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Principles for Training Students in Circular Economy Skills: Pedagogical and Ecological Areas

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ABSTRACT

The purpose of the study is to substantiate the principles of the formation of students' competencies in the circular economy in the pedagogical and ecological aspect, taking into account the achievement of the sustainable development goals. The methodological basis of the research is the systematic approach, which in pedagogy is aimed at revealing the value of pedagogical objects, identifying their various forms, components, types and relationships between them, which makes it possible to present the acquisition of competences among students for activities in the conditions of the circular economy as a whole presentation of actions using various forms, methods, means of teaching students in heigher education institutions. In the article, the epistemology of social challenges in the direction of achieving the sustainable development goals due to the implementation of the principles of the circular economy and the need in this context for the formation of relevant competencies of students of higher education institutions is substantiated. The characteristics that should correspond to the competence of the circular economy according to the characteristics of the integrated quality of the individual have been determined. The components that form the competences of the circular economy have been identified, which include: axiological, cognitive, practical-technological, and institutional.

KEYWORDS: Circular economy, sustainable development, competences, students, pedagogy, higher education institutions, ecology, environment.

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Principios para la formación de estudiantes en competencias de Economía Circular: Áreas pedagógica y ecológica

RESUMEN

El propósito del estudio es fundamentar los principios de la formación de competencias de economía circular de los estudiantes en el aspecto pedagógico y ecológico, teniendo en cuenta el logro de las metas del desarrollo sostenible. La base metodológica de la investigación es un enfoque sistemático, que en pedagogía tiene como objetivo revelar el valor de los objetos pedagógicos, identificando sus diversas formas, componentes, tipos y relaciones entre ellos, lo que permite presentar la adquisición de competencias entre los estudiantes para actividades en las condiciones de una economía circular en su conjunto cuadros de acciones que utilizan diversas formas, métodos y medios de enseñanza a los estudiantes en instituciones de educación superior. El artículo fundamenta la epistemología de los desafíos sociales hacia el logro de los objetivos del desarrollo sostenible debido a la implementación de los principios de la economía circular y la necesidad en este contexto de la formación de competencias relevantes de los estudiantes de las instituciones de educación superior. Se han determinado las características que deben corresponder a la competencia de la economía circular según las características de la calidad integrada del individuo. Se han identificado los componentes que forman las competencias de la economía circular, que incluyen: axiológicos, cognitivos, práctico-tecnológicos e institucionales

PALABRAS CLAVE: Economía circular, desarrollo sostenible, competencias, estudiantes, pedagogía, instituciones de educación superior, ecología, medio ambiente.

Introduction

The modern post-industrial paradigm of the world development places new demands on society. In accordance with the globalization of the sustainable economy, which simultaneously focuses attention on the economic, social and environmental spheres, the circular economy is gaining more and more importance. The circular economy helps to reduce the burden on the environment due to wide implementation of secondary processing, greening of production, and the creation of closed cycles of waste-free production. In the 80s of the last century, with the introduction of the "green growth" concept due to the greening of production, the idea of introducing a circular closed economic cycle of production gave way from a theoretical concept to a philosophy of actions of economic subjects.

Achieving the sustainable development goals became a priority for the entire world community, which ensured the spread of renewable energy sources, careful use of depleted resources, careful treatment of the environment, and the introduction of circular

production processes. The circular economy is based on the principle of careful, frugal use of resources through the closure of economic and ecological cycles of the flows of the resource use. The circular economy is a modern lifestyle philosophy is aimed at increasing well-being and the efficiency of ecosystem development due to the fact that the resource consumption, energy leaks and emissions into the ecosystem are minimized by stopping the existence of harmful, resource-consuming, material-intensive and energy-consuming production cycles. A great role in the circular economy is given to the processing and disposal of products, rethinking the directions of the product use, restoration of old products and their further exploitation, etc. But, at the same time, a very important aspect for achieving the sustainable development goals and spreading the principles of the circular economy is the readiness of the community for its acceptance and implementation, which requires the development of ecological culture. The formation of the circular economy competencies among young people is important, which can be achieved by increasing attention to these issues in the pedagogical sphere, and especially in the higher education sector. Therefore, the pedagogical-ecological aspect in higher education teaching is becoming more and more relevant and requires further research in this scientific area.

