspaces, Metaverse, Microsoft Mesh, Gather.
17	Holzgräwe-Eichmann et al. (2025) Germany	To record digital applications in selected areas of occupational healthcare and provide an overview of the current state of research on their use.	• Applications of artificial intelligence (AI) and metaverse technologies were identified as relevant areas of application in occupational healthcare. • Digital access to care is widely accepted. • It is concluded that "training and knowledge transfer among users remain necessary". • Digital applications in occupational medicine will become even more important in future.	Digital Applications, Artificial Intelligence (AI), Metaverse, Telemedicine.
18	Kliestik et al. (2024) Slovakia	To demonstrate how enterprise generative AI, fintech based on blockchain and the industrial metaverse can improve talent management, production processes	• Generative AI can improve recruitment processes, job performance and provide synthetic training data for skills development. • Blockchain-based fintech operations enable the tokenisation of assets and the automation of financial processes, the basis of smart contracts. • These technologies drive agile,	Digital Twin Industrial Metaverse, Generative Artificial Intelligence (GenAI), Blockchain, Internet of

		and algorithmic decision-making.	transformative change in the digital twin industrial metaverse. • They shape demanding yet rewarding work experiences, measuring and supporting efficiency and productivity.	Things (IoT).
19	Bansal et al. (2024) India	To provide in-depth insight into the role and applications of Virtual Reality (VR) and the metaverse in effective remote working and virtual team collaboration.	• The metaverse makes it possible to create immersive, interconnected virtual work environments that transcend traditional boundaries. • It facilitates effective collaboration and creative innovation among remote teams. • It covers specific applications such as business communication, negotiation techniques and workplace training.	Metaverse, Virtual Reality (VR).
20	Lim et al. (2024) India	To review the potential applications of the metaverse in various areas of Human Resource Development (HRD) and reflect on its significance for employee and organisational development.	• It offers an analytical view of the metaverse compared with other training or learning technologies. • It evaluates its effectiveness in employee development. • It provides insights into how metaverse-based interventions can reshape organisational culture and improve employee performance. • It addresses theoretical and practical issues relating to the HRD problems that arise from the metaverse.	Metaverse, Virtual Reality (VR), Augmented Reality (AR).
21	Nair et al. (2024) India	To evaluate the impact of learner characteristics (attitude towards the metaverse and experience with technology) on motivation to take part in metaverse-based training programmes.	• Both attitude towards the metaverse and experience with technology have a strong positive relationship with learner motivation. • Attitude towards the metaverse has a stronger relationship with learner motivation than experience of use. • Organisations should focus on how to introduce the metaverse into workplaces and take into account employees' attitudes towards technological change and strategy when implementing these training programmes.	Metaverse
22	Bartolotta et al. (2023) Italy	To investigate the role of immersion in metaverse-based training on employees' empathic communication skills, comparing an immersive (VR) condition with a non-immersive (desktop) one.	• Both groups (immersive and non-immersive) reported good levels of self-perceived communication competence and satisfaction with the experience. • There was no significant difference in training effectiveness between the immersive and non-immersive groups. • The immersive group did report significantly higher levels of embodiment and sense of presence. • Immersion alone is not the key element of a meaningful learning experience in the metaverse.	Metaverse, Virtual Reality (VR).

23	Induji et al. (2024) India	To examine the emerging role of the metaverse in reshaping HR strategies and in promoting a more dynamic, connected and immersive work environment.	• Companies use the metaverse for virtual job fairs, skills training simulations, team-building events and immersive, gamified training courses. • It can improve remote working and collaboration, employee training and development, and accessibility. • It represents an innovative way to streamline HR processes and improve employee engagement and career growth. • Its implementation raises privacy and security issues that must be addressed.	Metaverse, Virtual Reality (VR), Augmented Reality (AR).
24	Reddy et al. (2024) India	To explore the possibilities and challenges introduced by the convergence of the metaverse and the healthcare industry.	• It enables more engaging and personal online medical consultations. • It facilitates remote patient monitoring. • It improves the training of doctors and nurses with realistic practice. • It creates a virtual workplace for scientists to collaborate on drug research and formulation.	Metaverse
25	Tang et al. (2024) China	To conduct a review of the application and potential of the metaverse in the field of occupational health, identifying its prospects and challenges.	• The metaverse has broad application prospects in immersive training, occupational risk identification and assessment, and monitoring and diagnosis of occupational diseases. • It offers more efficient and intelligent solutions for occupational health management and safer working environments.	Metaverse, Virtual Reality (VR), Artificial Intelligence (AI).
26	Dimitriou et al. (2024) Italy	To elucidate the role of Human Resources (HR) in ensuring that the metaverse evolves into a safe and inclusive working environment, and to underline the urgency of establishing a legal framework for this domain.	• A new HR strategy will be required for virtual recruitment, training and employee development. • Companies need to create safe and effective virtual workspaces that foster productivity and engagement. • Potential challenges such as virtual fatigue and burnout need to be addressed. • It is urgent to establish a legal framework to regulate this domain and provide a basis for sustainable and ethical practices.	Metaverse
27	Poonkuzhali et al. (2024) India	To introduce a virtual learning environment in the metaverse, tailored for people with intellectual disabilities, that facilitates learning musical instruments as a livelihood skill in order to pursue a profession.	• The system provides fully interactive and individualised educational opportunities in the metaverse. • It allows users to learn to play musical instruments (drums, ukulele, piano, xylophone) from the comfort of their homes, without the need for expensive equipment. • It includes an assessment system that carries out a pre-assessment and a post-assessment to measure the learner's progress and provide valuable feedback.	Metaverse

