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Research article

STAFF COMPETENCIES FOR DIGITAL TRANSFORMATION: RESULTS OF BIBLIOMETRIC ANALYSIS

Zanda Gobniece, and Jelena Titko

Abstract. The impact of digital transformation on the future of the working environment is one of the hot topics on the agenda both at the micro- (business) and macro- (national economy) levels. Digitalization and automatization of business processes are treated by many employees as a potential threat to their jobs. The digital skills gap is one of the main barriers to the successful implementation of digital strategies in many companies. Thus, the upskilling of the staff is one of the urgent needs and, simultaneously, issues (due to the staff resistance) in the path towards successful digital transformation. The goal of the article is to gain a deeper understanding of the intensity and scope of research in the field of personnel training in the context of digital transformation on a global and Latvian scale. The article provides the results of the bibliometric analysis, based on 2109 papers published in 2000-2023 in the sources indexed by SCOPUS. Visualization was made by the application of VOSviewer tools. The analysis yielded five clusters that combine 177 terms – namely, "Digital transformation and technologies", "Human resources and innovation", "Education and learning", "Higher education and the Pandemic", and "Information technologies and competencies". Besides, the authors analysed the content of 41 defended doctoral dissertations by Ph.D. students of Latvian Universities in 2012-2023. As a result of the examination, it became evident that the practical solutions put forth are largely disconnected from the focus of this research. This, in turn, indicates the need for an in-depth investigation of the above-mentioned concepts, namely - productivity, motivation, and mitigating resistance in the context of business digital transformation.

Keywords: employees' skills; competencies; technologies; digital transformation.

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1. Introduction

The digital-transformation-related issues are frequently debated in the academic and business literature [1-7]. Various aspects have been investigated in the context of different industries and business fields, such as higher education, the creative industry, the retail sector, manufacturing, marketing, transportation, supply chain management, and others [8-14].

One of the prerequisites for successful digital transformation in business is staff competencies and engagement [15-16]. One of the key takeaways from the 2022 webinar "Digital upskilling, reskilling & finding talent: The role of SME ecosystems", which gathered participants from 44 OECD and non-OECD countries, was that "Lack of skills is one of the greatest barriers for SMEs' digital transformation" [17]. Besides, successful digital transformation requires "motivated employee involvement" [18]. An increasing number of academicians and practitioners are inclined to believe that human factors are more important than technology itself [19-21].

The incentive for the current research is substantiated by the goals of a big-scale study that is planned to be done by Latvian researchers in the field of staff management issues (specifically, re-skilling and up-skilling) in the context of digital transformation. There are several papers devoted to digital transformation issues published by Latvian authors [22-26]. However, the authors were not able to find any paper focusing on staff skills and human resource management regarding digitalization. This fact proves the necessity to conduct an in-depth study to find out valuable sources for our future research.

The goal of the current research is to gain a deeper understanding of the intensity and scope of research in the field of personnel training in the context of digital transformation on a global and Latvian scale. To achieve the established goal, the research activities were performed in two main directions: 1) bibliometric analysis of the related concepts, and 2) analysis of the doctoral dissertations defended in Latvian Universities in 2012-2023. The data for the bibliometric analysis was extracted from the SCOPUS database for 2000-2023 and processed by VOSviewer software.

A bibliometric analysis, as the main research method, is widely used among scholars for exploring such concepts as personnel competencies, technology, and digital transformation separately [27-35]. In contrast, this study stands out with uniqueness, as it combines these crucial concepts within a single analysis, providing an opportunity to gain a holistic view of these aspects and offering a comprehensive understanding of how these concepts interact with each other. Additionally, this research specifically focuses on the Latvian scale, providing insight into how intensively these issues are explored in the Latvian academic environment. The findings indicate that, at the Latvian level, researchers pay minimal attention to exploring these issues, highlighting a research niche and emphasizing the need to expand research in the field of personnel competence and digital transformation in the context of Latvia.

The paper is structured, as follows. Literature review chapters are devoted to a brief overview of labour market trends and challenges in the digital transformation process related to the lack of skills and low motivation. The methodology part describes the main stages of the data selection process. Results summarize the main findings of the given study, specifically, the

confirmation of the fact that the topics related to staff competencies in the context of digital transformation are not the focus of researchers in the Baltics, and also Eastern Europe as a whole. We use a broad understanding of "Eastern Europe", based on the information about the members of the East European Countries' Committee (EECC) [36].

2. Literature Review

2.1. Contemporary Labour Market Development Trends

The European Union (hereafter EU), including Latvia, is undergoing demographic changes. Forecasts of Eurostat statistical data show that by 2100 the European population will have decreased by 6 %, which is equivalent to 27.3 million people [37]. Another significant trend is the increase in the average age of the population, with more than one-fifth of EU citizens now being 65 years of age or older. Eurostat data and forecasts up to the year 2100 show that this trend of an aging society will continue and intensify. European populations are aging and there will be an increase in the proportion of older adults, while the group of children and young people up to the age of 20 will decrease. Consequently, they will not be able to fully compensate for the increase in the portion of residents aged 65 and older. These trends are associated with long life expectancy, low mortality, and low birth rates [38].

These changes present challenges for society and policymakers. Eurostat's published forecasts on EU/EEA population changes indicate that between 2022 and 2100, the population will decrease in 15 EU member states and Latvia will experience the most rapid population decline (-37.8%) [39]. Forecasts by the Latvian Ministry of Economics until 2030 indicate a decrease in available labour resources and this trend is related to the reduction in the number of working-age population and the aging of the current workforce. The number of people aged between 15 and 64 could decrease by more than 7% by 2030, affecting the labour supply [40].