The purpose of the study is to substantiate the principles of the formation of students' competencies in the circular economy in the pedagogical and ecological aspect, taking into account the achievement of the sustainable development goals.

To achieve the goal, the following tasks were solved:

- the epistemology of social challenges in the direction of achieving the sustainable development goals due to the implementation of principles of the circular economy, and the need in this context for the formation of relevant competencies among students of higher education institutions is substantiated;

- the content of the concept of competencies and their meaning is highlighted, taking into account the factors that inhibit the processes of implementing principles of the circular economy;

- the characteristics that should correspond to the competence of the circular economy are defined in accordance with the characteristics of the integrated quality of the personality, which is one of the basic components of the person's successful activity in a certain field of the professional activity, situation, everyday life, as well as with regard to

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the common characteristics of competencies of the circular economy among students of higher education institutions;

- the components that form competences of the circular economy were identified, which include: axiological, cognitive, practical-technological, institutional.

1. Literature Review

The formation of students' competences regarding greening, environmental protection and the features of the formation of the circular economy is an extremely relevant topic. Indeed, at the current stage of the society development, the issues of the environmentalization of production and formation of the circular economy and implementation of the sustainable development goals, which are studied by many scientists, are extremely important. The research of scientists (Marhasova V. et al., 2023; Kholiavko N. et al., 2023; Popelo O. et al., 2022) is of practical importance, within which the peculiarities of the development of higher education and the formation of competences among students within the framework of the implementation of the sustainable development concept are considered.

As for pedagogical aspects in the formation of environmental competences among students, the following publications should be considered. Within the framework of the study (Setiadi Hermawan et al., 2023), the importance of the eco-literacy formation among students was proven, which will contribute to the preservation of the natural environment. Studies of modern trends in the formation of environmental literacy demonstrate low environmental awareness, which, according to the authors, can cause many problems related to the negative impact on the environment and natural disasters. Scientists (Mongar Kishore, 2023) are investigating the impact of the students' competences acquired on the environmental sustainability. The article proves the need for the development of the ecocentric worldview to support sustainable development. A significant number of students noticed a change in the attitude towards the environment, their behavior and promotion of environmental sustainability based on the acquisition of competences in the environmental sustainability.

The authors (Blanco María Eugenia, et al., 2022) analyze the formation of eco-healthy culture among students in the conditions of climate change. Based on the results of the analysis, it was established that damage to the environment should be avoided by

means of the individual behavior change, promotion of the implementation and development of greening processes, which should be emphasized in modern universities in the sustainability context. The purpose of the study (Amador-Alarcón M.P. et al., 2022) is to analyze the environmental problems that society is currently facing, as well as to determine the possibilities and prospects for solving these problems under the influence of digital technologies through the educational component in universities. The results indicate that the majority of students are aware that the use of electronic devices for educational purposes affects the environment and forms certain environmental competencies.

Article (Pet'ko L. et al.,2021) reveals the features of using the project methodology based on the solution of environmental projects in the training of modern specialists, which contributes to the formation of ecological thinking in them. According to the authors, the analysis of environmental problems helps to realize the importance of solving them to ensure sustainable development. It has been proven that students should possess the skills of effective actions in solving various environmental problems due to the formation of environmental awareness and the desire for the independent cognitive activity in the field of ecology, which should be classified as a priority task of the modern educational process. Scientific paper (Sharapovna N. A. et al., 2022) is devoted to the study of environmental education and the analysis of the results obtained after the application of innovative technologies. The authors focus on the formation of environmental competence of high school students and conducted a survey, the results of which showed that conducting an elective course using innovative technologies in environmental education is the most useful, convenient and necessary method of forming the environmental competence of high school students.

