THE KEY COMPETENCIES OF FUTURE SPECIALISTS IN THE FRAMEWORK OF THE SUSTAINABLE DEVELOPMENT CONCEPT

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Abstract: The article aims to identify key competencies of specialists in the context of the sustainable development concept. The method of cluster analysis was used to assess the key competencies of specialists in the context of sustainable development. The research used the OECD Skills for Jobs database (2021), which contains estimates of surplus (score from -1 to 0) and deficit (score from 0 to +1) of different skill groups of specialists in 44 EU countries, OECD, and other countries.The key competencies of specialists in the context of sustainable development include systemic, strategic, critical thinking, creativity, cooperation, integrated problem solving, empathy, interdisciplinarity. The assessment and analysis of workforce competencies across countries and the productivity of the employed prove the importance of skills development for sustainable economic development.

Keywords: *sustainable development, eco-education, competence, competencies, skills of specialists, education for sustainable development.*

1 Introduction

Education for sustainable development (ESD) is a component of the worldwide process of promoting sustainable economic, social, environmental development, the basis of which is eco-education (EE), developed in the second half of the last century. In this context, EE and ESD should be combined in the area of efficient use of natural resources by people. In the first phase of the development of eco-education, EE and ESD mainly focused on the term's nature, ecology, ecological crisis, finding solutions to overcome it (Sims et al., 2013). Later, however, the idea of assisting in the development of competencies of students, students on environmental issues emerges. This idea began to develop in the nineteenth century by educators and philosophers focused on environmental issues (Mathar, 2015).

Education is key in transforming values in the context of sustainable development. Higher education plays an important role in working toward such change because of its impact on future professionals. Higher education institutions play an important role in shaping the competencies of future professionals important for sustainable development by shaping new knowledge, fostering the development of relevant competencies, and raising awareness of sustainable development issues. In recent years, many HEIs have taken steps to develop higher education with a focus on sustainability (HESD) (Rieckmann, 2012). Recently, a growing number of HEIs have adopted sustainability strategies, thus confirming their commitment to the concept by signing dozens of declarations, including sustainability in practical research, management. 100 institutions of higher education have signed international declarations, universities have committed to the implementation of sustainability in their activities, education, and practical research in the field of sustainable development. For example, in the permanent consumption sub-industry, some universities are initiating creative projects to change campus life and influence the attitudes and behaviors of staff, faculty, and students toward sustainability. In addition, initiatives in Central and Eastern Europe show major changes in sustainability issues integrated into curricula, plans, especially in the context of intensive coal mining, urban planning (Adomßent, et al., 2014). However, despite the declaration of intentions and development of sustainability policies at the national, regional, and international level, there are few achievements in terms of holistic integration of education in the concept of sustainable development, in particular in curricula to develop competencies of future professionals (Fadeeva, et al., 2010). The integration of competencies in the concept of sustainable development into curricula can be seen as a suitable step to ensure it. However, the difference between the intentions and the actual activities of the curriculum leaders to integrate competencies is evident in only a few universities. Moreover, the wording and content of the proposed competencies differ (Staniškienė, et al., 2020).

Thus, the purpose of the article is to highlight the key competencies of specialists in the context of the concept of sustainable development.

2 Literature review

The recent research in higher education in the context of sustainability has presented the results of learning practices and competencies that educational programs seek to develop in students to shape them as professionals towards sustainability (Sipos et al., 2008; Svanström et al., 2008; Mochizuki et al., 2010; Wiek, et al., 2011). However, there is a great deal of debate regarding the required set of competencies for permanency because of the diversity of definitions of the term's sustainability, resilience, competence, and competence in the educational setting (Mochizuki et al., 2010). Despite the distinction of different concepts such as abilities, skills, abilities, knowledge, learning outcomes, and competencies, the existence of some criticism on the use of these terms, there is a need to define competencies in the context of sustainability to facilitate their integration into instructional programs (Wiek, et al., 2011). Wals (2010) proposes the elements of sustainability competencies or Gestaltungskompetenz, a term used by German sustainability educators that is based on Gestalt, which is thinking. The term expresses students' sustainability abilities and competencies and is defined as the ability to shape future scenarios, solve problems through engaging, active participation in modeling and transforming society towards sustainable practices (Barth, 2007).

