Sinergie SIMA
Management Conference

# Rediscovering local roots and interactions in management

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## *Long Papers*

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Long Papers

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*Arabella Mocciaro Li Destri, Marta Ugolini,*
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To the reader,

this volume contains the long papers of the Sinergie-SIMA 2023 Management Conference, hosted by the LUM University and University of Bari at Mercure Villa Romanazzi Carducci (Bari) on June 29th and 30th 2023.

Theory and practice in the field of management have been challenged by the emergence of deep transitions such as those driven by globalization, the rise of social and environmental issues, and the diffusion of digital technologies. Events such as the ensuing geopolitical crises and the pandemic further contribute to spur management scholars to feel the call to produce impactful research with theoretical and managerial implications on the relationship between location and strategy (Bathelt and Li, 2022).
As a consequence, scholars and practitioners have been asked to design new business models and rethink value chains in a twofold direction (Mazutis et al., 2021). First, the relevance of local roots sheds light on the way people create and shape places, as much as places shape people and their organizations, suggesting a need to rethink how all lives 'take place' in places, as well as how all business happens in paces (Sternad et al., 2017). Second, a need for new interactions emerges, suggesting that businesses are deeply connected to their roots, that are their homes, from which they draw inspiration, identity, and sources of competitive advantage (Soderstrom and Weber, 2020).
Rediscovering local roots and specific assets, as well as developing new ways of interaction among the economic actors and their stakeholders, can help firms to design effective and innovative strategies to create and share values (Mair et al., 2016), with positive economic, social, and environmental impacts (Attig and Brockman, 2017).
Several research questions stimulate an interdisciplinary debate in the field of management. These questions relate to the ability of firms and managers to move, among the others, between global and local relations, near/physical and far/digital interactions, reshoring and offshoring activities, omnichannel competition and retail interactions, market transactions and system operating structures, traditional and innovative approaches, social/local benefits and financial/global performances, business ethics and ethics in business.
In the same way, different theories, methodological approaches, and units of analysis are required to generate scientific research that has an impact not only in terms of theoretical contribution but also on the real business world.

The Sinergie-SIMA 2023 Management Conference was a great occasion to discuss about the research efforts of our research community on thematic tracks related to the Conference theme (the function of territorial or cultural roots and of operational interactions in management) and the SIMA thematic groups (Entrepreneurship, Innovation & technology management, International business, Marketing, Retailing & Service management, Small & family business, Strategic communication, Strategy & Governance, Supply chain management, logistics & operations, Sustainability, and Tourism and culture management).

The Conference call for papers gave the opportunity to submit either short or long papers. Overall, the editorial staff received 215 short papers and 63 long papers.

For the *short and long papers*, the evaluation followed the peer review process, with a double-blind review performed by two referees - university lecturers, expert about the topic - selected among SIMA and the community of Sinergie members.

In detail, the referees applied the following criteria to evaluate the submissions:
- clarity of the research aims,
- accuracy of the methodological approach,
- contribution in terms of originality/innovativeness,

- theoretical and practical contribution,
- clarity of communication,
- significance of the bibliographical basis.

The *peer review* process resulted in full acceptance or rejection of the submissions. In the case of disagreement among reviewers' evaluations, the decision was taken by the Chairs of the SIMA thematic groups or conference track. Each work was then sent back to the Authors together with the referees' reports. The suggestions received by the referees were used by the Authors during the presentation of their research works at the Conference.

The evaluation process ended with the acceptance of 215 short papers and 62 long papers, which were published in two distinct volumes.

All the long papers published in this volume were presented and discussed during the Conference and published online on the web portal of Sinergie-SIMA Management Conference (**https://www.sijmsima.it/**).

While thanking all the Authors, Chairs and participants, we hope that this volume will contribute to advance knowledge about the rediscovering local roots and interactions in management.

The Conference Chairs

*Angelantonio Russo, Savino Santovito, Arabella Mocciaro Li Destri and Marta Ugolini*

# SUMMARY

# Human Resource Development and Artificial Intelligence in the view of Personal Development: a literature review and bibliometric analysis

FRANCESCO LAVIOLA[*] NICOLA CUCARI[•] HARRY NOVIC[♠]

## Abstract

**Framing of the research.** *The advancement of AI is transforming the way human resources are managed in organizations, introducing new capabilities to Human Resource Management (HRM). Thus, there is a pressing need to examine new and more effective approaches to Human Resource Development (HRD).*

**Purpose of the paper.** *This paper aims to shed light on the current knowledge and contributions of the AI in HRD. In this way, we develop a holistic view of the role of AI in the employee journey.*

**Methodology.** *To achieve our goal, two types of bibliometric analysis was carried out: Keyword Co-occurrence Analysis and Bibliographic Coupling Analysis on a total of 151 publications published between 2002 and 2022. A similarity visualization program (VOSviewer) was used to visually showcase the results.*

**Results.** *Findings highlight the Top 5 Authors, Sources, Papers and Institutions, in terms of the prolificacy of contributions in the field of AI in HRD. The relevant contribution is the identification and classification of main topics and clusters that have been highlighted.*

**Research limitations.** *It should be acknowledged that the findings are rooted in one database, Scopus, and only publications in English were considered.*

**Managerial implications.** *We offer three theoretical and institutional implications for advancing further research on the AI in HRD literature. At the same time, findings from this research may also be of practical interest to companies.*

**Originality of the paper.** *This is one of the first bibliometric studies in the HRD and AI field in the view of Personal Development. Thus, we provide a first systematization of the contributions developed in the last twenty years in this novel field of research.*

**Key words**: *Artificial Intelligence; Human Resource Management; Human Resource Development; Personal Development; Literature Review; Bibliometric Analysis*

[*] PhD Candidate in *Business Management* - Sapienza University of Rome - Italy
e-mail: francesco.laviola@uniroma1.it

[•] Assistant Professor of *Management* - Sapienza University of Rome - Italy
e-mail: nicola.cucari@uniroma1.it

[♠] CEO and Founder - Rocky.ai.
e-mail: harry@rocky.ai

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## 1. Introduction

Human Resource Development (HRD) can be defined "*as a set of systematic and planned activities designed by an organization to provide its members with the opportunities to learn necessary skills to meet current and future job demands*" (Werner and DeSimone, 2011). The two major components of HRD are: i) training and development; ii) organization development (Swanson, 1995). Our research is related to training and development that is the "*process of systematically developing expertise in individuals for the purpose of improving performance*" (Swanson, 1995, p. 218). On this context, Artificial Intelligence (AI) - as computing technologies that simulate or imitate human-like intelligent behavior (Vrontis *et al.*, 2021) - can have an impact on humanity and the workplace. Although the discussion is often related to the percentage of traditional jobs that could be displaced by AI (Jackson and Kanik, 2019; Acemoglu and Restrepo, 2020; Ray and Mookherjee, 2022), it is important also to stress the benefits of AI in HRD, and generally in Human Resource Management (HRM).

Indeed, the advancement of AI is transforming the way how HR is managed in organizations, introducing new capabilities to HRM (Pillai and Sivathanu, 2018). For example, Strohmeier and Piazza (2015) have studied six key scenarios of AI in HRM, including turnover prediction using artificial neural networks, candidate search using knowledge-based search engines, staff rostering using genetic algorithms, HR sentiment analysis using text mining, resume data acquisition using information extraction, and employee self-service using interactive voice response (Strohmeier and Piazza, 2015). According to Makridakis (2017), the AI revolution seeks to replace, augment, and amplify tasks traditionally performed by humans, becoming a formidable rival to human labor. As a result, AI is poised to support all functions of HRM (Sivathanu and Pillai, 2018), playing a role in all stages of the Employee Life Cycle (Lee *et al.*, 2019; Zel and Kongar, 2020), and paving the way for "Smart Human Resources 4.0" (Sivathanu and Pillai, 2018).

Our focus in this research is related to Personal Pevelopment as a practice of HRD and can be understood as "*the employee opportunities to acquire and develop valuable resources in the form of skills, abilities and knowledge*" (Fletcher, 2019, p. 5).

In a rapidly changing economy, companies invest in electronic HR systems that support personal development of employees and thus they change their approach to learning (Lejeune *et al.*, 2021). However, one critical area is the implementation of appropriate learning strategies to employees. AI can help companies to solve these problems, enabling them, for example, to personalize employee career development and training programs (Zel and Congar, 2020), or to nurture their social and soft skills (Nambiar *et al.*, 2017; Aviv *et al.*, 2021).

This paper aims to develop a holistic view of the role of AI in the employee journey, *from cradle to grave*: from the university and the nurturing of student*'*s hard and soft skills to the assessment of the future skills needed to manage AI and extract more value from its use, all the way to the personal and professional development that takes place in firms.

