SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 215

SUSTAINABLE COMPETENCIES: TERMINOLOGY, CLASSIFICATION AND BIBLIOMETRICS

Katarzyna PIWOWAR-SULEJ[1*], Agata AUSTEN[2]

[1] Wroclaw University of Economics and Business; katarzyna.piwowar-sulej@ue.wroc.pl, ORCID: 0000-0002-4627-4344
[2] University of Economics in Katowice; agata.austen@uekat.pl, ORCID: 0000-0002-1362-2736
* Correspondence author

Purpose: The article aims to respond the following questions: 1) What are sustainable competencies? What are the components of these competencies? 2) What does the science map for sustainable competencies look like?
Design/methodology/approach: The article utilizes the narrative and bibliometric review methods of papers on sustainable competencies, indexed in the Scopus database.
Findings: The authors identified different approaches to the analyzed competencies. They proposed a division of sustainable competencies, taking into account different professional groups. They showed that the greatest research attention has so far been focused on higher education for sustainable development. There is a paucity of research on practices undertaken by employers as part of human resource development.
Research limitations/implications: This research is limited to literature indexed in the Scopus database.
Practical implications: This article educates readers about the role of sustainable competencies in today's working world. It can help them to better understand what skills are crucial for their career success. Giving concrete examples of sustainable competencies and their role in different professional fields can provide practical guidance for people who are looking for career development tips. Furthermore, the article shows how – i.e., through the use of sustainable competencies – employees can contribute to social and environmental progress.
Social implications: By highlighting the importance of sustainable competencies, the paper contributes to a broader understanding and adoption of sustainability practices, ultimately leading to more sustainable societies.
Originality/value: This is the first review on sustainable competencies. A division of these competencies into those required from all employees and those represented by sustainability specialists (including representatives of so-called green jobs) is proposed. The authors also formulated future research directions.
Keywords: sustainable competencies, definitions, typology, green jobs, science mapping.
Category of the paper: Literature review.

1. Introduction

Over the last few years, the topic of sustainability has gained enormous popularity worldwide. Increased public awareness of the impact of human activity on the environment, climate change, and the need for sustainable resource management has made sustainability a key area of interest for society, companies and institutions at various levels (Piwowar-Sulej, 2022a). Social needs have also gained in importance, which, alongside economic and environmental needs, is one of the three pillars of sustainable development (Elkington, 2004).

According to Jonker et al. (2011), companies have a high capacity to react quickly to existing problems and implement corresponding changes. Therefore, their role in achieving the Sustainable Development Goals at national or international level cannot be overestimated. This has given rise to the concept of organizational sustainability, which promotes management that simultaneously and equivalently takes into account economic, social and environmental issues related to the functioning of a company (Dyllick, Hockerts, 2002). Moreover, the concept of sustainable human resource management (HRM) has also emerged, which incorporates business, social and environmental aspects in the management of people. Its main objective is to create a harmonized approach that contributes to a balance between organizational effectiveness, employee satisfaction, as well as social and environmental values (cf. Ehnert, 2009). One of the main activities of sustainable HRM is the development of human resources, which is part of the company's long-term growth orientation (Piwowar-Sulej, 2022b). Indeed, no concept can be implemented effectively without a properly prepared workforce. In this connection, the need to provide organizations with so-called sustainable competencies (competencies in sustainability, competencies for sustainability/sustainable development, sustainability competencies) is exposed (Piwowar-Sulej, 2023).

Sustainable competencies are becoming increasingly important in today's dynamic business environment. Furthermore, society is becoming increasingly aware of sustainability issues. It is therefore important to provide an understanding of what competencies are and will be important in the long term, not only for the development of individual careers, but also for society as a whole. It is also worthwhile to analyze the existing body of knowledge devoted to these competencies in an objective and reproducible way. Therefore, the aim of the article was set to answer the following questions:

1) What are sustainable competencies? What are the components of these competencies?

2) What does the science map for sustainable competencies look like?

The first part of the article – to answer the first question – uses a narrative literature review. In turn, the second part of the article uses science mapping which is a bibliometric data analysis technique that helps to understand the structure and dynamics of scientific knowledge, to identify research trends, and to assess the impact of specific studies or scientific areas (Chen et al., 2015). This was carried out using the Scopus database of scientific publications.