Goh et al. conducted study, confirms that demographic factors, especially the age structure of the population, are closely related to a country's economic performance such as domestic savings, real GDP, inflation, domestic investments, fiscal balance, and current account balance [41]. The study also indicates a correlation between changes in the population's age structure and several macroeconomic indicators, indicating a close and long-term interplay between these elements, but results of the study conducted by the authors [42] show a close relationship between the decline in population growth and the use of automation.

2.2. Technology as a solution for the future labour market

Robots and automation have emerged as key productivity-boosting instruments in countries with increasingly aging populations. This is evidenced by the increasing use of robots and the radiating increase in their sales, especially in developed countries. Robotization has changed the labour market, increasing the demand for skilled workers while decreasing the demand for physical, manual, and routine jobs [43].

The results of the econometric analysis reveal that the development of business depends to a large extent on the expansion of the implementation of digital technologies, which in turn confirms that digitization and the innovative approach of companies are strategically crucial business management tools that can increase the company's competitiveness and increase its

economic efficiency [44]. According to a World Economic Forum study, technology adoption will remain a key driver of corporate transformation over the next five years, more than 85% of companies confirm that they will increase the use of new, advanced technologies in business and that they will contribute to the expansion of digital access [45]. According to the World Economic Forum's 2023 report, by 2025, the global labour market will undergo structural changes. 69 million new jobs will be created, while 83 million jobs will be lost at the same time, this represents a net loss of 14 million jobs or 2% of current employment levels. It is also anticipated that by 2027, 42% of business tasks will be automated. This advancement implies that technology will replace work that is currently performed manually, making processes more efficient. In this context, the necessity for reskilling is highlighted, which might impact over 1.1 billion jobs by 2025 [46].

The Covid-19 pandemic accelerated the development of new technologies and digitalization in business, companies had to adapt quickly to remote work on a massive scale. This whole situation fast-tracked digital transformation and process automation like never before. The speed of digital adoption has made the "job of the future" evolve more rapidly than initially anticipated [47]. Many professions, including those currently held by people with higher education (bachelor's degree holders), will be automated by 2030. As technology and robotics become less expensive than labour, their accessibility will surely increase. In response to rising wages and living standards, China is encouraging businesses to replace human labour with robots. For example, the company Foxconn, which employs 1.2 million people, is presently investing in robots, which have the potential to affect human well-being and survival in the future [48]. PwC analysts calculated that technology might contribute to up to 14% of global GDP by 2030 [49]. To be effective and support long-term economic progress, technological developments require qualified and prepared labour, as without them automation will not foster development [50].

Future workplaces will be accessible to those employees who have sufficient skills and knowledge about new technologies, are ready to learn with a focus on lifelong education, can adapt to changes, and collaborate with technologies. Nowadays, attention is increasingly focused on the collaboration between people and technology. More and more often, tasks performed by employees are designed not only to replace human work but to enhance and complement it [51].

2.3. Challenges of Implementing Technology

Employees' digital skills are crucial for business growth and competitiveness, particularly for business leaders who want to fully leverage digital technologies [52]. According to research [53], humans play an important role in the digitization and technological revolution. Assessing and detecting skill gaps is critical for the effective deployment of new technology, particularly among manufacturing workers. This lack of awareness affects the capacity to identify areas where personnel need to be upskilled or retrained. Global events and the continuous progress of Industry 4.0 technologies are consequences that contribute to expanding the range of skills. This means that individuals need to develop not only technical and digital skills but also the ability to use technology practically, wisely, responsibly, and sustainably [54].

The international company Salesforce has published the latest data of the global digital skills index, based on surveys of 23,000 employees in 19 countries. According to the results of the study, a high portion of respondents believe they are not fully prepared in terms of digital skills to meet company requirements. Furthermore, 73% of respondents do not consider learning digital skills a priority. Although 82% of those surveyed plan to develop their digital skills over the next five years, currently only 28% are participating in digital acquisition programs [55].

Companies in the ERT (European Round Table for Industry) member countries have analysed more than 200 retraining projects and identified labour market imperfections that affect the quality and efficiency of retraining. To overcome these issues, improvements are needed in business culture, cooperation between educational institutions and businesses, addressing market imperfections, adapting skill offerings to industry needs, promoting, and monitoring individual retraining, as well as providing financial resources. These measures are essential to improving skill development and ensuring successful retraining in Europe [56].

In its report, the European Commission emphasizes that more than 90% of all professions in the European Union require basic digital knowledge and other skills. About 42% of workers in the European Union lack such basic digital knowledge and skills [57]. The Digital Economy and Society Index (DESI) for 2022 concluded that only 54% of Europeans aged 16 to 74 have acquired digital skills. In the case of Latvia, this indicator in the acquisition of digital skills is 51%, thus lagging behind the average indicators of the entire European Union. It is recommended to significantly promote and invest more in the development of digital education and digital skills [58].

According to Brusbarde B., an economist at the Bank of Latvia, several factors affect the involvement of Latvian residents in improving digital skills. She points to the low participation in adult lifelong learning initiatives and the low investments by entrepreneurs in professional training. In contrast, EU-funded training initiatives tend to focus more on the quantity of participants rather than on skill development. The situation will improve if adult participation in lifelong learning initiatives is promoted and entrepreneurs invest more in the professional training of their employees, thereby improving the skills of the workforce simultaneously [59].

The analysis of labour market dynamics in recent years indicates a growing imbalance between the supply and demand of skills. This phenomenon is fuelled by the widespread use of the internet and social media, closely linked to the global digitization of the economy and work environment [60].