Indeed, the existing research efforts on AI in personal development and HRD are sparse and fragmented. Moreover, the few literature reviews insisting on those themes lack generality: although these efforts provide useful insights into how AI can be used in HRD, they focus either on specific applications or domains. For the former case, Rahimi *et al.* (2021) focus only on virtual working environment applications; Jiang and Akdere (2021) investigate HR Analytics implications for HRD, and Henderikx and Stoffers (2022) focus on leadership and soft skills development. For the latter, Wollny and colleagues (2021) restrict their attention solely on the education sector, while Nosratabadi *et al.* (2022) analyze AI*'*s role only toward employees*'* on-boarding, failing, moreover, to consider several relevant contributions. Finally, the contributions of Kambur and Yildirim (2022) and Sivathanu and Pillai (2018) offer only a glimpse of the capabilities of AI in personal and employee development, not reporting enough practical use cases and more practitioner-oriented implications. None of these studies ultimately make use of bibliometric techniques to help visualize the structure of contributions in the literature, and the linkages between authors, theoretical constructs, and thematic streams.

Therefore, this paper will contribute to the HRD literature in the following ways.

Firstly, there is a pressing need to examine new and more effective approaches to HRD (Whysall *et al.*, 2019). Accordingly, a bibliometric and literature review was conducted by analyzing 151 papers published since 2002 by 2022. Bibliometric analysis tends to be more objective and extensive in scope than other types of reviews (Fan *et al.*, 2022) and enables scholars to identify and provide an overview of the principal trends that have been published.

Secondly, this paper highlights the need for technological investment in Personal Development with reference to either educational and organizational spheres. In analyzing the literature under such lenses, we adopt a cross-contamination perspective that enriches both domains under the umbrella of AI for the Personal Development of the individual, whether student (who will eventually transition into workforce) or employee.

Thirdly, our research was not limited to the superficial and merely statistical analysis found in other studies insisting on similar areas such as (Mishra *et al.*, 2021), but significantly and extensively complemented the software-based bibliometric analysis with the authors*'* analogic reasoned analysis on the every cluster as a whole and in relation with other clusters, and within each cluster on the individual contribution and its linkages with the overarching themes and the other contributions even outside its assigned cluster.

The remaining paper is structured as follows. The following section explores the method and tools used for our research. Subsequently, the bibliometric analysis results are presented. Finally, we discuss and conclude the investigation by indicating the managerial implications, limitations and future avenues of research.

## 2. Methodology

### *2.1 Search Strategy*

The primary data source for this study is Elsevier*'*s Scopus database to identify pertinent and related research, using the following search query:

*(TITLE-ABS-KEY (ai OR "artificial intelligence" OR "intelligent agent*" OR "human-agent interaction*" OR "robot-human interaction*" OR "intelligent automation" OR "machine learning" OR "deep learning" OR "neural network*" OR chatbot* OR "AI coach*" OR "AI tutor*" OR "AI mentor*")*

*AND*

*TITLE-ABS-KEY ("human resource* develop*" OR "human capital develop*" OR "human resource* improv*" OR "human capital improv*" OR "human capital train*"OR "human resource* train*" OR "human resource* coach*" OR "human capital* coach*" OR "hrd" OR "coaching" OR "personal develop*" OR "soft* skill*" OR "general skill*" OR "life* skill*"))*

*AND*
*(PUBYEAR > 1999)*
*AND*
*LANGUAGE(ENGLISH)*
*AND*
*(LIMIT-TO ( DOCTYPE,"cp" )*
*OR LIMIT-TO ( DOCTYPE,"ar" )*
*OR LIMIT-TO ( DOCTYPE,"cr" )*
*OR LIMIT-TO ( DOCTYPE,"ch" ))*
*OR LIMIT-TO ( DOCTYPE,"re" )*
*OR LIMIT-TO ( DOCTYPE,"bk" )*

The selection of search terms was informed by Vrontis *et al.*, (2021) and two sets of keywords were searched in various combinations, using the "advanced search" function.

The first set of keywords consisted of words that belong to or are related to AI, Machine Learning and chatbot domains.

The second set of keywords contained words that are relevant to Human Resource, HRM, coaching and Personal Development domains.

The purpose of having a wide range of keywords was to ensure the collection of literature was as wide and inclusive as possible. For this reason, we consider all the subject area of Scopus and academic works types (article, conference paper, review, book chapter and book).

### *2.2 Literature review relevance funnel*

The search with the above query on the database involved the title, abstract, and keyword (authors keywords + index keywords) fields (Crossan and Apaydin, 2010; Pisani *et al.*, 2017) in order to skim the non-relevant works at the source, which for example cited AI as a buzzword, and at the same time avoid analyzing papers resulting from linguistic ambiguity.

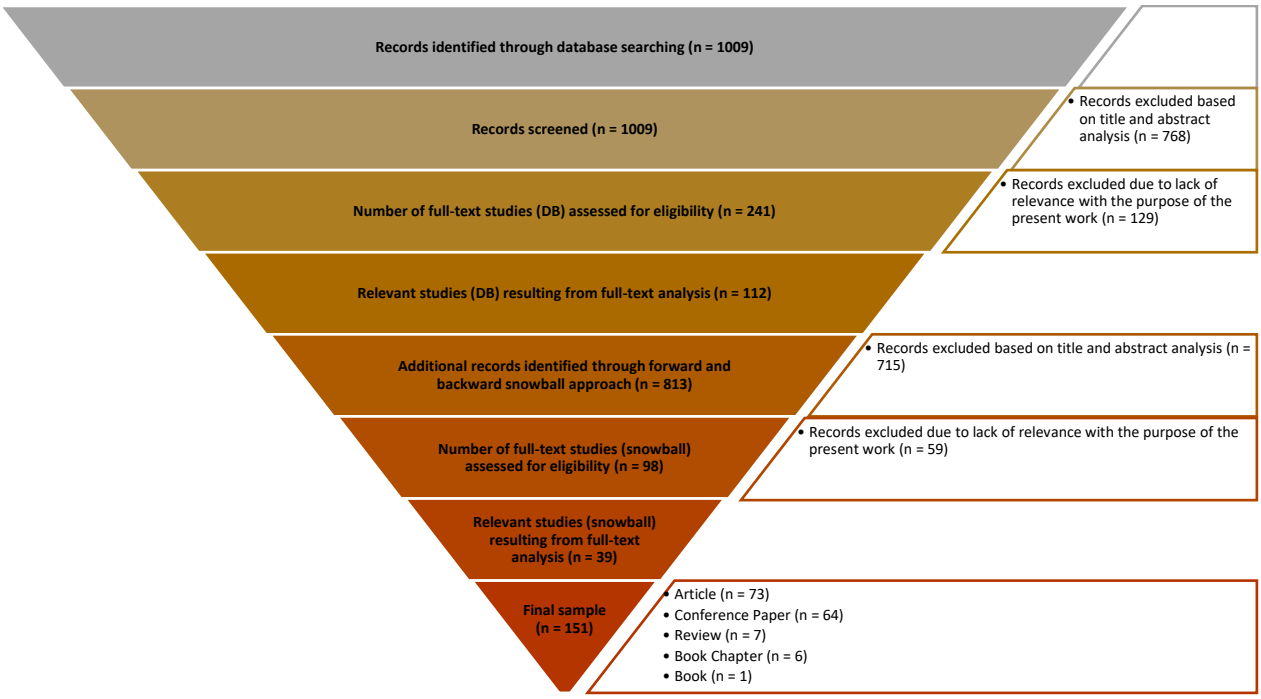
An additional screening effort was undertaken to address semantic ambiguity: for instance, in the fields of medical and environmental sciences, the acronym HRD represents vastly different concepts as compared to HR research, such as Homologous Recombination Deficiency, Hyper Reflective Dots, High-Risk Drinking, High-Resolution Density, and High Recommended Dose. As a result, these works were excluded from the present systematic literature review. This initial selection process was imperative in order to discard works deemed irrelevant and confine the full-text analysis to those that appeared pertinent for our literature review.

Based on the outcome of the first full-text analysis, it was deemed appropriate to expand the scope of exploration through the snowball methodology, utilizing Wohlin (2014) as a reference, and thus following both forward and backward snowball approaches. The corpus of scientific output resulting from the snowball approach was then subject to the same inclusion and exclusion criteria that were applied to the works resulting from the database search.

The first selection was based on the title and abstract, and only those deemed relevant were subjected to full-text analysis.

The flowchart for the dataset acquisition is shown in Fig. 1.

*Fig. 1: Dataset acquisition flowchart.*




Source: our own elaboration using a MS Word dynamic object.

### *2.3 Bibliometric analyses*

The final sample of papers (151) was analyzed using a similarity visualization program (VOSviewer) to visually showcase some of the results. VOSviewer is a professional software designed to visualize intellectual structure (van Eck and Waltman, 2010) and the methods employed are used in the science mapping literature. The analysis and visual representation are of significant importance as they may aid academics and practitioners in comprehending the areas that have been studied in these topics more effectively.

The focal analyses performed using VOSviewer are Keyword Co-occurrence Analysis (KCA) and Bibliographic Coupling Analysis (BCA).