2. Sustainable competencies: their scope and justification of the need for shaping them across groups of employees

Competencies for sustainable development have been broadly defined as a combined set of knowledge, skills, attitudes and values that enable effective global action on real-world sustainability issues, challenges and opportunities, according to the context (Brundiers et al., 2021). On the one hand, these competencies will form the basis for certain professions - commonly referred to as "green jobs" (Sulich et al., 2020). These professions of the future will make a significant contribution to the successful transformation of organizations towards sustainability, focusing primarily on the businesses' environmental goals. However, on the other hand, according to the definition presented in the introduction of the article, sustainability is not only about protecting the environment. The literature advocates, for example, the implementation of so-called frugal innovation, which refers to the development and implementation of new products, services or processes that are both economical and environmentally friendly. These innovations are usually focused on creating low-cost solutions that meet specific needs, especially in areas with limited financial resources. They are characterized by simplicity and efficiency (Iqbal, Piwowar-Sulej, 2023). Thus, sustainable competencies are needed for the engineers designing these processes and products.

Table 1 presents a selection of approaches to sets of competencies for sustainable development. Analyzing the presented competencies, the following common competencies can be observed:

1. Systems thinking – indicating the importance of understanding interconnected systems for sustainable development.
2. Anticipatory/future thinking – highlighting the need for proactive and forward-thinking approaches.
3. Normative competencies – emphasizing the ethical dimensions of decision-making.
4. Interpersonal competence – reflecting the recognition that interpersonal skills are crucial for collaboration, effective communication, and teamwork in the context of sustainable development.

Sustainability-related industries such as renewable energy and green technology have been and will continue to be a major source of green job creation. However, on 5 January 2023, the European Parliament's Corporate Sustainability Reporting Directive came into force and the first entities were obliged to report under it in 2025. Poland - as an EU member state - is obliged to transpose the provisions of the directive into national law by 6 July 2024. The directive expands the group of companies that have non-financial reporting obligations and unifies reporting standards in the form of European Sustainability Reporting Standards. These standards include a focus on the activities through which an organization has the greatest impact on the natural environment or society. As part of mandatory reporting, companies will also have to describe their sustainability objectives and measures, the processes in place to achieve these objectives and the level of achievement of these objectives (PwC, 2023).

Table 1.
Selected sets of competencies for sustainable development

Source	Glasser, 2016	Benders et al., 2016	Quendler, Lamb, 2016	Brundiers et al., 2021
Sustainable competencies	• Systems thinking, • Interpersonal Competence, • Normative competence, • Anticipatory skills, • Strategic competence, • An affinity for life, • Knowledge of the state and the planet, • Wise decision making, • Modelling sustainable behavior, • Social transformation	• Life cycle thinking, • Understanding eco-design principles, • Systems thinking, • Multidisciplinary approach to problem solving, • Ability to work in interdisciplinary groups, • Creativity, • Negotiation skills, • Social entrepreneurship attributes, • High business ethics, • Long-term thinking	• Competence for sustainable development: o system orientation, o future orientation, o social responsibility, • Skills: o environmental impact analysis, o economic optimization, o implementation of sustainable development concepts, o communication, o leadership and teamwork, • Knowledge of sustainability: o general, o how to analyze environmental impacts, o how to reduce environmental impact, o knowledge in economics, o knowledge of the value of nature, • Social aspects of sustainable development	• Systems thinking, • Anticipatory thinking, • Normative competence (value thinking), • Strategic competence (strategic thinking), • Interpersonal competence (collaboration), • Integrated problem-solving competence (metacompetence)

Source: own work based on (Brundiers et al., 2021; Burns et al., 2016; Glasser, 2016; Piwowar-Sulej, 2023; Quendler, Lamb, 2016).