A lack of understanding of the benefits of learning is the main reason why adults have low motivation to devote time to training and lifelong learning, according to OECD survey data. Only 7% of adults participate in training that is useful in their field of work. In addition, only 2% of respondents indicate that training will reduce the risk of losing a job. Meanwhile, in another survey, 24% of respondents expressed their belief that lifelong learning is not necessary for them, 18% stated that it is not possible to attend studies due to work, 14% of respondents believe that studying is too expensive, and 9% think that the learning opportunities are adversely affected by family conditions [61]. Lifelong learning is essential to reduce the skills gap and promote their development. While in other EU countries, the population's involvement in lifelong learning can be assessed as quite high, in Latvia these indicators are below the EU

average. Eurostat data show that in 2021, the EU average rate of population participation in lifelong learning reached 11%, while in Latvia it was within 9% [62]. To improve productivity and promote digitalization, Latvian business owners, especially small and medium-sized enterprises, need to invest in digitalization processes, concludes the OECD study "Going Digital in Latvia 2020". It is also recommended that there be provisions for support and financial incentives to facilitate the advancement of digital technologies [63].

The year 2023 has been designated as the European Year of Skills. The aim of the European Commission in the future is to encourage and ensure that at least 80% of European adults acquire basic digital skills through promotion activities. This is just one part of the overall target, which envisages a much wider effort to boost digital skills levels and employment across the European Union [64].

3. Methods

We carried out a detailed analysis of the research conducted by other Latvian researchers, the selection of works was based on selected keywords, which are characteristics of the topic of the sphere of our interests concerning the impact of technology on the development of the workforce, their competences and the efficiency of work performance. Keywords were grouped into three main blocks: employees, skills, and technologies. To cover our area of interest as widely as possible, the selected keywords were expanded with more frequently used synonyms. In total, 68 keywords were defined in both Latvian and English, the keywords used in the study are listed (Table 1), focused only on terms used in English.

Table 1. Groups of the keywords

Field 1: Employees	**Field 2: Skills**	**Field 3: Technologies**
Employee	Competencies	Automation
Employment	Digital skills training	Digitalization
Human	Knowledge	Digital transformation
Human resources	Learning	Development
Labour	Qualification improvement	Innovation
Personnel	Reskilling	Innovative work
Professionals	Skills	Machines
Staff	Training	Technology
Team	Upgrading	Technological progress
Workforce	Upskilling	Tech
Workers		

Source: developed by the authors.

Table 2 summarizes the stages of manual analysis for a doctoral dissertation published in Latvia from 2012 to August 2023. The selection of works utilized the centralized database "Kopkatalogs" and the "Primo" resource search tool of the National Library of Latvia, which effectively identified relevant studies. The research mainly focused on the keywords "employees," "technologies," and "skills," expanded with synonyms to ensure a broader perspective of the study. In this context, "employees" were interpreted as any organizational workforce, "technologies" as any digital or mechanical tools and systems used in work, and "skills" as specific knowledge, or abilities required for job performance.

Table 2. Stages of manual analysis of doctoral theses published in Latvia (2012 – August 2023)

	Stage	Filters	Result
1	Database used	National Library of Latvia's Union Catalogue and Primo	
2	Identification and definition of keywords	Main Keywords: Employees, Technologies, Skills; Expanded with Synonyms for Broad Coverage	68 keywords
3	Identification of search field in the database	Doctoral theses	At least one defined keyword in the doctoral thesis title
4	Time interval	2012-2023 August	49 doctoral theses
5	Selected scientific field for search in the database	Subfields of Social Sciences – Economics, Business Administration, Business Management	41 doctoral theses
6	Language	English, Latvian	41 doctoral theses
7	Defence Location	Latvia	41 doctoral theses

Source: developed by the authors.

The analysis included those doctoral dissertations whose titles contained at least one of the defined keywords, selecting works from subfields of social sciences such as economics, business, and business management. The time frame was from 2012 to August 2023, with only the latest works considered, ensuring that the data are current and reflect the present research landscape. The works were selected in both Latvian and English, in line with the specifics of Latvian doctoral research and considering the primary use of these two languages in Latvia. The analysis included only doctoral dissertations defended in Latvia, to discover what other researchers in Latvia have already studied and to identify the research connection with the themes of interest to the study's author. As a result, 41 doctoral dissertations were selected [65-105]. Within the framework of this article, to achieve one of the set goals and gain a deeper understanding of the research problem, a bibliometric analysis was conducted using the Scopus database as the primary source of data. The Scopus database is widely recognized as one of the most extensive databases in scientific literature, providing a broad range of peer-reviewed publications, summaries, and citations across various scientific fields [106]. The scientific literature was selected using the following selection criteria strategy (Table 3).

Table 3. Stages of the bibliometric analysis

	Stage	Filters	Result
1	Database used	Scopus	
2	Tools used for analysis	VOSviewer 1.6.19; Microsoft Excel	Science mapping, charts
3	Identification of search field in the database	Article title, Abstract, Keywords	
4	Search query	Employees OR staff OR "human resource*" AND skill* OR competenc* OR reskilling OR upskilling AND digitali*ation OR technolog* OR automatization OR "digital transformation"	14203 publications
5	Time interval	2000-2023	13120 publications
6	Subject area	Social science, Business, Management and Accounting, Economics, Econometrics and Finance, Decision Sciences	3443 publications
7	Language	English	3215 publications
8	Type of the documents	Journal articles only; conference papers, books, and chapters of books excluded	2109 publications
9	Manual check	Analysing the paper in the context of its importance	2109 publications

Source: developed by the authors.