KCA is a preliminary thematic analysis and aims to construct a Keyword Co-occurrence Network (KCN), which has been demonstrated to be useful in exploring the relationship between research topics in various scientific fields. As noted by Radhakrishnan *et al.* (2017), multiple studies "*have demonstrated the practical value and advantages of KCN-based analysis over traditional literature review approaches*" (Radhakrishnan *et al.*, 2017, p. 2). KCA is suitable for preliminary research work which aims to guide future research efforts, by providing "*a knowledge map and insights prior to conducting a rigorous traditional systematic review*" (Radhakrishnan *et al.*, 2017, p. 1). This was accomplished by examining the relationship between keywords (both author and index keywords have been selected), using a full counting method. The threshold for the minimum number of occurrences of a single keyword was set to 2, and two keywords were considered to co-occur if they both appeared in the same title, abstract, or citation context. Furthermore, since the distance between two keywords in a KCN is approximately inversely proportional to their co-occurrence similarity, the clustering function in VOSviewer groups together keywords that frequently co-occur in the publications sample. This allows for a visual representation of the relationships between keywords and an understanding of how they are connected. In other terms, the clustering is based on the similarity (relatedness) of the keywords, with keywords that have a higher rate of co-occurrence being placed closer together (Waltman *et al.*, 2010; Bornmann *et al.*, 2018).

BCA, instead, is designed to analyze the intellectual structure of the subject. First introduced by Kessler (1963), bibliographic coupling seeks to identify links between publications that jointly cite another publication. Kessler proposed that bibliographic coupling can be utilized to indicate which papers should be read by whom (Weinberg, 1974) and has five main characteristics: i) bibliographic coupling is independent of language and words; ii) no expert judgment is required; iii) bibliographic coupling encompasses both the past and future; iv) the method does not produce a static classification for a given paper as the groupings are subject to change based on changes in literature usage; and v) papers that share a unit of coupling with a given paper can be considered its "logical references". In contrast to other techniques such as co-citation analysis, bibliographic coupling is forward-looking, tends to prioritize younger research, and is useful in detecting the connections among research groups. It is also deemed more appropriate for studying emergent literature fields (Liu, 2017). The relatedness of documents in bibliographic coupling is established through the number of shared references. In this method, "N" documents are considered coupled when they possess "n" common references, where "n" is a minimum of 1. The connection between these documents is based on the overlap of their reference lists. The greater the number of shared references between two publications, the stronger the relationship between them.

## 3. Results

### *3.1 General statistics*

The sample in this study consisted of a total of 151 publications by 160 authors affiliated with 160 institutions in 51 countries, which were published in 75 different sources and referred to 2156 cited references (cfr. Tab. 1). Database interrogation results were updated as of December 23, 2022.

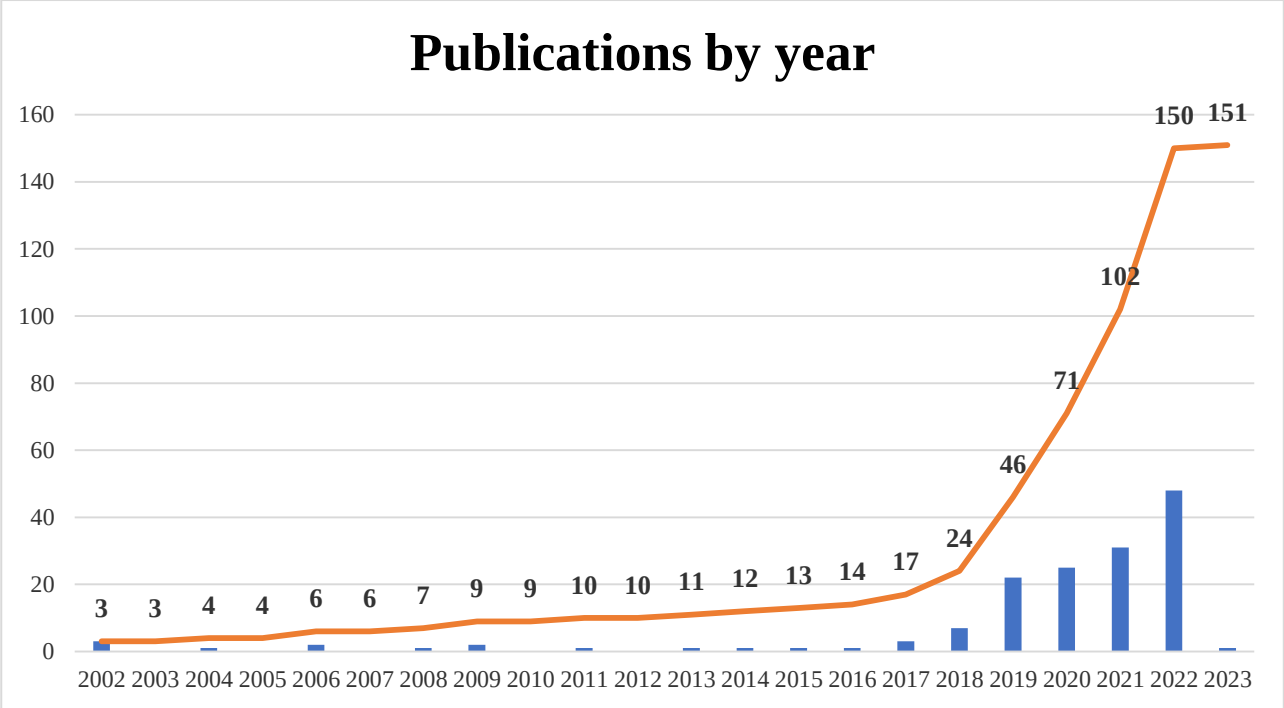
*Tab. 1: Descriptive statistics of resulting publications.*

| | |
|---|---|
| *Publications* | 151 |
| *Authors* | 160 |
| *Sources* | 75 |
| *Institutions* | 160 |
| *Countries* | 51 |
| *Cited references* | 2156 |

Source: our own elaboration on extraction process data.

Fig. 2 shows the distribution of publications in our sample by year, which indicates that the scientific field under observation is still in its infancy. Indeed, the graph shows that publications in three years have more than tripled, from 46 in 2019 to 150 in 2022.

*Fig. 2: Publications distribution in the sample by year.*



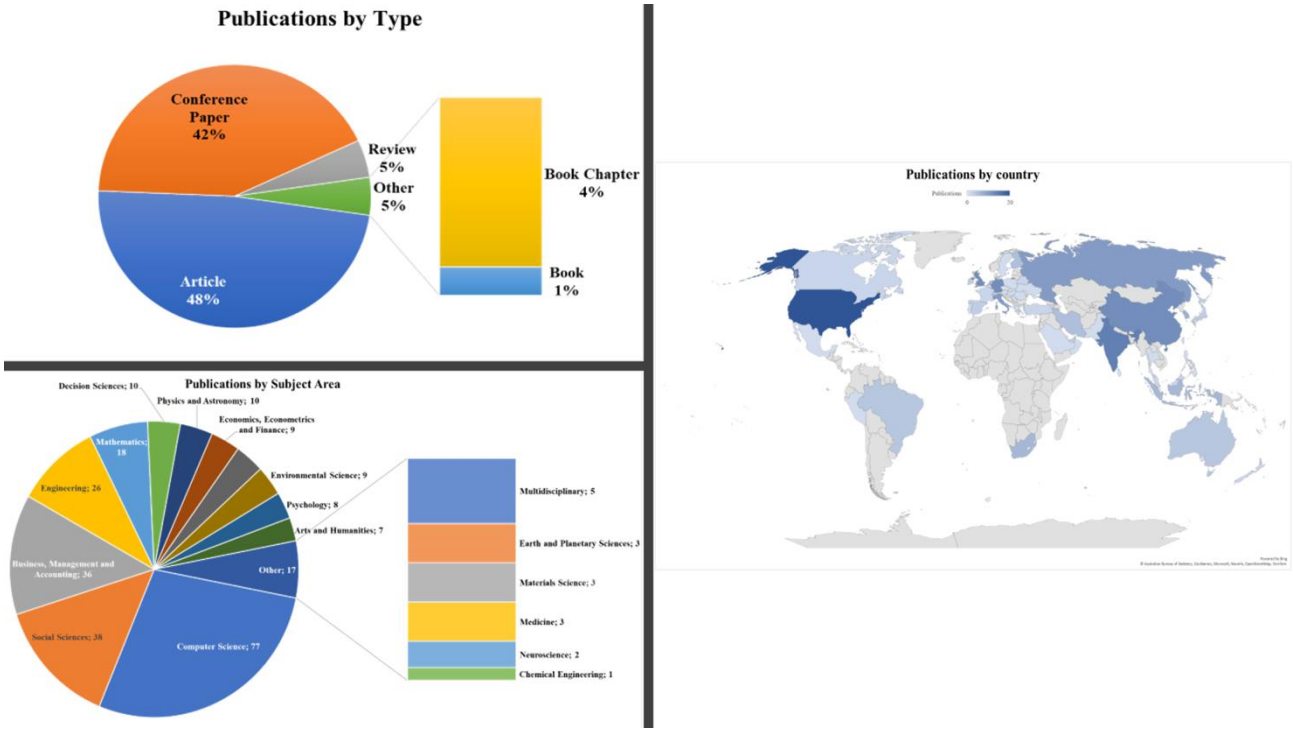

Source: our own elaboration on SCOPUS data.