The research of the authors (Romaniuk R. et al., 2021) is important, in which it was found that the formation of environmental competence is carried out by obtaining environmental education using interactive technologies, forms and methods of organizing the educational process. The article confirms the positive impact of involving students in research, nature conservation, ecological and naturalistic work during extra-curricular hours on the formation of their environmental competence. As a result of the study, the role of educational and production practices in the professional training of students and the formation of their environmental competence is emphasized. The study (Fabregá M.B. et al., 2020) is based on the analysis of the relationship between entrepreneurial abilities and

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commitment to innovation, as well as entrepreneurial skills and commitment to environmental protection as the drivers of the students' awareness of sustainable development. The result of the study is a proposal for the inclusion of the entrepreneurial skills program in higher education and research programs as a way to ensure commitment to innovation and environmental sustainability. Within the article (Aldawsari Norah Fahad et al., 2018), authors analyzed the relationships between intercultural competence, environmental awareness, social support and psychological adaptation of foreign students. The study found a significant positive relationship between autonomy and intercultural competence, as well as environmental mastery and social support.

Despite the considered publications, the issue of the formation of students' competencies in the circular economy, namely pedagogical and ecological aspects, requires in-depth research and analysis.

2. Methodology

For the formation of circular economy competencies among students, taking into account the pedagogical and ecological aspect, it is advisable to use a systematic approach, which in pedagogy is aimed at revealing the value of pedagogical objects, identifying their various forms, components, types and relationships between them, which allows to present the acquisition competencies as a holistic picture of actions using various forms, methods, means of teaching students in higher education institutions. A systematic approach in pedagogy using various means, methods and processes is necessary for targeted pedagogical influence on the formation of a personality with given qualities, in our case, circular economy competencies.

The use of system analysis, system design, system programming, etc., as methods of cognition, research and construction of reality, which is conditioned by the achievement of social goals of sustainable development due to the implementation of the circular economy principles, provides an opportunity to explain the nature of analyzed phenomena or artificially created models or objects. The systematic approach makes it possible to take into account every component of the student's professional training system and create pedagogical tools for high-quality training and acquisition of the necessary competencies by students. System-forming factors in the formation of the circular economy competences among students should be ideas of environmentalization, elements and principles of a

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systemic approach, which include: professional orientation, scientificity, innovativeness, systematicity, individualization, academic cooperation, unity of structural elements of training, typology in the process of training a future specialist in relation to the implementation of the circular economy principles in professional activity and everyday life of the individual.

3. Results

It should be noted that today there are certain factors that inhibit the implementation of the circular economy principles, which include:

- inappropriate attitude of the population, for example, regarding throwing away garbage, using resources, caring for the ecosystem, etc.;

- lack of specialists who are fully aware of the principles of the circular economy implementation, including business models and production processes;

- insufficient investment resources and low interest of investors in long-term financing of projects related to the implementation of the circular economy principles;

- low interest in implementing new circular economy business models, etc.

One of the directions for leveling the outlined factors inhibiting the implementation of the circular economy principles is the implementation of certain circular economy competencies in the training of students in higher education institutions.

Integration processes occur in all spheres of human life, and higher education is no exception. Today, higher education acts as an integrated education in the international space, there is an active exchange of students, and joint educational and scientific programs are being created. According to modern trends, students acquire competence. The concept of competence is very broad and has a multifaceted meaning. So, competencies are (Fig. 1):

- set of knowledge, abilities and skills, relationships and experience that students acquire and can use depending on the situation in their professional direction;

- ability to successfully perform assigned tasks at a high quality professional level;

- effectiveness of studies at a higher education institution;

- qualitative state of being of a person;

- ability to perform various activities characteristic of a person, such as work or study, and to be ready for changes;

- set of discrete competencies that can be independently verified by objective means;

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- possibility of choosing from the acquired competences the one that allows the most optimal achievement of the set goal in a specific context.