The search criteria included article titles, abstracts, and keywords with the query "employees OR staff OR "human resource*" AND skill* OR competence* OR reskilling OR upskilling AND digitalization OR technolog* OR automatization or "digital transformation*." Data selection was conducted for the period from 2000 to 2023, with the year 2000 chosen as the starting point for analysis, marking the onset of the 21st century characterized by significant technological and social changes, that substantially impact the research field. The analysis included only journal articles, excluding conference theses, books, and book chapters, focusing on social science, business, management and accounting, economics, econometrics and finance, and decision sciences. Data analysis employed VOSviewer 1.6.19 and Microsoft Excel, which facilitated data mapping, visualization, and chart creation.

4. Results and Discussion

Figure 1 shows the distributions of scientific publications by sector, which reveals that in such science sectors as social sciences (18%), engineering (14%), computer science (14%), energy (14%), and business management (12%), occupies a dominant in terms of the volume of scientific publications.

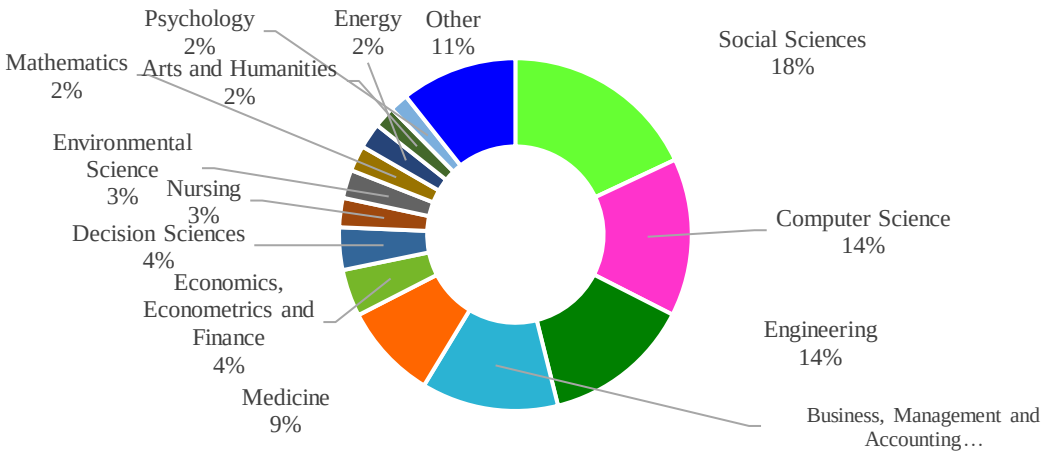

Figure 1. Distribution of scientific publications by sectors selected using keywords related to employees, skills, and technologies, indexed by the database Scopus
Source: developed by the authors.

Figure 2 shows the dynamics of the number of scientific publications and their citations from 2000 to 2023 in the selected field. The study identified a total of 2109 publications. The findings demonstrate a rise in the number of publications with an average annual growth rate of 14%. This indicates a growing interest in research within this field. Over the period there has been an increase of nearly thirteenfold in total publications with a particularly notable surge occurring in 2017, which could be associated with digital transformation, as well as increased investment in innovative technologies such as artificial intelligence, data analytics, and cloud computing. Conversely, the increase in the number of publications in 2022 can be explained by the surge in research demand caused by the COVID-19 pandemic, remote work, digital education, and economic adaptation to changes, etc. Considering the formula 1, the polynomial growth trend in recent years indicates significant growth in research.

$$y = 0.5987x^2 - 7.2332x + 56.055, \quad R^2 = 0.9155 \qquad (1)$$

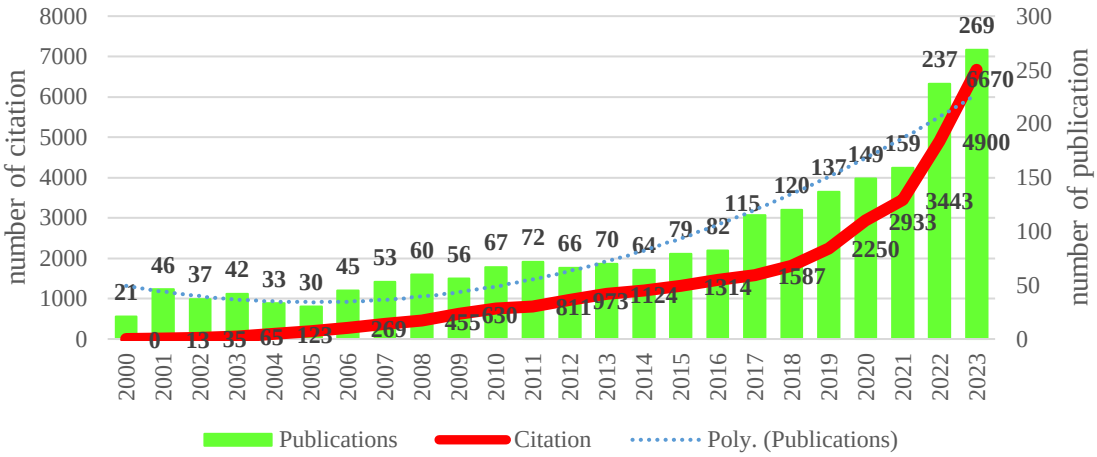

Figure 2. Dynamics of scientific publications 2000-2023 selected using keywords related to employees, skills, and technologies, indexed by the database Scopus
Source: developed by the authors.