Fig. 3 shows the distribution of publications by type, subject area, and country.

The extreme novelty of the field under investigation motivates the consistent presence of conference papers in the sample, since conferences offer swifter publishing mechanisms than journals and are more suitable to discuss novel topics and future scenarios among peer scholars. It's worthwhile to note also that the significant diversity of contributions in terms of subject areas (as indexed by SCOPUS) reflects the remarkably cross-cutting nature of AI as a General Purpose Technology (GPT) (Bekar *et al.*, 2017), encompassing even very diverse branches of knowledge.

Analyzing the distribution by country, we can observe the dominance of the United States of America, with 20 papers, followed by India, China, Germany, and the United Kingdom, which are the 4 most prolific countries after the US. However, it is important to note that the interest in the field is globally quite widespread, as our sample is populated by authors from 51 countries around the world (cfr. Tab. 1).

*Fig. 3: Publications distribution by type, subject area and country.*




Source: our own elaboration on SCOPUS data.

Tab. 2, 3, and 4 show respectively most prolific authors, sources, and institutions of the papers taken into consideration in the sample.

The significant presence in the conference paper sample is confirmed, as 3 of the top 5 sources are collections of proceedings. This is undoubtedly due to the aforementioned swifter publishing mechanisms peculiar to conferences, which favor the publication of papers in research streams that are not yet fully established, such as the one investigated.

In general, a fair distribution of scientific production is noted, considering that the Top 5 Authors, Sources, and Institutions, in terms of the prolificacy of contributions, represent in the most significant case (Top 5 Sources) less than 20% of the total sample. This result symbolizes a certain degree of plurality in the scientific landscape insisting on AI in Personal and Human Resource Development processes.

*Tab. 2: most prolific authors (Top 5).*

| **Most prolific Authors (Top 5)** | **Papers** |
|---|---|
| *Terblanche, N.* | 5 |
| *Molyn, J.* | 3 |
| *Graßmann, C.* | 2 |
| *Härting, R.C.* | 2 |
| *Jayagopi, D.B.* | 2 |

Source: our own elaboration on SCOPUS data.

*Tab. 3: most prolific sources (Top 5).*

| Most prolific Sources (Top 5) | Papers |
|---|---|
| *Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics* | 9 |
| *International Journal Of Manpower* | 5 |
| *Journal Of Physics Conference Series* | 5 |
| *Sustainability Switzerland* | 5 |
| *ACM International Conference Proceeding Series* | 4 |

Source: our own elaboration on SCOPUS data.

*Tab. 4: most prolific institutions (Top 5).*

| Most prolific Inst. (Top 5) | Papers |
|---|---|
| *University of Stellenbosch Business School* | 4 |
| *Vrije Universiteit Amsterdam* | 3 |
| *Oxford Brookes University* | 3 |
| *University of Southern California* | 3 |
| *Texas State University* | 3 |

Source: our own elaboration on SCOPUS data.

Tab. 5 shows most cited Sources sorted by number of global citations, and Tab. 6 the most relevant publications in the sample under investigation sorted by normalized citations. It's worthwhile to note that with the exception of that of Sivathanu and Pillai (2018), which is a review paper, the most influential contributions are all recent papers, which in spite of their young age and given the limited scope of the field have already accumulated a significant number of citations. This remark also holds true as further evidence of the vibrancy that has characterized research in this area in recent years.

*Tab. 5: most cited sources (Top 5).*

| Most cited Sources (Top 5) | Citations |
|---|---|
| *IEEE Intelligent Systems* | 870 |
| *Sustainability (Switzerland)* | 199 |
| *Human Resource Management International Digest* | 135 |
| *Proceedings of the National Conference on Artificial Intelligence* | 88 |
| *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* | 75 |

Source: our own elaboration on SCOPUS data.

*Tab. 6: most influential publications sorted by normalized citations (Top 5).*

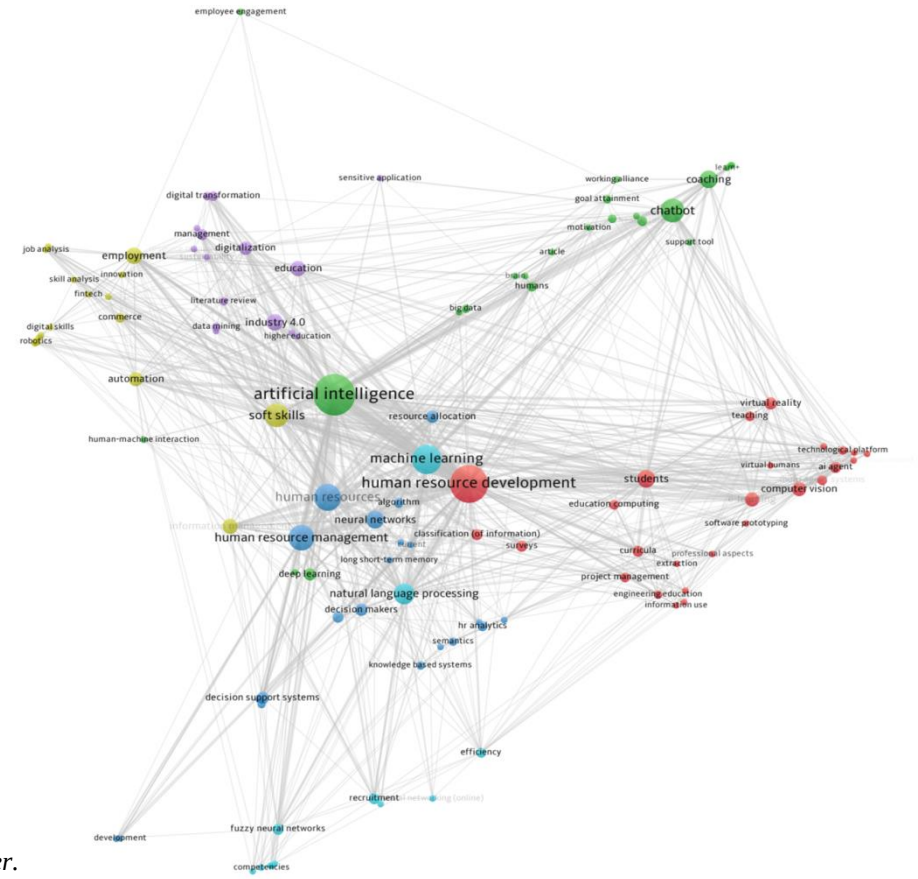
| Most influential Publications by normalized citations (Top 5) | Authors | Year | Journal | Citations | Norm. Cit. | Source Type |
|---|---|---|---|---|---|---|
| *impact of artificial intelligence on employees working in industry 4.0 led organizations* | malik n.; tripathi s.n.; kar a.k.; gupta s. | 2022 | international journal of manpower | 15 | 17.1429 | Article |
| *influences of the industry 4.0 revolution on the human capital development and consumer behavior: a systematic review* | sima v.; gheorghe i.g.; subić j.; nancu d. | 2020 | sustainability (Switzerland) | 126 | 12.9098 | Article |
| *a study of artificial intelligence on employee performance and work engagement: the moderating role of change leadership* | wijayati d.t.; rahman z.; fahrullah a.; rahman m.f.w.; arifah i.d.c.; kautsar a. | 2022 | international journal of manpower | 5 | 5.7143 | Article |
| *smart hr 4.0 – how industry 4.0 is disrupting hr* | sivathanu b.; pillai r. | 2018 | human resource management international digest | 135 | 5.3693 | Review |
| *employees' perceptions of the implementation of robotics, artificial intelligence, and automation (raia) on job satisfaction, job security, and employability* | bhargava a.; bester m.; bolton l. | 2021 | journal of technology in behavioral science | 22 | 4.8028 | Article |

Source: our own elaboration on SCOPUS data.

## *3.2 Keyword Co-occurrence Analysis*

The KCN generated by VOSviewer, with the minimum numerosity of each grouping set to 10, consists of 113 keywords interconnected by 1005 links with a total link strength of 1623. The visualization of the network, as shown in Fig. 4, highlights the presence of six distinct thematic clusters, which exhibit some degree of imbalance in terms of their size, with at the ends of the spectrum Cluster 1, collecting 26 keywords, and Cluster 6, hosting only 12.