In the case of people working in jobs and positions with duties connected with the achievement of company sustainable performance, sustainability-related competencies will be professional competencies. The latter are defined as competencies that enable one to perform the tasks of a particular occupation or position (Taradejna, 2014). In addition to hiring people responsible for sustainability policies, processes and reporting, it is important to build sustainable competencies among all employee groups. This is because everyone should practice sustainable thinking, which is about choosing decisions that do not have negative consequences for present and future generations (Deniz, 2016). This is because employees may not be aware that what they do not only directly affect the employer's financial performance, but also the achievement of organizational social and environmental goals. Therefore – drawing on the

International Labor Organization's proposal for environmental competencies – two groups of competencies for sustainable development can be proposed (see Table 2).

Table 2.
Competence for sustainable development - by groups of employees

Employee group	Competencies
All employees	• awareness of and respect for the environment and society; willingness to learn and improve in the field of sustainable development, • flexibility - ability to adapt to changing conditions, • adaptability to enable staff to acquire the theoretical and practical knowledge of new technologies and processes needed to green their workplaces and make them more socially inclusive, • ability to work as a team, responding to the need to work together within an organization to find solutions to reduce the organization's environmental footprint and negative social impact, • communication and negotiation skills, in order to promote the required changes among colleagues and external stakeholders of the enterprise, • entrepreneurial skills, to exploit the potential of low-carbon technologies to adapt and reduce environmental and social impacts
Representatives of sustainability-related professions (including green jobs)	• analytical and systems thinking, necessary to interpret and understand the need for change and the resources and inputs required to do so, • coordination, management and business skills, which may include an interdisciplinary approach to economic, social and environmental objectives, • strategic and leadership skills to help politicians and company managers identify appropriate incentives and create conditions conducive to the development of green production and transport and pro-social activities, • skills to innovate, identify opportunities and develop new strategies to respond to green and social challenges, • marketing skills to promote greener products and services and pro-social activities, • consultancy skills to support the company's external stakeholders in understanding green and pro-social solutions and the diffusion of green/pro-social technologies, • networking, IT, and language skills to operate in global markets

Source: own work based on (International Labor Organization, 2019; PARP, 2022).

The above considerations are both theoretical and practical. At this point, it is worth emphasizing that science provides managers with a number of benefits that help them to effectively manage their company, team and make better strategic decisions. Therefore, the next section of the article presents science mapping, which is used to better understand the direction of science, identify areas that need more attention, and support strategic decision-making in the given field of research (Chen et al., 2015).

3. Bibliometric analysis of publications on sustainable competencies

The literature review presented here was carried out using a science mapping approach, which relies mainly on bibliometric data and links between keywords (Chen et al., 2015). In the first step, for the phrase: "sustainable competencies" OR "competencies in sustainability" OR "competencies for sustainability" OR "competencies for sustainable development" OR

"sustainability competencies" (search area: title, abstract, keywords) on 8th November 2023 Scopus showed 342 documents. The search result was then narrowed down to articles written in English and published (in final stage of publication, excluding early view papers). A total of 225 documents were obtained. A list containing these documents was exported to a CSV file, which was used to develop a keyword linkage map in the VosViewer software (van Eck. Waltman, 2014).

The first article on the analyzed competencies was published in 2007 in the International Journal of Sustainability in Higher Education. As can be seen from the information presented in Figure 1, interest in the topic of sustainable competencies is growing year on year.