In Germany, the development of "Gestaltungskompetenz" ("formative competence") (Michelsen, 2014) is discussed as a major educational goal. "Formative competence" includes a set of core competencies that are expected to ensure active, reflective, and cooperative participation in the direction of sustainable development. Those who possess these competencies can, through their active participation in society, change and shape the future of society and guide its social, economic, technological, and environmental changes toward sustainable development. According to De Haan (2010), this "formative competence" includes the following key competencies: competence in anticipation thinking, competence in interdisciplinary work, competence in cosmopolitan perception and change of perspectives, competence in handling incomplete and complex information, participator encouragement, competence in dealing with individual position dilemma, competence in self-motivation and motivating others, competence in reflection on individual, and cultural models, competence in independent action, competence in ethical action capacity for empathy and solidarity.

Wals (2010) proposed the following types of sustainable development competencies: the ability to think prospectively, combat uncertainty; the ability of interdisciplinary cooperation and work; competency of open perception, cooperation, transcultural understanding; competency of participation; competency of planning, implementation, implementation; ability to feel sympathy, empathy, solidarity; ability to motivate oneself and other team members, leadership; the ability of remote display of individual and cultural notions.

The development of certain competencies in future professionals is especially important to develop sustainability literacy (Stibbe, 2009), to activate students to ensure the transformation of personal and work life or activities (Sipos, et al., 2008). The use

of different types of pedagogies and approaches, teaching strategies will contribute to the development of competencies necessary for sustainability work. Critical and creative thinking skills, problem-solving skills, action competence, collaboration, and strategic thinking about the future should be prioritized, which creates a responsible attitude among professionals and empower them to make strategic changes (Wals, 2010).

There are four key implications for studying the development of ESD competencies amongst student teachers can be drawn from this research:

- The development of teaching and learning processes and evaluation strategies towards the improvement of ESD learning is an essential step to contribute to better teacher training in this area at the university level.
- Future research needs to develop evaluation tools that can provide information on student competence mobilization in a context close to their professional practice. It would enable the exploration of the ESD competencies of student teachers and the opportunities and challenges they face when trying to promote these in schools.
- Interdisciplinary work and practice, critical thinking, creativity, values clarification, management of emotions, social interaction, and teamwork need to be enhanced through teacher education studies to integrate ESD in in-service teaching.
- Envisioning alternative future scenarios and developing future-thinking competency amongst students promotes the challenging of existing worldviews and assumptions in ESD, fosters responsibility and commitment, and leads to innovation and action strategies for change. (Cebrián et al., 2015).

ESD includes holistic and transformational education, which is focused on educational content and results, pedagogy on the learning environment. In particular, the content should include the problems of environmental development and the ecology, the problems of poverty, old consumption in educational programs (Rieckmann, 2018).

In the context of the concept of old-growth, the OECD project "Identification and selection of competencies" classifies the competencies of teachers into three groups: interactive use of tools, devices; interaction in heterogeneous groups (ability to interact with others, teamwork, collaboration, management skills, and conflict resolution); acting autonomously (ability to develop and implement plans, personal projects, protection of rights, interests, needs) (Mochizuki? et al., 2010).

The results of Sims et al. (2013) research indicate the importance of experiential, interdisciplinary, and inter-institutional learning, problem-based learning for the real-life community and natural environment issues, as well as partnership building with colleagues, students, and community organizations. The results of Staniškienė et al. (2020) showed that the relevance of competencies for the old development is still underestimated in most educational programs. The analysis showed that the competencies for development related to critical thinking and cooperation are widely integrated, while the competencies related to self-consciousness or pre-determined and normative aspects are mostly absent.

Faham et al. (2017) based on the literature and viewpoints of subjective experts, sustainability competencies included three classes of competencies:

a) Understanding of the sustainability;
b) Skills: critical thinking in sustainability, creative thinking in sustainability, systemic thinking, empathy, and interdisciplinary collaboration;
c) Attitudes: commitment to sustainability, respect for the past, present, and future generations.

The results of Rieckmann (2012) show that twelve key competencies are crucial for sustainable development, and the most relevant skills of systems thinking, strategic thinking, and critical thinking can be identified.

Thus, the literature generally identifies key competencies of professionals in the context of sustainable development, the main ones being: systems thinking, strategic thinking, critical thinking, creativity, collaboration, integrated problem solving, empathy, and interdisciplinarity. However, there is a lack of research on linking the role of competencies in sustainable development.