It can be noted that competences have a very broad meaning and occupy an important place in the pedagogy of higher education. Taking into account the outlined challenges of the development of society in the direction of achieving the sustainable development goals and the implementation of the circular economy concept, the competence of the circular economy acquires significant importance. This thesis is also proven by practice. So, for example, in Finland, higher education has introduced the largest number of courses on the circular economy, as well as introduced the circular economy competencies for all students of higher education institutions. And this has already yielded results both in the practice of implementing circular economy business models and in raising the public's awareness of the need and importance of implementing the circular economy in life. This is confirmed by the fact that among the surveyed Finns, 88% of the population believe that they can personally play an important role in promoting the principles of the circular economy, and 82% of the population expect to create new jobs on the labor market under the conditions of the implementation of the circular economy principles.

Today, the philosophy of education in the world operates in the thesis "education throughout life, not education for life", that is, a person must learn, acquire new knowledge and competences throughout his life. Students receiving higher education must acquire competences taking into account the goals of greening the economy, this can be done through the introduction of the circular economy principles into educational programs, introduction of new courses and specific circular economy competences for all students of higher education institutions.

Competencies of students for activities in the conditions of the circular economy, taking into account the polyvariance of the concept of "competence", which we previously considered in the study, should correspond to the following characteristics (Fig. 2):

- firstly, to be characterized by an integrated quality of personality, which is one of the basic components of a person's successful activity in a certain field of professional activity, situation, everyday life. Integrated quality can be manifested in:

a person's desire and readiness to realize his potential for professional activity, as well as to realize his own latent opportunities in professional activity, taking into account the acquired competencies of the circular economy (motivational aspect);