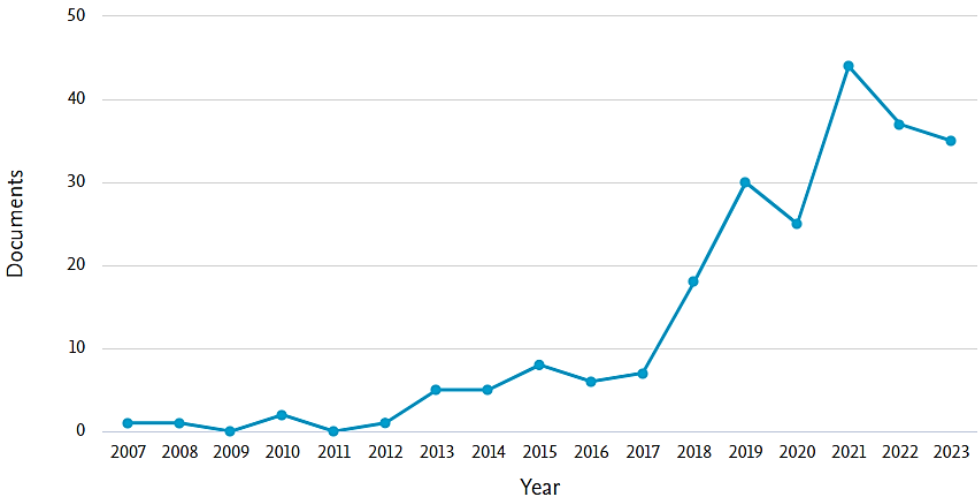

Figure 1. Number of publications on sustainable competencies according to the Scopus database (as for 8th November 2023).

Source: own elaboration using the analytical tools of the Scopus database.

Table 3 shows the titles of journals that published more than two articles on sustainable competencies. Journals specializing in education predominate in the sample.

Table 3.
The most productive journals publishing works on sustainable competencies

Journal	Number of articles
Sustainability (Switzerland)	71
International Journal of Sustainability in Higher Education	32
Journal of Cleaner Production	9
Environmental Education Research	7
Sustainability Science	6
Journal of Teacher Education for Sustainability	4
Frontiers in Sustainability	3
International Journal of Engineering Education	3

Source: own work.

The most productive authors (see Figure 2), published as many as 10 papers on the topic of competencies for sustainable development.

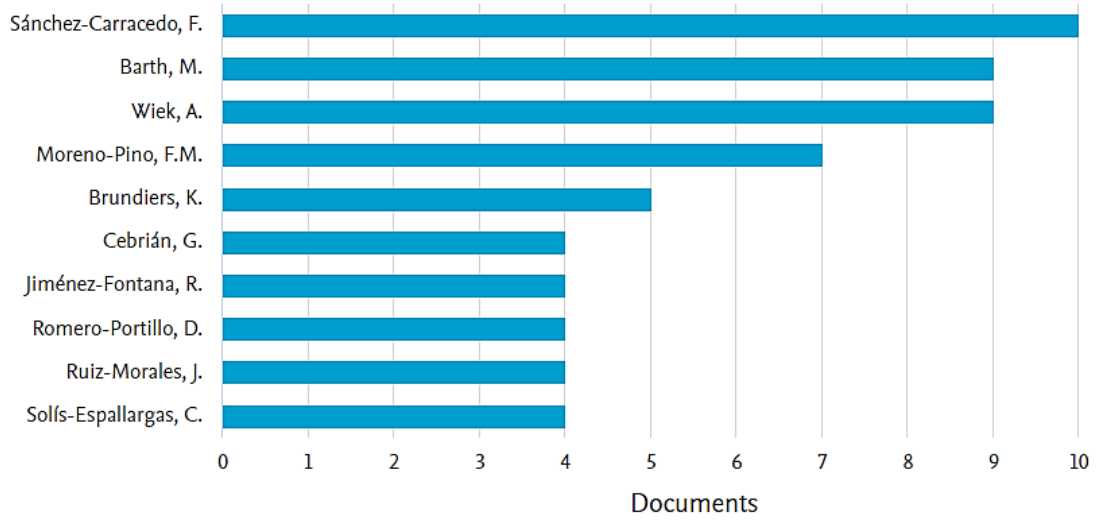

Figure 2. Most productive authors in the field of sustainable competence according to Scopus (as for 8th November 2023).

Source: own compilation using Scopus analytical tools.

Although the largest number of publications come from Spain and the United States, the most productive countries include representatives from the Americas, Europe and Asia (Figure 3).