*Fig. 4: Keyword Co-occurrence Network.*




*Source: VOSviewer.*

The following tables, 7a through 7f, illustrate the keywords contained in each of the six thematic clusters. The number of occurrences of each keyword within the entire sample of papers is displayed, as well as their average "seniority". The frequency of keyword occurrences provides insight into the dominant themes addressed in the reviewed literature, while the average seniority helps analyze the temporal trends present within each thematic strand.

*Tab. 7a: KCN Cluster 1 (red) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *human resource development* | 1 | 56 | 2018 |
| *students* | 1 | 12 | 2020 |
| *computer vision* | 1 | 8 | 2014 |
| *e-learning* | 1 | 8 | 2013 |
| *virtual reality* | 1 | 6 | 2015 |
| *ai agent* | 1 | 5 | 2007 |
| *classification (of information)* | 1 | 5 | 2020 |
| *curricula* | 1 | 5 | 2020 |
| *surveys* | 1 | 5 | 2020 |
| *education computing* | 1 | 4 | 2020 |
| *multi agent systems* | 1 | 4 | 2004 |
| *project management* | 1 | 4 | 2017 |
| *teaching* | 1 | 4 | 2015 |
| *engineering education* | 1 | 3 | 2020 |
| *technological platform* | 1 | 3 | 2008 |
| *architecture* | 1 | 2 | 2012 |
| *distance learning environment* | 1 | 2 | 2002 |
| *extraction* | 1 | 2 | 2022 |
| *information use* | 1 | 2 | 2019 |
| *intelligent vehicle highway systems* | 1 | 2 | 2009 |
| *learning* | 1 | 2 | 2021 |
| *professional aspects* | 1 | 2 | 2014 |
| *professional competencies* | 1 | 2 | 2020 |
| *software prototyping* | 1 | 2 | 2006 |
| *technological resources* | 1 | 2 | 2002 |
| *virtual humans* | 1 | 2 | 2011 |

Source: our own elaboration on VOSviewer export data.

*Tab. 7b: KCN Cluster 2 (green) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *artificial intelligence* | 2 | 66 | 2019 |
| *chatbot* | 2 | 22 | 2019 |
| *coaching* | 2 | 12 | 2021 |
| *deep learning* | 2 | 6 | 2021 |
| *health care* | 2 | 4 | 2019 |
| *humans* | 2 | 4 | 2022 |
| *big data* | 2 | 3 | 2020 |
| *goal attainment* | 2 | 3 | 2022 |
| *human computer interaction* | 2 | 3 | 2018 |
| *article* | 2 | 2 | 2022 |
| *brain* | 2 | 2 | 2020 |
| *competences* | 2 | 2 | 2021 |
| *digital storage* | 2 | 2 | 2022 |
| *employee engagement* | 2 | 2 | 2021 |
| *human-machine interaction* | 2 | 2 | 2022 |
| *learn+* | 2 | 2 | 2022 |
| *mental health* | 2 | 2 | 2019 |
| *motivation* | 2 | 2 | 2021 |
| *reflection* | 2 | 2 | 2021 |
| *self-disclosure* | 2 | 2 | 2021 |
| *support tool* | 2 | 2 | 2018 |
| *systematic literature review* | 2 | 2 | 2022 |
| *working alliance* | 2 | 2 | 2021 |

Source: our own elaboration on VOSviewer export data.

*Tab. 7c: KCN Cluster 3 (blue) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *human resources* | 3 | 28 | 2020 |
| *human resource management* | 3 | 26 | 2019 |
| *neural networks* | 3 | 12 | 2019 |
| *decision makers* | 3 | 6 | 2017 |
| *decision support systems* | 3 | 6 | 2020 |
| *resource allocation* | 3 | 6 | 2021 |
| *managers* | 3 | 5 | 2019 |
| *algorithm* | 3 | 4 | 2017 |
| *hr analytics* | 3 | 4 | 2021 |
| *employee performance* | 3 | 3 | 2021 |
| *knowledge based systems* | 3 | 3 | 2019 |
| *semantics* | 3 | 3 | 2015 |
| *current* | 3 | 2 | 2021 |
| *development* | 3 | 2 | 2009 |
| *evaluation modeling* | 3 | 2 | 2014 |
| *image analysis* | 3 | 2 | 2020 |
| *long short-term memory* | 3 | 2 | 2020 |
| *ontology* | 3 | 2 | 2012 |
| *organisational* | 3 | 2 | 2021 |
| *simple multiattribute rating technique (smart)* | 3 | 2 | 2019 |
| *software design* | 3 | 2 | 2021 |

Source: our own elaboration on VOSviewer export data.

*Tab. 7d: KCN Cluster 4 (yellow) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *soft skills* | 4 | 22 | 2019 |
| *employment* | 4 | 11 | 2021 |
| *information management* | 4 | 9 | 2020 |
| *automation* | 4 | 8 | 2021 |
| *commerce* | 4 | 4 | 2019 |
| *robotics* | 4 | 3 | 2020 |
| *digital economy* | 4 | 2 | 2021 |
| *digital skills* | 4 | 2 | 2019 |
| *fintech* | 4 | 2 | 2020 |
| *innovation* | 4 | 2 | 2019 |
| *job analysis* | 4 | 2 | 2021 |
| *job satisfaction* | 4 | 2 | 2021 |
| *labor market* | 4 | 2 | 2020 |
| *r&d* | 4 | 2 | 2020 |
| *skill analysis* | 4 | 2 | 2020 |
| *support vector machines* | 4 | 2 | 2021 |

Source: our own elaboration on VOSviewer export data.

*Tab. 7e: KCN Cluster 5 (violet) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *industry 4.0* | 5 | 11 | 2020 |
| *education* | 5 | 9 | 2020 |
| *digitalization* | 5 | 7 | 2021 |
| *management* | 5 | 5 | 2017 |
| *digital transformation* | 5 | 4 | 2021 |
| *data mining* | 5 | 3 | 2019 |
| *leadership* | 5 | 3 | 2021 |
| *literature review* | 5 | 3 | 2021 |
| *case study* | 5 | 2 | 2021 |
| *higher education* | 5 | 2 | 2020 |
| *resource management* | 5 | 2 | 2020 |
| *sensitive application* | 5 | 2 | 2021 |
| *south korea* | 5 | 2 | 2021 |
| *strategic approach* | 5 | 2 | 2021 |
| *sustainability* | 5 | 2 | 2021 |

Source: our own elaboration on VOSviewer export data.

*Tab. 7f: KCN Cluster 6 (light blue) keywords list.*

| Keyword | Cluster | Occurrences | Avg. Year |
|---|---|---|---|
| *machine learning* | 6 | 33 | 2020 |
| *natural language processing* | 6 | 17 | 2021 |
| *fuzzy neural networks* | 6 | 5 | 2016 |
| *recruitment* | 6 | 5 | 2021 |
| *efficiency* | 6 | 4 | 2021 |
| *competencies* | 6 | 2 | 2016 |
| *knowledge management* | 6 | 2 | 2016 |
| *knowledge workers* | 6 | 2 | 2021 |
| *lifelong learning* | 6 | 2 | 2021 |
| *process automation* | 6 | 2 | 2022 |
| *productivity* | 6 | 2 | 2022 |
| *social networking (online)* | 6 | 2 | 2021 |

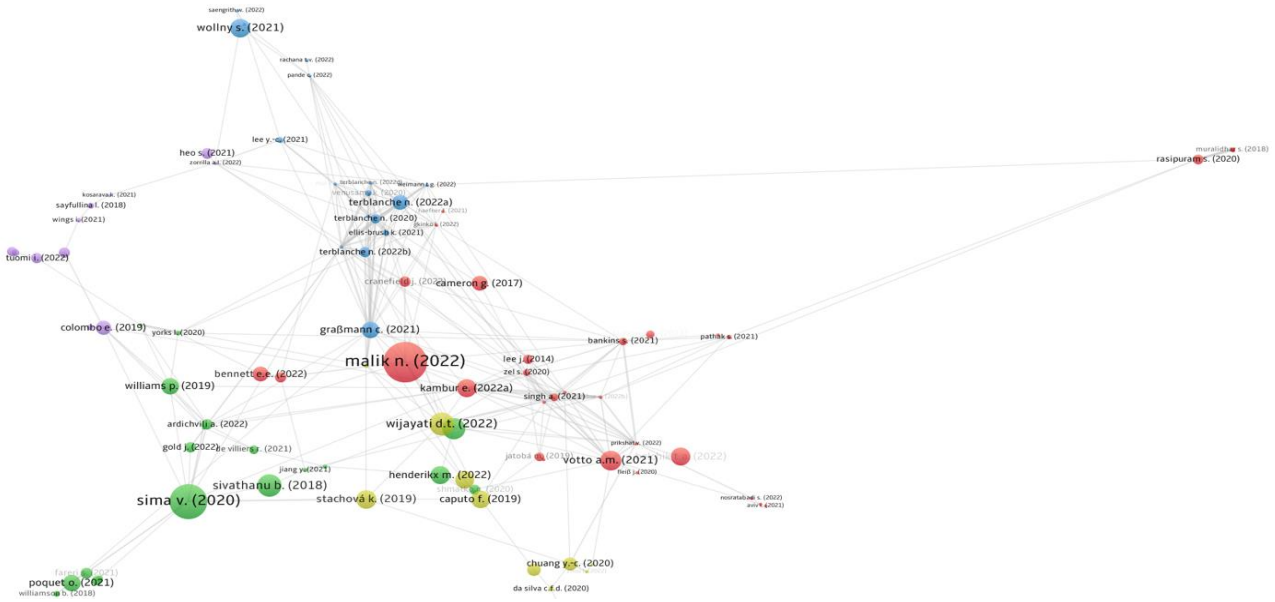
Source: our own elaboration on VOSviewer export data.