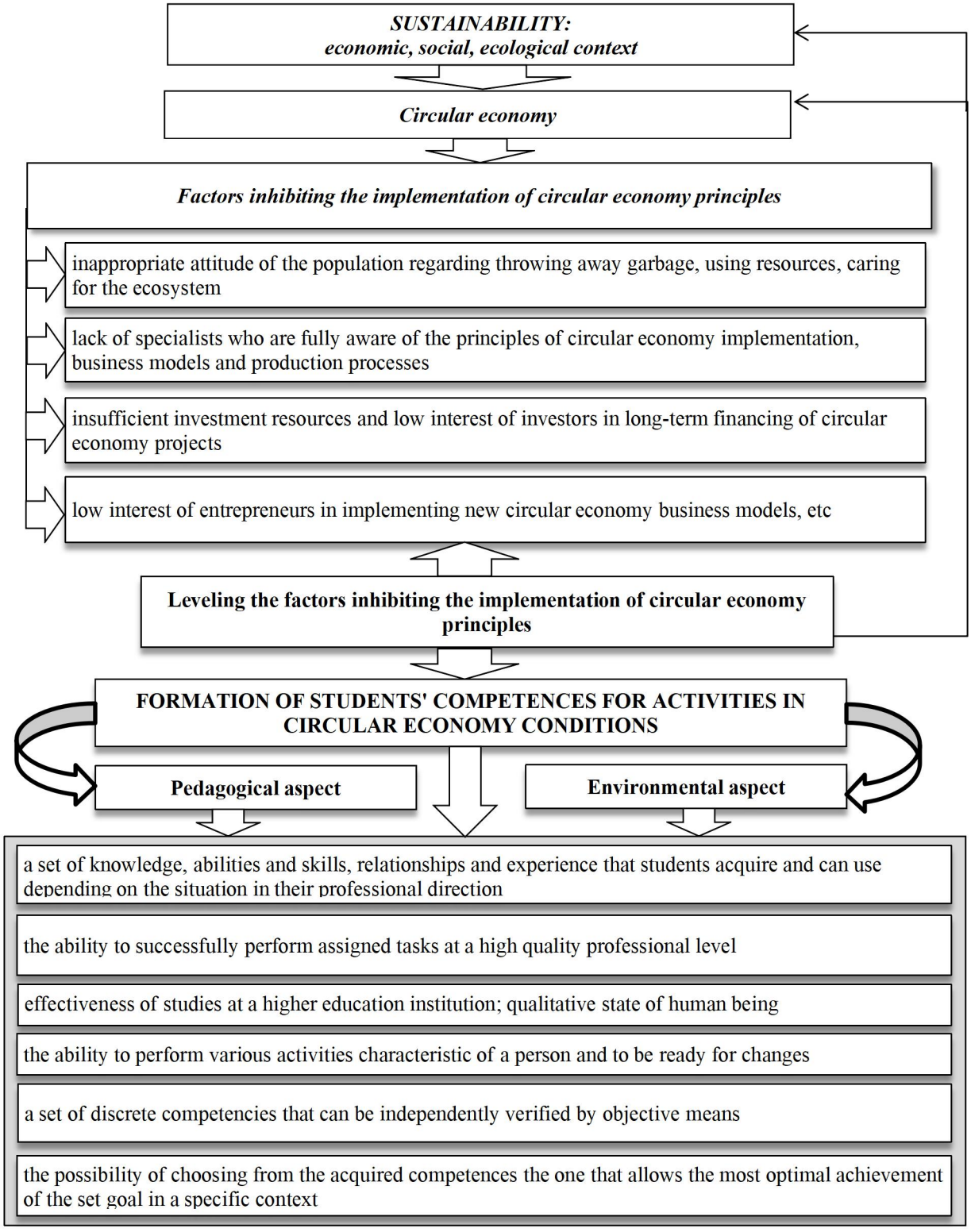

Figure 1. Pedagogical and ecological aspect of the competence formation for activities in the conditions of the circular economy
Source: built by the authors

confirmation in practice of the ability to implement the knowledge, skills, and experience acquired by the individual for successful creative, innovative, creative professional activity (cognitive-behavioral aspect);

awareness of social and environmental significance, personal responsibility for the results of one's professional activity and striving for its constant improvement, acquisition of new knowledge and competences (value-meaning aspect);

- secondly, all circular economy competencies have a number of common features, which should include:

multifunctionality, which must be acquired in order to achieve goals and solve complex problems of the sustainable development and circular economy principles in various situational circumstances;

interdisciplinarity, which involves the application of the competences of the circular economy in situations of professional, household, political, public activity;

wide-ranging, which includes diverse mental processes and intellectual skills, including analytical and critical thinking, commutative skills, etc.;

creativity, which is a need for significant intellectual development, abstract thinking, self-reflection, determination of personal position.

Taking into account the above, it is advisable to single out the components that form the competences of the circular economy, which, according to the authors, should include:

- firstly, axiological, ensures the formation of internal motives that motivate a person to activities aimed at achieving the sustainable development goals and implementing the circular economy principles, implementation of ecological activities depends on the sphere of personal experiences and is based on the formation of spiritual principles, theoretical and cognitive prerequisites, moral -ethical attitude to the environment in a person's professional activity and everyday life. In turn, the moral-ethical attitude to environmental problems, the attitude to the subject-object relations between man and nature determines the social activity of a person, his environmental awareness at all stages of life and attitude to the principles of circular economy and achieving the goals of sustainable development;