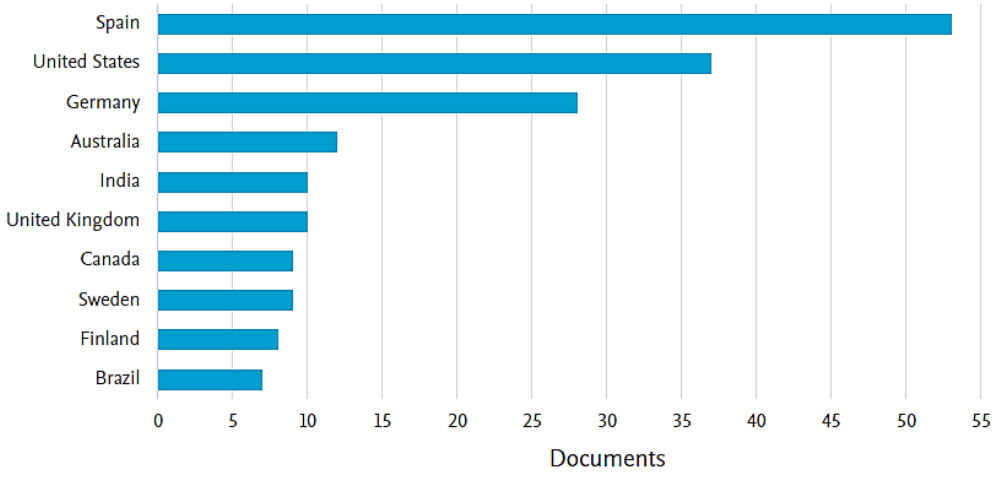

Figure 3. Countries with the most publications on sustainable competencies according to the Scopus database (as for 8th November 2023).

Source: own compilation using Scopus analytical tools.

A total of 765 author keywords occurred in the analyzed publications. As some of the words meant the same thing but were written differently (e.g. education for sustainable development and education for sustainability), the Thesaurus tool was used to clean the keyword database of unnecessary repetition. After setting the number of occurrences of each word to 5 (as indicated by van Eck and Waltman (2014) 20 keywords that formed the map shown in Figure 4.