The highest citation index of 6670 and the largest number of citations per publication (25 citations per publication) was achieved in 2023. The overall H-index is 77, indicating high citation frequency and impact in the respective field. Meanwhile, publications from 2003, 2005, and 2012 are the TOP 3 most cited. These include Ritter & Germüded [107] a publication on the topic – Network Competence: Its Impact on Innovation Success and its antecedents, with a total citation count of 568. The article analyses how a company's network competence – the ability to form and use technological relationships between different organizations – fosters product and process development. The study involved 308 German mechanical and electrical engineering companies and focuses on four factors influencing this competence and identifies differences in resources and competencies.

Clarysse et al. [108] published an article on the topic – Spinning out new ventures: A typology of incubation strategies from European research institutions, with a total citation count of 508. In this article, the authors analyse various business incubation strategies used by European research institutions to create new companies, examining their goals, resources, and activities. Additionally, the authors of the article identify differences in resources and competencies related to finance, organization, human resources, technology, and infrastructure. Meanwhile, Guthrie et al. [109] published an article titled – Reflections and Projections: A Decade of Intellectual Accounting Research, with a total of 493 citations. The authors explore the field of Intellectual Capital Accounting Research (ICAR), analysing its development trends over the last decade, identifying the main tendencies in this scientific area, and potential future research directions. Figure 3 illustrates the distribution of the 10 most published scientific articles by countries, compared with the number published in Latvia, in the selected field from 2000 to 2023. The data indicate significant differences in academic contributions among counties in the chosen area. The United States (389 publications, 18% of the total volume) and the United Kingdom (240 publications, 11% of the total volume) stand out as the leading countries in terms of the number of scientific articles published. In comparison, Latvia, with only 2 publications

in this period, shows considerably less research activity, which may indicate differences in resources or priorities in academic research.

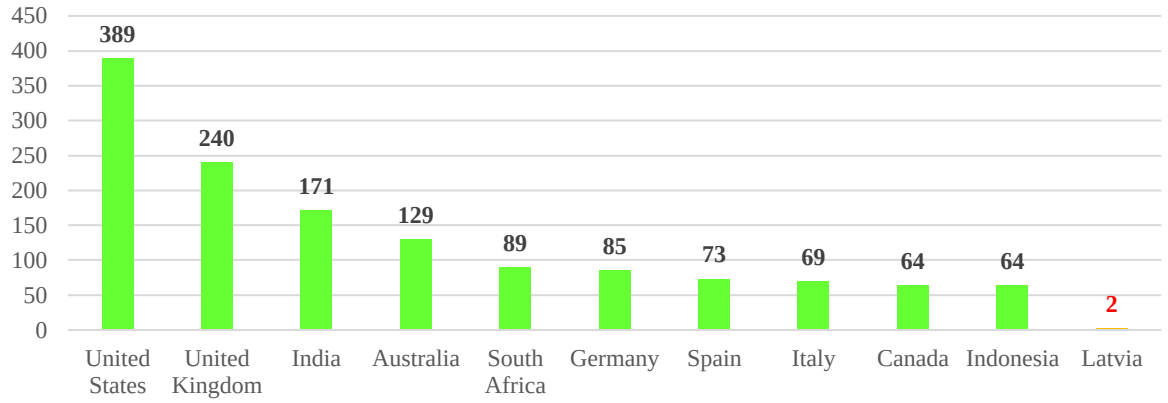

Figure 3. Publications within countries, indexed by the database Scopus (Top 10 and Latvia)
Source: developed by the authors.

Figure 4 reflects the results of the same procedure, but focuses on the countries representing the East European Countries' Committee (EECC) [36] and, additionally, the United States and the UK.

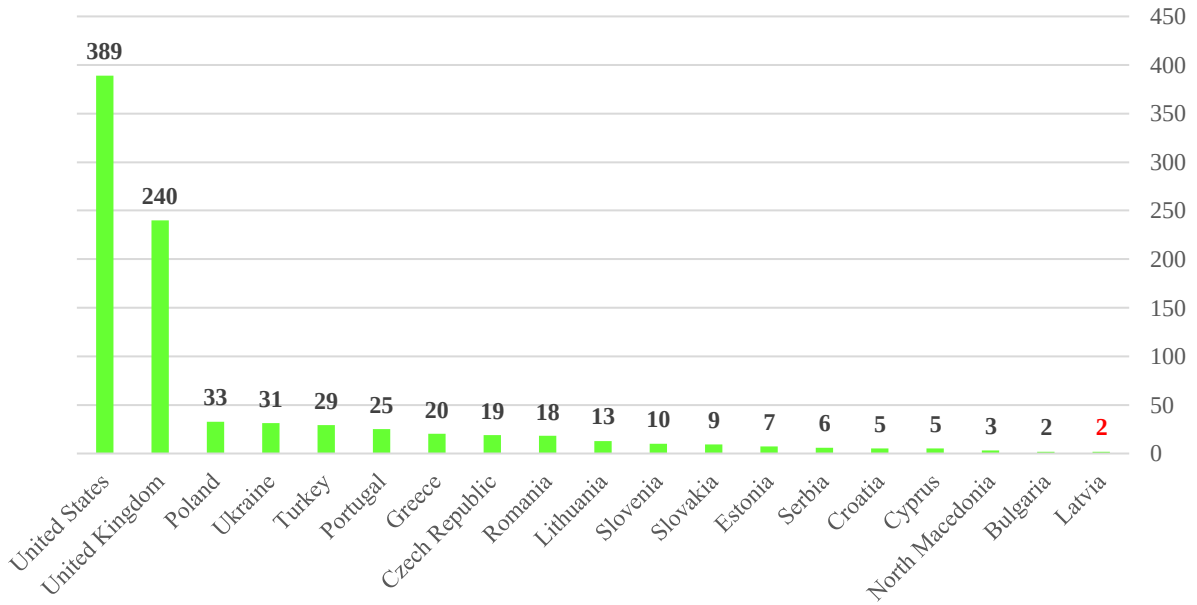

Figure 4. Publications within countries, indexed by the database Scopus (EECC, USA, UK)
Source: developed by the authors.