### *3.3 Bibliographic Coupling Analysis*

The Bibliographic Coupling Network (BCN) generated by VOSviewer, with the minimum numerosity of each grouping set to 10, consists of 92 (out of 151) papers interconnected by 274 links with a total link strength of 466. The visualization of the network, as shown in Fig. 5, highlights the presence of five distinct bibliographic clusters, which exhibit some degree of imbalance in terms of their size, with at the ends of the spectrum Cluster 1 collecting 31 papers and Cluster 5 hosting only 11. The network nodes have been weighted by normalized citations: in this way the larger ones represent the most relevant contributions also in relation with their "seniority". From a brief visual overview of the network, it is apparent that clusters are mostly well segmented from each other, apart from Cluster 2 and Cluster 4 that present a discrete overlapping in terms of

intercluster proximity, meaning that those neighboring contributions share a fair amount of references with each other, even though they belong to different clusters. Cluster 3, on the other hand, appears incredibly verticalized thematically, and of all the clusters in the BCN presents the highest degree of internal consistency: such an excellent result could be related to the compactness of the reference literature that specifically insists on AI coaching and its recency (in terms of mean publication year), as compared to the other clusters and the full sample of papers. It's worthwhile to note also that intracluster distance is in most cases not exaggerated, hence we can expect a fair amount of coherence between neighboring papers insisting on the same cluster. They are apparent, however, some peripheral sub-clusters which exhibit a large intracluster distance, strikingly represented by (Nambiar *et al.*, 2017; Muralidhar *et al.*, 2018; Rasipuram and Jayagopi, 2020; Nayak *et al.*, 2022) and to a lesser extent by (Wollny *et al.*, 2021; Kuhail *et al.*, 2022; Saengrith *et al.*, 2022) and (Williamson *et al.*, 2018; Fareri *et al.*, 2021; Poquet and de Laat, 2021). From these contributions we can expect less intracluster and furthermore intercluster coherence, since are linked with other contributions by few references. It also cannot be neglected that 59 contributions out of the total 151 populating the sample under review have not been clustered by VOSviewer: this is because they apparently share no reference either with those 92 included in Fig. 5 network nor with each other. This testifies the extreme interdisciplinary nature of scientific research effort on AI, even in a niche such as the one investigated. Likewise, this attests to the extreme vibrancy of the field, given that many of the contributions in the sample rest on unshared and not yet consolidated literature.

*Fig. 5: Bibliographic Coupling Network.*




Source: VOSviewer.

## 4. Discussion

### *4.1 Keyword Co-occurrence Analysis*

Cluster #1-red (*AI in students' skills development*) largely shows topics concerning students and AI systems to support the development of students' skills, including professional skills. The papers that insist on these themes are mostly institutional-oriented in nature. For example Odrekhivskyy *et al.* (2019) propose a novel approach to the building of Intellectual Virtual Learning Environments (IVLE) in the university education system, toward the transformation of the *student learning journey* from a "*teacher-student system into a teacher-IVLE-student system*" (Odrekhivskyy *et al.*, 2019, p. 4). In those systems AI acts as an expert system that supports the learning process and

evaluates its outcomes, with the teacher that assumes a more creative role, making final decisions, and managing the double-ended interaction process. Another interesting example is that of Johnson *et al.* (2019), who propose an intelligent tutoring system fueled by an AI agent that trains and evaluates students' negotiation skills and tactics. The authors show that students interacting with those intelligent agents "*improve in their use of both value-claiming tactics through a combination of practice and personalized feedback*" (Johnson *et al.*, 2019, p. 125).

Cluster #2-green (*AI Coaching with chatbots*) addresses the multifaceted theme of coaching with intelligent systems and agents like AI chatbots, with reference to studies that devote such tools to both students (Mai *et al.*, 2021; Terblanche *et al.*, 2022c), and workers and managers (Graßmann and Schermuly, 2021; Schermuly *et al.*, 2021). The former perspective is represented for example by Mai *et al.* (2021), that by testing the interaction between a chatbot and university students on exam anxiety offer useful insights on how the disclosure by chatbot of information about the topic leads to the increase of interaction, self-disclosure and rapport by the user. The authors conclude also that, in line with other contributions (Justice *et al.*, 2020; Vysotskaya *et al.*, 2020; Yorks *et al.*, 2020), the interaction with a chatbot acting stimulates users' personal reflection, which is seen as a goal in coaching (Kanatouri, 2020). The latter orientation can be usefully synthesized by Graßmann and Schermuly (2021), who offer innovative insights on the use of AI in HRD processes and how it can be used in coaching as a key tool. The authors in fact provide a conceptual systematization of AI coaching, defining it as "*a machine-assisted, systematic process to help clients set professional goals and construct solutions to efficiently achieve them*" (Graßmann and Schermuly, 2021, p. 109). The authors argue that AI coaching systems can learn from large databases of human-to-human coaching processes and become more efficient in helping clients achieve their goals, and they have the advantage of adaptability to the user they interact with. However, the study also points out that it is unlikely that AI will completely replace human coaches and that human coaches are essential in the beginning of the coaching process as AI cannot understand clients' underlying needs and goals.

Cluster #3-blue (*AI and HR analytics*) refers to a small number of contributions proposing the implementation of AI-fueled decision support systems to improve HR allocation, evaluate employee performance and augment HR analytics. An illustration of the application of AI in HR analytics can be seen in the study conducted by Salvetti *et al.* (2022). The authors collaborated with an Italian insurance company to develop a training project that leverages HR analytics and AI. The HR analytics helped to gather valuable information, such as the organizational climate, performance metrics, and key competencies and skills of each employee. This information was used to design a learning and development plan, which was implemented using an online learning platform featuring mixed-reality simulations enabled by virtual reality (VR) and AI technologies. Another example in this vein is that of Solichin and Hana Saputri (2021), who proposed a method to improve HR allocation through the use of Artificial Neural Networks: based on several HR metrics, their system was able to provide recommendations to the managers of an Indonesian manufacturing company regarding the transfer of employees to other branches, thereby enhancing the efficiency and effectiveness of HR decision-making processes. Another study that insists on this issue is from Sihombing and colleagues (2019), who implemented a decision support system to assist HRD managers in the selection of the best employee in a more effective and efficient way, overcoming the limitations of human biases and bounded rationality.

Cluster #4-yellow (*AI and future skills development*) represents the broad themes of soft skills, future skills and employment scenarios in a deeply and more than ever digitized workplace environment and society in general. For example De Villiers (2021) proposed a model that can be used by business schools to ensure that graduates can fully contribute to a society impacted by automation and AI by entering the workplace with the requisite skills: the author identifies seven guiding principles to aid educators in the preparation of accounting students for the changes (and challenges) brought by automation and AI. Another example is that of Rodriguez-Ruiz *et al.* (2021), who implemented Natural Language Processing (NLP) tools based on AI to develop and especially assess students' digital literacy skills. The authors show that the use of the proposed NLP tools in the skills assessment phase helps to "*avoid interpretation biases on the part of the teacher and*

*provoke a perception of trust on the part of the students*" (Rodriguez-Ruiz *et al.*, 2021, p. 7), enhancing the perception of the validity and reliability of those assessment instruments. A further example on these issues is that of Johnson *et al.* (2020), who propose a novel approach, based on Machine Learning (ML) and other digital technologies, to the teaching of software engineering to Computer Science undergraduate students. The authors demonstrate that using this approach enhances students' career readiness, by "improving preparedness in students for computing job interviews" (Johnson *et al.*, 2020, p. 10).

Cluster #5-violet (*Industry 4.0 and contextual factors*) appears to be at the nexus between Cluster 1 and Cluster 4: this should not be surprising, since all literature reviews in the sample (Sivathanu and Pillai 2018; Sima *et al.* 2020; Härting *et al.* 2021; Rahimi *et al.* 2021; Wollny *et al.* 2021; Gkinko and Elbanna 2022; Kuhail *et al.* 2022; Nosratabadi *et al.* 2022) can be traced back to this cluster. This cluster encompasses a mixture of broad themes treated in other clusters, with no contribution, apart from reviews, pertaining exclusively to it.