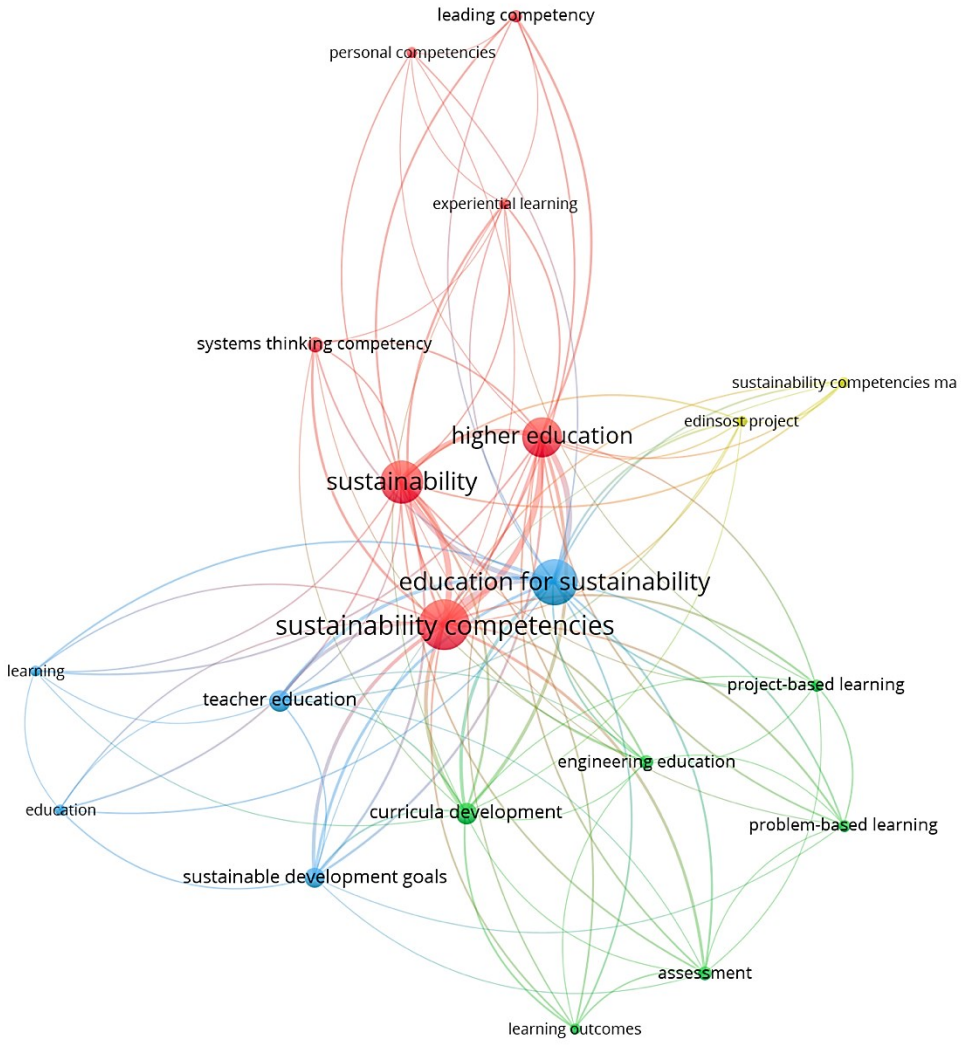

Figure 4. Map of keyword associations.

Source: own elaboration using VosViewer software.

Figure 4 shows the clusters of author keywords. Starting with the largest, they are:

- Red cluster (7 items): This cluster focuses on higher education's role in teaching sustainability, with an emphasis on developing specific competencies. It includes terms like "Higher education", "Sustainability competencies", and "Experiential learning". This suggests a focus on how higher education can integrate sustainability into its curriculum and the specific competencies needed for sustainability, like systems thinking, leadership, and personal skills.
- Green cluster (6 items): This cluster seems to focus on the methods and approaches of teaching in engineering and related fields, with an emphasis on curricula development and innovative learning methodologies like project-based and problem-based learning. It reflects an educational approach that is hands-on and problem-oriented, likely with sustainability as a context, mainly applied for engineering education.

- Blue cluster (5 items): This cluster is more broadly focused on the concept of education for sustainability and on the overall approach and philosophy of integrating sustainability into education at various levels. It also related to education of teachers who are responsible for teaching sustainability issues.
- Yellow cluster (2 items): The smallest cluster, relates to a particular project named "Edinost project" and its connection to development of sustainability competencies map.

4. Conclusions

Sustainable competencies are essential to address a wide range of environmental, social and economic challenges. They enable individuals and organizations to make responsible, ethical and sustainable choices that lead to positive outcomes for individuals, the planet, society and the economy. Employers should therefore value employees who possess not only traditional professional skills, but also sustainable competencies such as flexibility, collaboration, the ability to solve socially-oriented problems and concern for the environment, among others.

Disseminating knowledge about sustainable competencies is essential for raising awareness and bringing about change. This article educates readers about the role of sustainable competencies in today's working world. It can help them to better understand what skills are crucial for their career success. Giving concrete examples of sustainable competencies and their role in different professional fields can provide practical guidance for people who are looking for career development tips. Furthermore, the article shows how – i.e., through the use of sustainable competencies – employees can contribute to social and environmental progress.

With a view to the contribution of this article to management theory, the authors have identified different approaches to the analyzed competencies. In addition, they proposed a division of sustainable competencies, taking into account different professional groups. Using bibliometric analyses, they showed that the greatest research attention has so far been focused on education for sustainable development taking place in institutions set up for this purpose (e.g., universities). As this article demonstrates, there is a paucity of research on practices undertaken by employers as part of staff development. Furthermore, most of the research to date has been carried out in Spain, the US and Germany and has focused on selected competencies, including those related to environmental protection. As sustainable competencies require knowledge from multiple disciplines such as environmental sciences, social sciences, economics and management, researchers – in future international research projects also bringing together authors from e.g. Central Europe – should also work in interdisciplinary teams to develop and test comprehensive theories and models. It would be important to recognize which competencies are particularly needed in different industries and how this phenomenon changes over time.