3 Materials and research methods

Methods

The method of cluster analysis was used to assess the key competencies of specialists in the context of sustainable development. The cluster analysis is a generalized name for a fairly large set of algorithms used to create a classification. In this research, the attributes of the ball scores of the specialists' competencies, namely the excess or deficiency of competencies. In the process of countries' classification according to the competencies, distances between clusters are calculated, reflecting the degree of similarity, proximity of objects (countries) to each other according to the whole set of used attributes. The measure of closeness and the degree of objects' similarity are presented as the inverse of the distance between objects based on Euclidean distance:

$$d_{ik} = \left(\sum_{j=1}^{m} \left(x_{ij} - x_{kj} \right)^2 \right)^{\frac{1}{2}} \quad (1)$$

Where d_{ik} – distance between i th and k th objects;

x_{ij} and x_{kj} – numeric values of j th variable for i th and k th objects accordingly;

m – the number of variables used to describe the object.

Data

The research uses the OECD Skills for Jobs (2021) database, which contains surplus (-1 to 0) and deficit (0 to +1) estimates of various skill groups in 44 EU, OECD, and other countries (Argentina, Brazil, Bulgaria, Cyprus, Malaysia, Peru, Romania, South Africa) for 2020. In total, the database provides skill assessments for the following skill groups:

1) Basic Skills (Content);
2) Basic Skills (Process);
3) Social Skills;
4) Complex Problem Solving Skills;
5) Technical Skills;
6) Systems Skills;
7) Resource Management Skills. A clustering of the region was carried out according to the skills assessments.

At the second stage, a polynomial model of the relationship between skills scores in different countries and the labor productivity of an employed worker was constructed, to estimate which GDP per person employed between 2015 and 2020 was used (average growth).

4 Results

There was made a tree-structured diagram to determine the number of clusters of countries (Figure 1). The figure shows this diagram. It allows schematically identify three groups of countries' clusters by assessments of surplus/deficiency of skills in various sectors of the economy:

1) the first group with a deficit within 0.6 – 1 points;
2) the second group with a deficit of skills 0.4 – 0.6 points;
3) the third group with a deficit of skills 0.2 – 0.4 points.

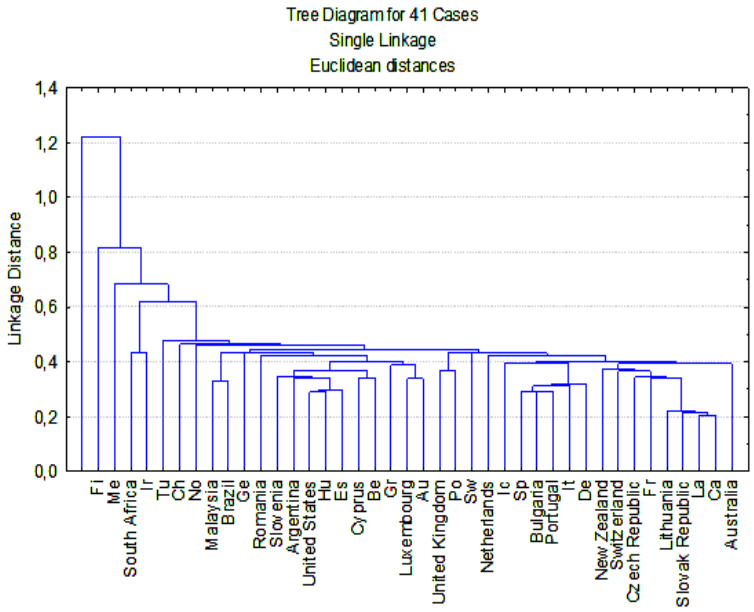

Figure 1 – The tree-structured diagram
Source: author's elaboration based on OECD (2021a).

The diagram of the average values of competency surplus/deficit scores for each country within each cluster (Figure 2) indicates that there are significant differences between countries in the development of the skills needed for sustainable development.