Cluster #6-light blue (*Fuzzy logics in HR recruitment and training*) refers to a discrete number of contributions in our sample that address the selection and training of human resources with the support of AI systems based on fuzzy logics. For example da Silva *et al.* (2020) leverage Fuzzy Sets Theory to analyze HR data of two companies in the electric sector in Brazil: their model was able to understand the main aspects that must be improved to develop human capital in a more reliable way, by reducing the subjectivity due to human evaluation. Since human capital stands as "*one of the main factors of competitive advantage*" (da Silva *et al.* 2020, p. 5) of companies, this study fuels the belief that the implementation of AI systems in those HR processes effectively yields a competitive advantage. Another technical contribution to this topic is that of Maddumage *et al.* (2019), who proposed an intelligent recruitment system based on NLP techniques supported by a fuzzy inference system. In particular, their system demonstrated effectiveness in resolving ambiguous scenarios where human evaluators face difficulty in making decisions, such as when two candidates receive the same score. The implementation of fuzzy logics in such situations helps to clarify and make a final decision. Similar results are those presented by Fachrizal *et al.* (2019), whose e-recruitment system is made to speed up the recruitment process and support HR decisions, and by Michalopoulos *et al.* (2022), with the quantification and prediction of employees' skills and productivity that provides granular metrics for each employee enabling a more effective employee ranking process. An additional contribution is that made by Zhou and colleagues (2022), as their method is not limited to the evaluation of candidates' performance, but also provides constructive criticism or suggestions for employees in professional and personal improvement, pushing the AI intervention toward an actual HRD.

### *4.2 Bibliographic Coupling Analysis*

Cluster #1-red (*AI in HR and contextual factors*) is the most crowded of the five and appears as a large scientific cauldron populated with loosely coupled papers. Although they all deal with the themes of AI in HR in the context of Fourth Industrial Revolution (4IR), there are contributions (Jatobá *et al.*, 2019; Mishra *et al.*, 2021; Pathak and Solanki, 2021; Singh and Shaurya, 2021; Votto *et al.*, 2021; Kambur and Yildirim, 2022; Nosratabadi, *et al.* 2022; Xin *et al.*, 2022) that address those themes with a broad perspective on all HR processes encompassing all phases of the employee lifecycle. For the purposes of the present paper, it is useful to highlight, for instance, the result by Votto and colleagues (2021), who state that AI has the potential to make HR processes more efficient in organizations by providing customized training recommendations based on employee strengths, interests, and potential for success. Digital training assistant, like AI-based chatbots, can store experienced employees' best practices and monitor performance; they do not possess, however, the in-depth knowledge that experienced workers have and are therefore unable to completely replace HR trainers. In addition, by utilizing AI-based virtual reality simulations for mandatory employee training, companies can improve participation, boost efficiency, and lower costs of training initiatives. These AI-enhanced training tools should be used to supplement

employee development, with human input providing a personalized touch to the employee's on-boarding process. Organizations can therefore create smarter learning platforms to improve performance and cultivate talented, innovative and diverse employees; in this scenario, AI tools must be designed and geared to interact with employees and foster their growth within the company.

Other contributions (Nambiar *et al.*, 2017; Muralidhar *et al.*, 2018; Rasipuram and Jayagopi, 2020; Aviv *et al.*, 2021) focus on AI-based soft skills assessment and training in the workplace. These works mainly highlight the benefits for job candidates and employees deriving from the interaction AI-based virtual agents, which enable them to receive automatic and personalized feedback to improve their social and soft skills. Several other studies (Rahimi *et al.*, 2021; Bennett and McWhorter, 2022) further elaborate on the implications of AI in virtual training of employees, by studying the transformation of virtual workplace environments and digital employee experience related to AI. For example, digital automation frees up HR teams' time, allowing them to focus on building stronger relationships with employees, managers, and job candidates to better meet their needs (Zel and Kongar, 2020).

Cluster #2-green (*AI in education and future skills*) insists on the influence of new technologies on personal development in an educational perspective, and the implications in terms of skills needed for the workplace of the future. In this vein, Sima *et al.* (2020) state that the 4IR exerts a significant influence on human capital development, changing the way work and employment are conducted and the required skills of employees. The rise of automation and robotization is leading to job loss in repetitive, routine sectors, mainly affecting lower-educated workers. As a result, workers need to acquire new skills to cope with the transformations in production processes and attain greater job satisfaction and security (Bhargava *et al.*, 2021). Digitalization is affecting the entire economic and social environment, requiring a new set of skills for emerging types of work and impacting higher education. Labor markets are experiencing a lack of ICT professionals, with a shortage in the advanced manufacturing sector where big data and cybersecurity skills are needed. To cope with these changes, the authors recommend a combined effort from government, schools and universities, trainers, and companies, in order to adapt curricula and increase IT skills and innovation skills of the workforce. 4IR requires education systems that focus on knowledge beyond what is currently taught and stimulates creativity from an early age (Sivathanu and Pillai, 2018). The educational point of view toward 4IR is also pursued by Williams (2019), who stresses for instance the importance for universities to leverage AI-enabled learning analytics, to preemptively identify students at risk of failure and tailor tutoring initiatives for them. Poquet and de Laat (2021) then address the topic of learning analytics from the broader perspective of lifelong learning, stressing the opportunity to shift the purpose of learning from human capital to human development, with the focus on capabilities, envisioning "*AI-based technologies as a partner in cognition*" (Poquet and de Laat 2021, p. 1703).

Cluster #3-blue (*AI Coaching with chatbots*) appears incredibly verticalized, thematically speaking, on coaching implemented with AI-based chatbots and presents the highest degree of internal consistency. The contributions in this cluster also appear to be the most coherent and functional for the purposes of this paper. This cluster, indeed, exhibits a dual soul, which in a holistic review paper on AI, encompassing the entire employee journey *from cradle to grave*, is worth emphasizing: although the majority of contributions envision AI coaching in workplace scenarios, some influential papers, like for example that of Wollny *et al.* (2021), decline it in the educational context, shaping it in the form of AI tutoring and mentoring. According to Wollny *et al.* (2021), indeed, the primary objectives for the implementation of AI-based chatbots in the education sector can be summarized into four categories: i) Skill Improvement; ii) Efficiency of Education; iii) Enhancement of Student Motivation; and iv) Availability of Education. They identify also three different pedagogical roles assignable to AI chatbot in education: Learning, Assisting and Mentoring. Chatbots can in fact support learning in various ways, such as through integration into the curriculum as a learning aid or through additional offerings outside of the classroom. One example of this is a chatbot simulating a virtual pen pal that helps students practice language skills.

Chatbots can also assist students by simplifying their daily tasks, such as providing information or automating processes. Additionally, chatbots can serve as mentors to students, focusing on their Personal Development and encouraging reflection and assessment of their progress. Other contributions in Cluster 3 related to the educational domain (Mai *et al.*, 2021; Kuhail *et al.*, 2022; Terblanche *et al.,* 2022c) are quite consistent in results with (Wollny *et al.* 2021), producing pretty similar categorizations and taxonomies for AI tutors and mentors in terms of objectives and roles. Kuhail and colleagues (2022) however, highlight several limitations of these systems that are worth noting: inadequate dataset training, lack of user-centered design, losing interest over time, lack of feedback, and distractions.

Shifting the focus from the educational to the workplace and professional context, the research by Graßmann and Schermuly (2021) is by far the most prominent, representative and influential paper in Cluster 3. The authors present a pioneering examination of the utilization of AI in HRD and its potential as a crucial tool for coaching. They formulate a systematic framework for AI coaching, characterizing it as a "*a machine-assisted, systematic process to help clients set professional goals and construct solutions to efficiently achieve them*" (Graßmann and Schermuly, 2021, p. 109). The authors contend that AI coaching systems have the capability to acquire knowledge from extensive databases of human-to-human coaching sessions and, as a result, become more proficient in helping clients attain their objectives. The authors assert that AI coaching has the potential to effectively assist users in navigating various stages of the coaching journey and building strong working alliances. Additionally, these systems can adapt to the unique needs of each user. Nonetheless, the study highlights that complete substitution of human coaches by AI is improbable and human coaches play a vital role in the initial stages of the coaching process as AI is not yet fully capable of comprehending the underlying needs and goals of users, if implicit or not communicated clearly by them. According to the authors, the use of AI in coaching holds the promise of revolutionizing the coaching industry, presenting a cost-effective solution that can reach a wider range of users. As a result, AI coaching has the potential to become a valuable tool in the field of HRD (Terblanche, 2020), democratizing coaching processes in an effective and efficient way, like confirmed also by Terblanche *et al.* (2022a). Three are the factors that influence adoption of AI coaching chatbots: performance expectancy, facilitating conditions, and social influence (Terblanche and Kidd, 2022). In addition, the use of chatbots as coaches provides an added benefit of anonymous interaction, particularly in situations where sensitive information may be disclosed (Terblanche, 2020).