The purpose of this iteration was the intention to highlight the sharp difference between the productivity of researchers from the USA and UK versus Eastern Europe, specifically, Latvia. We cannot ignore the size of the country, but it is not the only factor affecting the intensity of research activity. The populations of the UK, Poland, and Turkey do not differ widely – 67, 40, and 86 million, respectively. In turn, the number of publications in the UK is substantially larger.

In the next stage of the study, data visualization was performed to create a bibliometric network map using VOSviewer 1.6.19, based on data selected from the Scopus database. During the visualization process, a Co-occurrence analysis was initially conducted, which allows the visualization of how various keywords appear together in publication titles or abstracts, helping to uncover frequently encountered themes and concepts. From the 6923 keywords obtained from Scopus, setting a Co-occurrence minimum threshold of 7 repetitions, 226 keywords were selected. To ensure data accuracy and relevance to the research theme, careful data cleaning was performed, during which keywords with identical meanings were merged. Keywords related to countries, medicine, and research methods were excluded, resulting in a retained set of 177 keywords. These keywords were divided into five clusters. Table 4 reflects the distribution of keyword clusters and lists the five keywords with the highest co-occurrence in each cluster and their link strength.

Table 4. Distribution of Top 5 keywords related to employees, skills, and technologies across clusters and their occurrences in Scopus from 2000 to 2023

Clusters	Clusters label	TOP5 Keywords	Occurrences	Links	Total link strength
1	Digital transformation and technologies	digitalization	104	89	199
		technology	90	92	187
		employment	61	83	214
		fourth industrial revolution	45	43	98
		skilled labour	34	50	112
2	Human resources and innovation	human resource management	159	118	347
		innovation	101	100	258
		competence	81	83	146
		human capital	49	59	111
		knowledge management	43	64	115
3	Education and learning	education	70	90	277
		human	64	73	398
		learning	51	78	207
		leadership	48	71	158
		teaching and learning	38	65	167
4	Higher education and the Pandemic	higher education	68	69	138
		covid-19 pandemic	57	61	115
		e-learning	38	61	114
		student	38	66	136
		academic libraries	33	33	48
5	Information technologies and competencies	information technology	91	102	239
		skills	80	98	264
		training	64	67	128
		communication technologies	24	28	39
		job satisfaction	21	32	34

Source: developed by the authors.

The co-occurrence analysis revealed that “human resource management” appeared 159 times, making it the most frequently used keyword. “Digitalization” and “innovation” were in second and third place with 104 and 101 occurrences, respectively. These are the central keywords, indicating their frequent association with other keywords.

Figure 5 displays the visualization of the keyword co-occurrence network, where 177 keywords from five clusters.

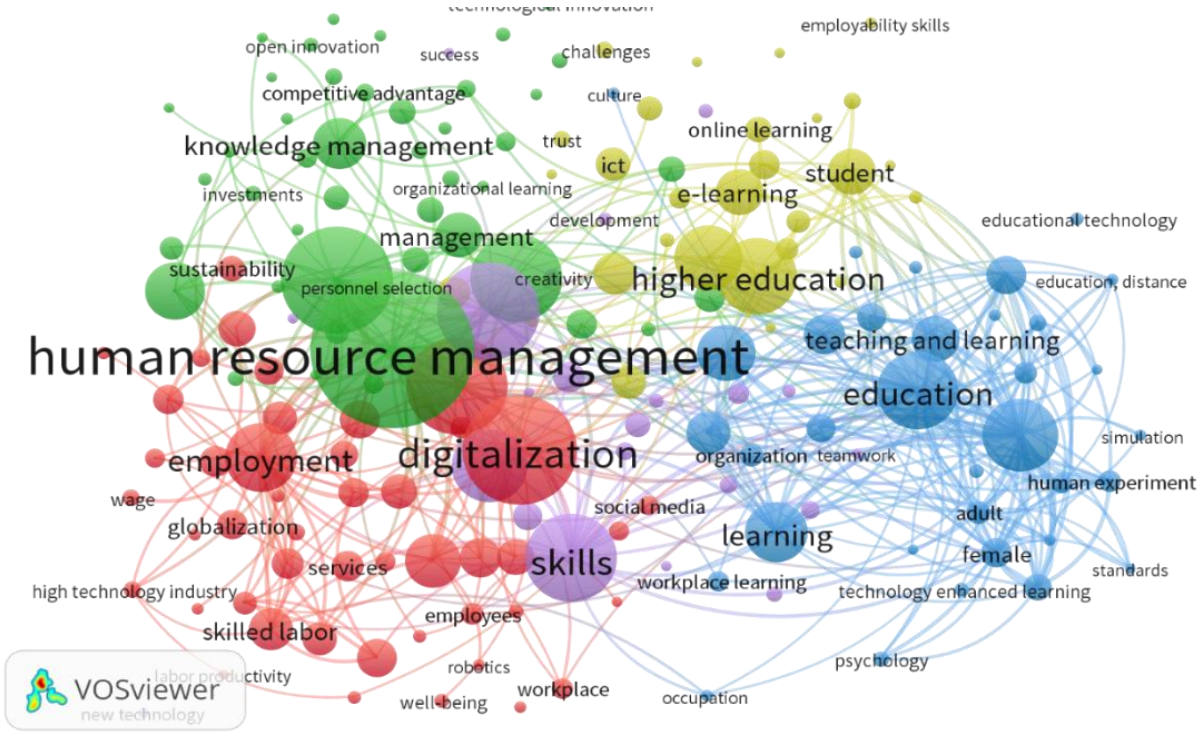

Figure 5. The results of co-occurrence analysis – Network visualization
Source: developed by the authors (based on the Scopus database using VOSviewer).