28	Kaarlela, et al. (2023) Finland	To present use cases that use Extended Reality (XR) and Digital Twins to create a bridge between virtual metaverse environments and real-world robotic systems in industry and academia.	• The metaverse is an enabler of the future digital workplace and digital learning spaces. • A connection (bridge) is required between the virtual world and physical production systems to enable these spaces. • The use cases presented demonstrate how Extended Reality and Digital Twins can create this bridge to control robotic systems remotely and immersively. • This enables the creation of realistic virtual training environments for academia and, by extension, for employee training in industry.	Metaverse, Extended Reality (XR), Digital Twins, Robotics.
29	Ortega-Gras, et al. (2023) Spain	To design a technological pathway (training pathway) for the development and implementation of Extended Reality (XR) training scenarios that empower Vocational Education and Training (VET) in the Wood and Furniture (W&F) sector with a focus on the circular economy.	• XR enables the simulation of work scenarios, providing training in a risk-free environment. • This results in cost savings, improved occupational risk prevention and better decision-making processes. • A training pathway is presented, focused on developing XR scenarios/labs (VR, 360° videos, MR). • It contributes to the digital and green transformation of Vocational Education and Training in the sector.	Extended Reality (XR), Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Metaverse.
30	Zambiasi, et al. (2023) Brazil.	To introduce an approach for creating metaverse-based software robotic tutors (softbots) to train and support Operator 5.0 workers with disabilities in Industry 5.0 work environments, promoting more inclusive industrial workplaces.	• A reference architecture is presented for creating softbot tutors in the metaverse for specific training and assistance situations. • The architecture was implemented as a proof-of-concept prototype. • Three industrial scenarios were designed to simulate maintenance training for Operator 5.0 workers with disabilities. • The approach contributes to the development of more inclusive, human-centred industrial workplaces.	Metaverse, Softbots (Software Robots), Intelligent Tutors.
31	Raj, et al. (2023) India	To demystify and analyse the metaverse in the context of Education 4.0, providing a detailed framework and a comparative study with conventional and online educational methods.	• The metaverse can improve collaboration and the training process. • It has the potential to create a happier workplace. • Large corporations such as Nvidia and Meta are adopting this pedagogical ecosystem. • A detailed framework for the metaverse in education and a comparative study with conventional and online education are presented.	Metaverse, Virtual Reality (VR), Augmented Reality (AR).

32	Weng, T.-S. (2023) Taiwan	To develop a level-based training system, within a virtual factory (metaverse), to train people in the mathematical literacy skills needed to operate inspection instruments in the electronics industry.	• The system simulates the scenarios of a company inspection room in the metaverse. • It includes a level-based system of mathematical problems that automatically determines and provides correct answers. • Survey results show that the system effectively improves students' learning attitudes and attention. • It achieves multiple objectives: developing awareness of the workplace before starting work, reducing connection conflicts during work and indirectly reducing skills development costs for employees.	Metaverse, Virtual Factory.
33	Lau, K. W. (2022) Hong Kong	To explore the possibilities of implementing the process and practices of tacit knowledge transfer in the metaverse and remote workplaces, and to understand employees' experiences of this.	• The use of the metaverse in remote workplaces could revolutionise established models of organisational learning, knowledge management and tacit knowledge transfer. • The findings suggest a modification of the classic SECI model (by Nonaka and Takeuchi) by adding a new "integration" component to the transfer process. • Three key perspectives were explored: acceptance of the metaverse for training, experiences of tacit knowledge transfer through it, and the role of immersion and interactivity.	Metaverse

Source: Own elaboration, 2025.