Further optimistic results on AI coaching performance and efficacy are those of Terblanche *et al.* (2022b): the study involved a comparison between human coaches and an AI chatbot coach. The results showed that both types of coaches were effective in helping users reach their goals, and the AI coach was as effective as human coaches by the end of the trials. This discovery has significant implications, as it suggests that AI coaching could scale coaching services and potentially grow demand for human coaches, while also potentially replacing human coaches with simplistic, model-based methods. At present, however, like stated also in Graßmann and Schermuly (2021), AI lacks empathy and emotional intelligence, which render human coaches not completely replaceable.

Finally, Ellis-Brush (2021) exhibits less enthusiastic results with respect to those in Graßmann and Schermuly (2021), since he found that although an AI agent can deliver positive outcomes through a conversational coaching process (e.g., with an improvement in self-resilience), a working alliance between the coachee and the AI coach has not been developed.

Cluster #4-yellow (*AI in HR recruitment and training*) exhibits a strong overlap with Cluster 2. Stachová *et al.* (2019) for example draw similar conclusions to those of Sima *et al.* (2020) from the analysis of the challenges and trends of personal development and education in the 4IR scenario. Indeed, the authors confirm the view that "*Industry 4.0, and in particular automation that interferes with multiple processes and professions, gradually changes employee education and skills requirements*" (Stachová *et al.* 2019, p. 13). This idea is also supported by Caputo *et al.*, (2019), with regard to firms*'* investments in Big Data and by Wijayati *et al.* (2022), with regard to AI in workplace.

Perhaps the most relevant contribution in Cluster 4 from a managerial perspective is that of Maity (2019), who proposed a model to identify future trends of AI in HR training and development processes. According to the author, the use of AI in knowledge management and employee training and development is becoming increasingly important for organizations. To stay competitive, companies need robust knowledge management practices that are easily accessible to all employees. AI is also playing a crucial role in shifting training and development from classroom-based programs to personalized, intuitive, and adaptive mobile learning experiences. AI has the potential to identify individual learner characteristics and design training programs tailored to those characteristics, which is crucial for meeting the current need for individualized training programs. From a technical point of view, instead, this cluster hosts different contributions to solve the issues of personnel selection and competence improvement (Chuang *et al.*, 2020; da Silva *et al.*, 2020; Michalopoulos *et al.*, 2022; Zhou *et al.*, 2022), to propose to employees alternative training scenarios (Kantola *et al.*, 2011) and to evaluate the success of training initiatives (Kalinouskaya, 2022).

Cluster #5-violet (*AI in soft skills development*) is in a sense complementary to Cluster 2, as most contributions deal with AI and the assessment and development of soft skills in the context of 4IR also, but not exclusively, in the field of education. Indeed, these papers appear to be more market-oriented and anchored to the organizational reality of companies. Colombo *et al.* (2019), for example, found that soft and digital skills tend to moderate the job displacement effects of automation technologies even in highly automatable sectors, complementing the use of machines and software, and "*making the job less substitutable*" (Colombo *et al.* 2019, p. 35). Of an entirely different nature is the work by Sayfullina *et al.* (2018), who propose several approaches based on a Neural Networks model to match soft skills required by job postings and those present in candidates*'* CVs. Their proposal offers an effective solution for firms looking to automate the initial phase of candidate evaluation, as the model can effectively disambiguate the soft skills matching process and reduce false positives significantly. This work provides an innovative solution for HR departments looking to streamline their recruitment process and make more informed decisions based on the skills and characteristics of potential candidates. Likewise, the work by Wings *et al.* (2021) presents a practitioner-oriented nature, and is aimed at the automatic classification and extraction of hard and especially soft skills from candidates*'* CVs. It starts from the same technical assumptions but achieves a broader purpose instead the study of Chang *et al.* (2022), who, leveraging NLP and ML techniques, develop a skills extraction algorithm that can be used to analyze student skills, university course syllabi, and online job postings. By analyzing different data sources, the authors provide an initial landscape of skill needs for specific job titles and conduct a within-sector analysis based on programming jobs, computer science curriculum, and undergraduate students. They find that students have a range of hard and soft skills, but they may not be the ones desired by employers. Additionally, they observe a discrepancy between the skills taught in university courses and those in demand by industry, with a lack of emphasis on soft skills. These findings highlight the importance of aligning university curriculums with the needs of industry to ensure that students are well-prepared for their future careers (Kosarava, 2021). In line of the development of more practitioner-oriented AI tools and models stand the contributions by Pasikowska *et al.* (2013) and Schutt *et al.* (2017), who propose chatbots and virtual environments enriched by AI techniques directed respectively to patients with mental health issues and health professionals in training.

## 5. Conclusion

The implication of the integration of AI into the domain of Personal and Human Resource Development are manifold, and the shifting to the new HR 4.0 paradigm presents both opportunities and challenges for organizations and society as a whole. Following the guidelines by Donthu *et al.*, (2021), we carried out a bibliometric analysis to identify the structure of topics of AI in HRD field.

The structure includes a range of topics that cluster into six main groups: AI in students' skills development; AI Coaching with chatbots; AI and HR analytics; AI and future skills development; Industry 4.0 and contextual factors; Fuzzy logics in HR recruitment and training.

Thus, AI has the capability to optimize various HRM processes, such as recruitment, performance evaluation and employee training, by enabling HR professionals to make more data-driven and impartial decisions and provide valuable insights into employees' behavior and preferences. Despite its potential advantages, the adoption of AI in HRM must be approached with caution, considering factors such as data privacy, potential biases in algorithms, and ethical implications of the replacement of human workers with AI systems. Thus, a balanced and well-informed evaluation of the benefits and limitations of AI implementation in HRM is crucial to ensure its responsible and ethical deployment.

### *5.1 Theoretical and institutional implications*

Based on the findings, we offer three theoretical and institutional implications for advancing further research on the AI in HRD literature.

First, our findings enable researchers to understand the scope of research in this domain and how these domains can be evaluated by a cross-fertilization perspective. Researchers may use our results to explain the adoption of AI in HRD using other literature such as that from the educational domain.

Second, our findings provide researchers with critical information on prestigious and influential articles that may be seen as the foundations of this research field. More in details, new gaps to fill are related to: i) education policy and how these factors can influence social, economic, and educational outcomes; ii) labor dynamics regarding to the investigation of the mechanisms of adoption, acceptance, and trust in the educational and employment contexts; and iii) the identification of the key components that should be included in the initial conversation to build trust between the client and the chatbot coach.

Third, our findings highlight ethical issues about the impact of AI on society-wide social sorting and the potential amplification of discrimination and negative effects in the workplace. The impacts of AI adoption include information security, data privacy, drastic changes resulting from digital transformations and job risk and insecurity. Technostress creators among employees include work overload, job insecurity and complexity (Malik *et al.*, 2021). Consequently, a new ethical framework is needed to guide the application of AI in HRD area. Thus, this study calls for the focus of policy makers and professionals engaged in the legal and information technology domains to examine these factors.

### *5.2 Practical implications*

This study's findings may also be of practical interest to companies. Based on the results, we offer three practical implications for managers to facilitate the implementation and adoption of AI in HRD.

First, practitioners may utilize our research to understand the broad scope of AI's applicability in HRM processes and operations across diverse sectors and managerial domains (Lee *et al.*, 2021; Schermuly *et al.*, 2021).

Second, these practitioners may apply the findings of prestigious studies to discuss the design choices and trade-offs that may address major hindrances in AI's implementation in HRD. For example, further investigation is required to determine the optimal balance between human-like features and transparency about limitations. Factors that need consideration are: i) personality type of the user; ii) the level of humanness and anthropomorphic behavior displayed by the chatbot; iii) the appropriate use of user input and predefined options; iv) the setting of realistic expectations through the initial conversation; and v) the role of various other factors in technology adoption (e.g., trust).

Third, the findings imply the need to practically investigate the role of university to adopt AI in the educational programs to facilitate students' transition to workforce.

### 5.3 *Limitations*

The present review shows some limitations that should be considered.

Firstly, the scope of the study was limited to articles published in the Scopus database, which is one of the largest sources of published articles but may still exclude relevant studies that were published in other databases such as Web of Science or Google Scholar.

Secondly, the preliminary search was also limited to scientific documents written in English and excluded other languages. This may reduce the generalizability of the results and future research in this field may consider including other languages to provide a more comprehensive understanding of the field.

Thirdly, 39% of the full sample of papers was not included by VOSviewer in BCN network depicted in Fig. 5. Because of this, and limited to the analysis of the BCA results, this paper may have provided a partial view of the landscape of the literature concerned with AI in Personal and Human Resource Development. In this regard, however, it is important to mention the safeguard mechanisms put in place by the authors: first of all, the BCA is greatly strengthened by the preliminary thematic analysis (KCA), based on the keywords of the entire sample of papers (including those with missing full text and those not included in the BCN, which provided broad overarching themes that were largely reflected and confirmed by the analysis of BCA results. Secondary to this, but not least, a manual cross-check of the contributions not included in the BCN was carried out to make sure that no contribution relevant to the emerging scientific debate was missed.

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