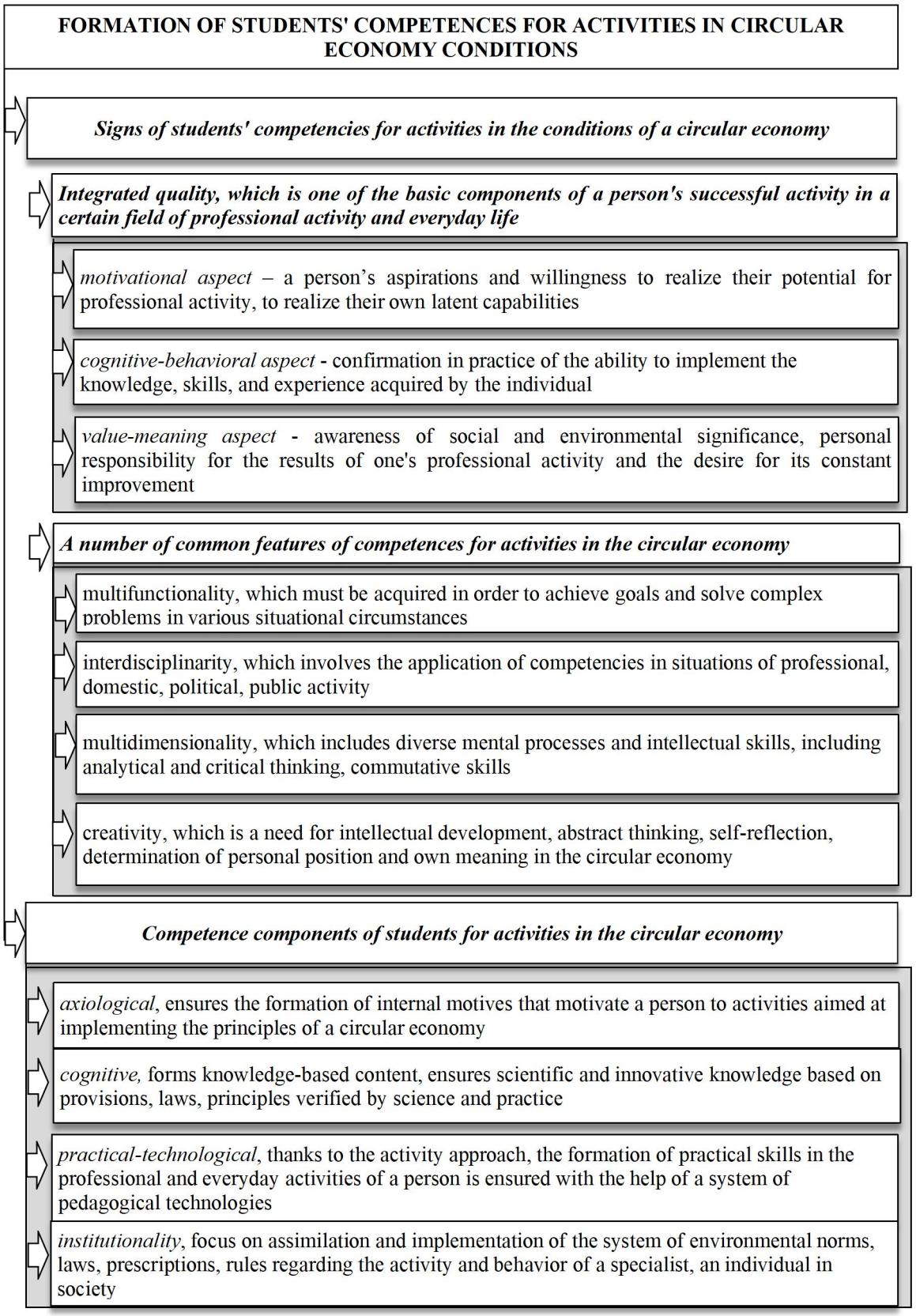

Figure 2. Principles of the competence formation for activity under the circular economy conditions

Source: built by the authors

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- secondly, cognition, forms knowledge-based content, ensures scientificity and innovativeness of knowledge based on provisions, laws, principles verified by science and practice regarding the formation of the circular economy in accordance with the development of systems in nature. Important in this component is the balance and variability of the content of educational needs, personal motives at various stages of professional formation in relation to the principles of the circular economy. Modern information technologies provide the opportunity to familiarize and introduce a large amount of various scientific information into the educational process of higher education institutions, sometimes this leads to the anticipation of the possibility of its awareness and perception;

- thirdly, practical-technological, thanks to the activity approach, the formation of practical skills in the professional and everyday activities of a person in relation to the implementation of the principles of the circular economy is ensured, it involves the creation of the conditions under which students in higher education institutions are not simply given certain knowledge about the circular economy, but with the help of a system of pedagogical technologies, the real content of human activity and its existence in society and nature is modeled and reproduced;

- fourthly, institutionality, focus on assimilation and implementation of the system of environmental norms, laws, regulations, prescriptions, rules regarding the activity and behavior of specialists, individuals in society in accordance with the principles of the circular economy.