References

1. Benders, J., Dimante, D., Atstāja, D., Tambovceva, T. (2016). *Development of Business Education for Circular Economy in Latvia.* International Conference "New Challenges of Economic and Business Development – 2016. Society, Innovations and Collaborative Economy, 21–22.
2. Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, *16*(1), 13-29. https://doi.org/10.1007/s11625-020-00838-2
3. Burns, H., Muñoz, M.C., Sager, M. (2016). Engaging Change-Makers: A Profile of the Leadership for Sustainability Education Graduate Program. *Sustainability: The Journal of Record*, *9*(4), 178-184. https://doi.org/10.1089/SUS.2016.29054
4. Chen, C., Dubin, R., Schultz, T. (2015). Science Mapping. In: *Encyclopedia of Information Science and Technology, Third Edition* (pp. 4171-4184). IGI Global. https://doi.org/10.4018/978-1-4666-5888-2.ch410
5. Deniz, D. (2016). Sustainable Thinking and Environmental Awareness through Design Education. *Procedia Environmental Sciences*, *34*, 70-79. https://doi.org/10.1016/j.proenv.2016.04.008
6. Dyllick, T., Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, *11*(2), 130-141. https://doi.org/10.1002/bse.323
7. Ehnert, I. (2009). *Sustainable Human Resources Management: A conceptual and exploratory analysis from a paradox*. Physica-Verlag HD.
8. Elkington, J. (2004). Enter the triple bottom line. In: A. Henriques, J. Richardson (Eds.), *The Triple Bottom Line: Does It All Add up?* (pp. 1-16). Earthscan.
9. Glasser, H. (2016). Toward the Development of Robust Learning for Sustainability Core Competencies. *Sustainability: The Journal of Record*, *9*(3), 121-134. https://doi.org/10.1089/SUS.2016.29054.hg
10. International Labor Organization (2019). *Skills for greener future: A global view*. International Labour Office.
11. Iqbal, Q., Piwowar-Sulej, K. (2023). Frugal innovation embedded in business and political ties: transformational versus sustainable leadership. *Asian Business & Management*. https://doi.org/10.1057/s41291-023-00248-z
12. Jonker, J., Rudnicka, A., Reichel, J. (2011). *Nowe horyzonty: przewodnik po społecznej odpowiedzialności i rozwoju zrównoważonym*. Centrum Strategii i Rozwoju Impact.
13. PARP (2022). *Zmiany na rynku pracy wynikające z wdrażania koncepcji zrównoważonego rozwoju*. Polskia Agencji Rozwoju Przedsiębiorczości.

14. Piwowar-Sulej, K. (2022a). *Zrównoważony rozwój personelu poprzez szkolenia*. UE we Wrocławiu.
15. Piwowar-Sulej, K. (2022b). Environmental strategies and human resource development consistency: Research in the manufacturing industry. *Journal of Cleaner Production*, *330*, 129538. https://doi.org/10.1016/j.jclepro.2021.129538
16. Piwowar-Sulej, K. (2023). Kompetencje na rzecz sustainability jako przedmiot kształtowania w ramach rozwoju kapitału ludzkiego organizacji. In: M. Juchnowicz, H. Kinowska (Eds.), *Zarządzanie kapitałem ludzkim w warunkach niepewności. Wyzwania i implikacje* (pp. 59-72). PWE.
17. PwC (2023). *Nowa dyrektywa oraz projekt standardów raportowania zrównoważonego*. https://www.pwc.pl/pl/artykuly/nowa-dyrektywa-oraz-projekt-standardow-raportowania-zrownowazonego.html
18. Quendler, E., Lamb, M. (2016). Learning as a lifelong process - meeting the challenges of the changing employability landscape: competences, skills and knowledge for sustainable development. *International Journal of Continuing Engineering Education and Life-Long Learning*, *26*(3), 273. https://doi.org/10.1504/IJCEELL.2016.078447
19. Sulich, A., Rutkowska, M., Popławski, Ł. (2020). Green jobs, definitional issues, and the employment of young people: An analysis of three European Union countries. *Journal of Environmental Management*, *262*, 110314. https://doi.org/10.1016/j.jenvman.2020.110314
20. Taradejna, B. (2014). Rola kompetencji zawodowych na współczesnym rynku pracy. *Bezpieczeństwo Pracy*, *8*, 22-26.
21. van Eck, N.J., Waltman, L. (2014). Visualizing Bibliometric Networks. In: *Measuring Scholarly Impact* (pp. 285320). Springer International Publishing. https://doi.org/10.1007/978-3-319-10377-8_13