The first cluster (red), "Digital transformation and technologies," is the strongest cluster with 48 keywords, focusing on digitalization, technology development, the labour market, the impact of technology on the labour market, and workforce demands. The second cluster (green), "Human resources and innovation," includes 44 keywords, focusing on human resource management, innovation, competence, human capital, and knowledge management. This demonstrates an interest in the effective management of human resources and their utilization for fostering innovation in organizations. The third cluster (blue), "Education and learning," contains 34 keywords, covering themes of education, human development, learning processes, management, and teaching methodologies, emphasizing the importance of education, and learning in human development and management skills. The fourth cluster (yellow), "Higher education and the COVID-19," with 28 keywords, combines, e-learning, student experience, and academic libraries, revealing the pandemic's impact on the education system and the student learning experience. The fifth cluster (purple), "Information technologies and competencies," with 23 keywords, focuses on information technologies, skills, training, communication technologies, and job satisfaction, indicating interest in the use of technology and skill development in the workplace.

The visualization reveals the multidimensionality of the research area, covering aspects from education to production and the digital transformation of companies, indicating the broad impact and significance of the theme across various sectors. This could mean that the theme has a wide-reaching impact and importance in multiple industries.

Figure 6 illustrates a network visualization map of research trends and changes in researchers' interests over time from 2000 to 2023. The colours used in the visualization symbolize different periods, showing the focus of researchers'' interests in specific themes during certain periods. The development of the research is visualized with nodes and links coloured from blue to yellow, indicating changes over time.

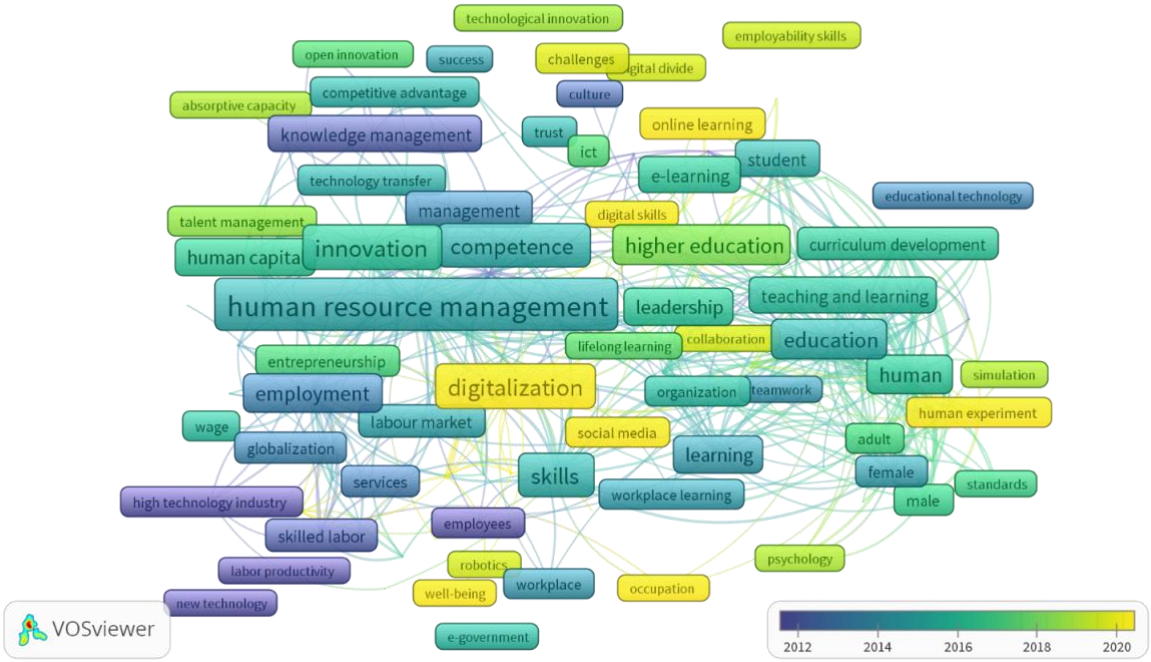

Figure 6. The results of co-occurrence analysis Overlay visualization map of changing trends published in 2000-2023
Source: developed by the authors (based on the Scopus database using VOSviewer).

Approximately from 2012 to 2018, researchers' interest predominantly focused on themes related to human resource management, innovation, human capital, competence, and technology. In contrast, over the past five years, researchers' attention has been centred on topics such as the fourth industrial revolution. Digital skills, digital competence, digitalization, well-being, occupation, automation, sustainability, online learning, and readiness for these changes. The heightened interest in these areas can be explained by several factors: rapid technological development, especially in digitalization and automation, which changes the ways we work and learn, global economic and labour market changes that require new skills and work approaches, sustainability issues becoming a priority for both businesses and society as a whole, and the COVID-19 pandemic promoting a shift to online learning, thereby creating a need to investigate online learning processes and readiness for digital changes in education.
As for the analysis of doctoral dissertations, the authors focused mainly on the goal, novelty elements, and main findings. This stage was essential to identify studies of similar content and to assess the potential and novelty of the proposed field. Research outcomes were linked to the keywords summarized in Table 1 and assigned to the fields "Skills" and "Technologies". The compilation is presented in Table 5.