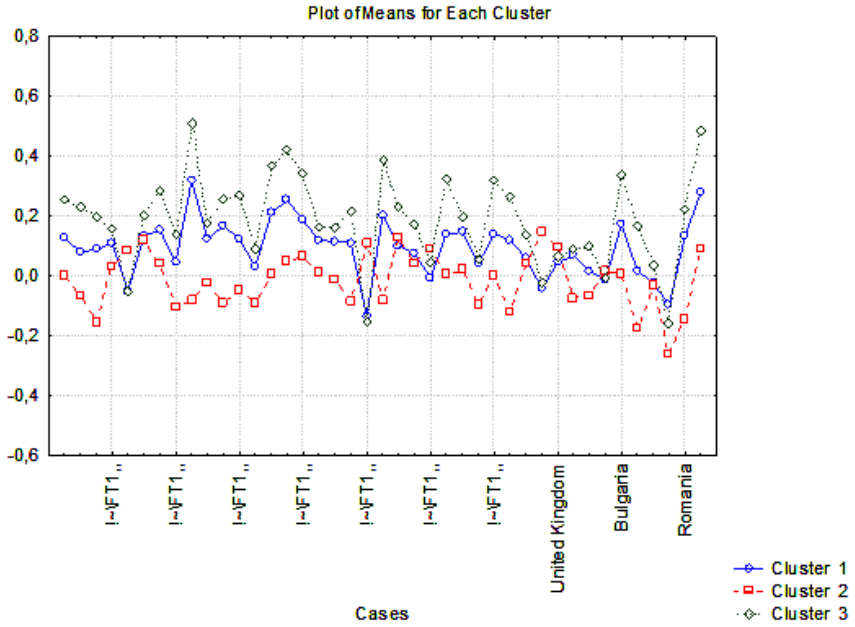

Figure 2 – The average skills score diagram for each country within each cluster
Source: author's elaboration based on OECD (2021a).

Table 1 shows the Euclidean distances between clusters, indicating significant differences in the values of surplus and deficit skills assessments across country clusters. For example, the similarity between cluster 1 and cluster 2 is low: the Euclidean distance is 0.1685; between cluster 1 and cluster 3 is 0.1132; between cluster 2 and cluster 3 is 0.2669.

Table 1 – Euclidean distances between clusters. Distances below diagonal. Squared distances above diagonal

Euclidean distances	No. 1	No. 2	No. 3
No. 1	0,000000	0,028411	0,012829
No. 2	0,168556	0,000000	0,071289
No. 3	0,113265	0,266999	0,000000
Clusters members			
No. 1	Australia, Austria, Belgium, Canada, Czech Republic, Estonia, France, Germany, Greece, Latvia, Lithuania, Luxembourg, New Zealand, Norway, Slovak Republic, Sweden, Switzerland, United States, Cyprus, Romania		
No. 2	Denmark, Finland, Iceland, Ireland, Italy, Netherlands, Portugal, Spain, Bulgaria, South Africa		
No. 3	Chile, Hungary, Mexico, Poland, Slovenia, Turkey, United Kingdom, Argentina, Brazil, Malaysia, Peru		

Source: author's elaboration based on OECD (2021a).

To estimate the dependence between the influence of specialists' competencies on productivity, which determines the stable economic development, the linear dependence model was built (Figure 3). This dependence explains the constancy of economic development of the country depending on the skills of the labor force by 5,45%, which indicates the presence of other significant factors of influence on the provision of stable productivity.

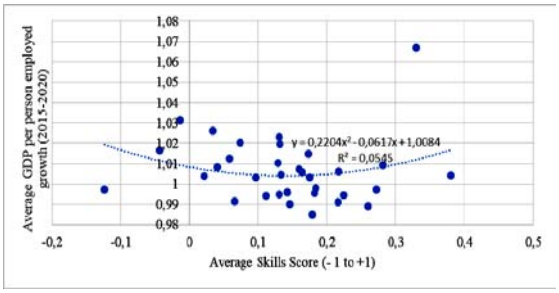

Figure 3 – The dependence between estimates of skill surplus/deficit (average of all skill groups) and countries' labor productivity (average of GDP growth per person employed between 2015 and 2020)
Source: author's elaboration based on OECD (2021a; 2021b).

At the same time, the estimated polynomial model also confirms that there are three groups of countries with different estimates of surplus/deficit competencies, which have different effects on the productivity of the employed in different countries. Consequently, the mean value of the competency deficit estimate of the first cluster is 0.13506 (insignificant skill deficit) with a mean value of 0.44% growth in the productivity of the employed between 2015 and 2020. The average value of the second cluster's competency deficit score is 0.2801 (significant skill deficit), with an average value of employment productivity growth of 0.73% during 2015-2020. The average value of the competency surplus assessment of the third cluster is -0.0134 (virtually no surplus skills), with an average value of employment productivity growth of 1.07% during 2015-2020. Hence, the assessment and analysis of workforce competencies in different countries and the productivity of the employed prove the importance of skills development for sustainable economic development.