Competencies of the circular economy in students of higher education institutions should be implemented using all forms, methods and technologies of modern education, which provide an opportunity to model the consequences of professional activity in the environment and ensure the formation of moral and ethical principles of environmental awareness.

4. Discussion

Considering the practically oriented study (Nugraheni Anggiyani Ratnaningtyas Eka et al., 2021), within which it is appropriate to pay attention to the developed training matrix for targeting the main circular competencies. In this educational matrix, the authors envisage the use of many learning strategies, such as interactive lessons, practical classes,

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laboratory experiments, learning based on inverted inquiries, citizen surveys, tours and exhibitions, as well as the use of various technologies, which will contribute to the development of relevant competencies, including from the circular economy.

Within the study (Sumter D. et al., 2021), the authors identified seven key circular competencies for design: design for reusable cycles, design for recovery, cyclical impact assessment, circular business models, circular user engagement, circular economy collaboration, and circular economy communication. The results of the survey carried out by the authors showed that the practical importance of two new competencies was emphasized: cyclical system thinking and cyclical materials and production. We believe that the obtained set of competencies is important and, as the authors of the study prove, it is the first internationally confirmed and agreed set of key competencies in the field of the circular economy, which will contribute to strengthening the pedagogical design base for the circular economy and guide the development of the circular design methodology.

Emphasizing the relevance of research (Ganiyu Abiodun et al., 2020), it should be noted that it is aimed at identifying and researching critical competencies with the effective use of waste in the circular economy. In the article, scientists identified four broad categories of competencies for the implementation of construction projects with efficient use of waste, which is an important aspect for practical activities.

Supporting the scientific achievements of scientists (Sumter Deborah et al., 2020), we would like to note that scientists have successfully researched the competencies that designers need to successfully develop products and services for a closed-loop economy. The authors used the general structure of sustainable development competencies, and as a result, it was concluded that the design of a closed-loop economy can be considered as a future, independent field in the field of sustainable development, which requires a certain set of competencies, methods and tools, which requires the development of appropriate educational programs.

Paying attention to the study (Pohrebniak A. et al., 2021), we'd like to emphasize the relevance of the study devoted to the peculiarities of enterprise management in the context of the circular economy in order to ensure their economic security.

The conducted analysis of scientific developments once again proved the relevance of the studied problem and the expediency of further research.

Conclusion

The scientific novelty of the research consists in substantiating the circular economy competencies of students of higher education institutions, which involves taking into account the pedagogical and ecological aspect and is based on: first, the epistemology of social challenges in the direction of achieving the goals of sustainable development due to the implementation of the circular economy principles, second, distinguishing the meaningful meaning of competence taking into account the factors that slow down the processes of implementing the circular economy principles in society, third, proving the general and specific features of the circular economy competences, fourth, include components, including: axiological, cognitive, practical-technological, institutional .

It is substantiated that the circular economy competencies of students in higher education institutions should meet the following characteristics:

- firstly, to be characterized by an integrated personality quality, which can be manifested in a person's desire and readiness to realize his potential for the professional activity, confirmation in practice of the ability to implement the knowledge, skills, experience acquired by the individual, as well as in the awareness of social and ecological significance;

- secondly, to meet common features, including: multifunctionality, interdisciplinary, multidimensionality, creativity.

The issue of substantiating the method of formation of system thinking and innovative competences of students of higher education institutions regarding the implementation of circular economy principles and achieving the goals of sustainable development of society requires further research.

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