Table 5. Results of the doctoral dissertations analysis

Author	FS	FT	Author	FS	FT
Popovs (2023)	-	✓	Minder (2016)	-	-
Hager (2022)	-	-	Popova (2016)	-	-
Skadina (2022)	-	-	Sander (2016)	-	-
Gribanova (2021)	-	-	Willutzky (2016)	-	-
Lauck (2021)	-	-	Bolzern-Konrad (2016)	-	-
Bole (2020)	-	-	Brenninger (2015)	-	-
Ergle (2020)	-	-	Staita (2015)	✓	-
Kenzhin (2020)	-	-	Petersone (2015)	-	-
Apsalone (2020)	✓	-	Buligina (2015)	✓	-
Teltz (2020)	-	✓	Tarvids (2015)	-	-
Donina (2020)	✓	-	Egger (2015)	-	-
Arhipova (2020)	-	-	Landzmane (2014)	✓	-
Schreder (2019)	-	-	Dubra (2014)	-	-
Eisenberg (2019)	-	-	Lukjanska (2014)	-	-
Gaile (2019)	✓	-	Berke-Berga (2013)	-	-
Veipa (2018)	✓	-	Vanags (2013)	-	-
Straujuma (2018)	-	-	Kulberga (2013)	✓	-
Starineca (2017)	-	-	Giesa (2013)	-	-
Ozolina-Ozola (2017)	-	-	Zasova (2012)	-	-
Jesilevska (2017)	-	-	Cirulis (2012)	✓	✓
Judrups (2017)	✓	✓			

Note: FS – field skills, FT – field technologies.
Source: developed by the authors.

The study's analysis and categorization of doctoral theses revealed that most of the selected works do not directly focus on specific fields like "Skills" and "Technologies" within a single research framework. The researched theses primarily concentrate on fields such as human resource management and organizational development, paying attention to the human factor and internal organizational processes, rather than technological or skill development aspects. Of the 41 analysed doctoral these, eight focus on the "Skills" field, two on "Technologies," but only two combine both "Skills" and "Technologies" aspects. For instance, Cirulis [105] focused on developing e-training systems using VR/AR technologies, while Judrups [85] developed a theoretical model to enhance learning effectiveness by applying this model in educational environments. The main conclusions from this final stage are that studies conducted by Latvian researchers do not emphasize technology factors, analysing staff skills and competencies development.

5. Conclusions

Within the scope of the study, this research project was based on two separate studies. As an initial step, there was performed a bibliometric analysis of 1209 journal articles selected from the Scopus database. In the next stage, there were analysed 41 doctoral theses defended in Latvia in the period from 2012 to August 2023. The main goal of this study was to get a deeper understanding of research intensity and scope in the context of staff training and digital transformation on a global and Latvian scale, as well as to identify the main research trends and their development. This type of analysis made it possible to understand the research activity in

the chosen field, identify research patterns, and gain an understanding of its development trends and possible future directions of research in the scientific environment of Latvia.

The Co-occurrence analysis data shows that terms like “reskilling” and “upskilling” which are currently hot topics in the field of the workforce and the future labour market right now are not frequently used in academic publications. This conclusion may suggest that this topic is not receiving enough attention, particularly in the context of digital transformation and staff development, however there it is also possible that these concepts are still relatively new or that researchers are more frequently using other alternative keywords to describe these trends.

Analysing the Co-occurrent analysis results, we uncover a frequent and close link between the keyword “Technology” and the field of education, showing the relevance of education in skill development. Our attention was also drawn to keywords such as “readiness,” “well-being,” and “psychology”. While these terms were included in the visualization they are not linked to other words, indicating that these areas have not been properly studied. However, based on the bibliometric analysis data, we predict that the number of scientific publications in the field of the impact of technology on skill development and workforce adaptability to technological changes will continue to rise in the future.

While doctoral theses were analysed, it was found that there are relatively few studies in Latvia dealing with specific topics such as “skills” and “technology” within one study. The majority of the selected dissertations focus on human resource management and business development, paying more attention to the human factor and internal business processes than to aspects of technological skills, and employee training in terms of digital transformation. This finding reveals a research gap and indicates that more thorough research on the role of technology in improving skill development is needed. Such a direction has the potential to greatly expand Latvia's scientific basis and also promote the labour market and technological development, highlighting the importance of technology in the development of personnel skills and competencies. This approach can significantly contribute to the sustainable development of Latvia's economy and labour market, responding to the challenges created by modern technological, demographic, and economic indicators.

We believe that this is the first study that uses the bibliometric methodology, which allows us to assess the intensity of research in the field of employee skills, competencies, technology, and digital transformation in both Latvian and global contexts.

There are some limitations to this study. First of all, the Scopus database was chosen as the primary data source, selecting only the data for the period starting from 2000, which was chosen as the starting point of the analysis, because the 21st century marks a time characterized by significant technological and social changes. Second, only journal articles focused on social sciences, business, management and accounting, economics, econometrics, and finance, as well as decision sciences were included in the analysis.

Further research attention could be paid to the study of keywords such as "reskilling" or "upskilling", because, as the data of Co-occurrence analysis shows, these terms, which are currently relevant in the field of workforce and future workforce, are not used in academic publications in the context of technology or skills development.

As the Scopus database is dynamic and new articles are indexed regularly, there is a possibility that shortly, inconsistencies in the results of studies may appear and need to be revised. It is also possible to use other databases, such as Web of Science, Google Scholar, etc., for obtaining more extensive data.

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