5 Discussion

In the process of receiving formal education, the student receives a primary low level of competence (basic process and content skills), characterized by varying degrees of mastery of specific knowledge, skills, and abilities. The main thing at this stage is the formation of primary competencies, i.e., formation of the need to study and preserve a healthy natural environment around oneself from an early age, formation of the ability to perceive nature as the essence of our life and oneself as an organic part of the nature. The initial (2nd) level of generalization of specific knowledge is weakly involved. New facts and phenomena are memorized and serve as a basis for the formation of reflexive behavior. The intermediate level of competence is acquired in college and further on at the bachelor's level, where basic concepts and abilities to trace general interrelations between human activity and environmental behavior in general and concerning a specific area of human activity are formed. As a result, a person becomes able to apply inductive methods of matching specific knowledge, which leads to the formation of a higher level of generalization, the understanding of the essence of specific phenomena is formed. However, inductive methods are fundamentally unsuitable for obtaining a true general idea of the essence of the observed phenomena.

In the vast majority of cases, incomplete induction, which is used to conclude about, for example, the consequences of environmental disasters, is intuitive in nature, where the process of inference is not logical in the full sense. The result is a system of knowledge in which new phenomena or theories are poorly aligned with a person's knowledge system. Such a system is "unstable" and prone to collapse. "Stopping" the student at the 2nd level of competence formation inevitably leads in the future to "rolling back" to a lower level of competence, as gradual destruction of the "unstable" system of knowledge leads to loss of life reference points, deformation of worldview or contributes to the transformation of the system of knowledge into an orthodox system.

The next, high level of competence is acquired at the second and third stages of higher education in masters and post-graduate courses. The knowledge system, formed, as a rule, as a result of quality but classical education, based on memorization of many facts, is "flexible" but "passive". At this level, it is most important to form the skill of systematizing incoming information and aligning it with the existing multi-level knowledge system. Without this type of skill, there will be a decrease in its competence over time, and such knowledge cannot guarantee the planned and consistent implementation of managerial decisions in the field of sustainable development.

Formation of the system of sustainable development competencies can take place based on deep ecological education, the obtaining of which is seen today in the concept of "Lifelong learning". At the same time, eco-education must be comprehensive and continuous in nature: from the development of a child's reflex to systematic professional development of managers of enterprises, ministries, and departments in the field of assessing the impact on the environment and its protection. Taking into account that in modern conditions of comprehensive informatization and development of distance education, (when education is no longer a process of transferring knowledge in the traditional form through a teacher in a classroom, and the emphasis is shifted to the ability to learn and to independent mastering of knowledge) the task of the teacher, including as a developer of materials online learning, development of the need to seek knowledge and formation of a worldview that allows perceiving, is to generalize and analyze information through the lens of the ecological danger of the phenomena and processes that occur in the world.

6 Conclusion

The key competencies of specialists in the sustainable development context include systemic, strategic, critical thinking, creativity, cooperation, integrated problem solving, empathy, interdisciplinarity. The study identified three groups of country clusters according to assessments of surplus/deficit competencies of specialists in different industries:

1) the first group with a deficit within 0.6 – 1 point;
2) the second group with a deficit of skills 0.4 – 0.6 points;
3) the third group with a deficit of skills 0.2 – 0.4 points.

The constructed dependence of the employees' productivity on the skills' level explains the constancy of the economic development of the country depending on the skills of the labor force by 5.45%, which indicates the presence of other significant factors of influence on the provision of stable productivity. There are three groups of countries with excellent estimates of surplus/deficit competencies, which have different effects on the productivity of the employed in different countries. Consequently, the mean value of the competency deficit score of the first cluster is 0.13506 (insignificant skills deficit) with a mean value of 0.44% growth in employment productivity during 2015-2020. The average value of the second cluster's competency deficit score is 0.2801 (significant skill deficit), with an average value of employment productivity growth of 0.73% during 2015-2020. The mean value of the competency surplus assessment of the third cluster is -0.0134 (virtually no surplus skills), with an average value of employment productivity growth of 1.07% during 2015-2020. Thus, the assessment and analysis of workforce competencies in different countries and the productivity of the employed prove the importance of skills development for sustainable economic development.

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Primary Paper Section: A

Secondary Paper Section: AM