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A competency-bazed approach in the environmental education of the students - future biology teachers

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Abstract: *The contemporary trends of globalization and enhanced international cooperation, as well as the aim at building a knowledge-based society, have put higher education institutions in an ever-increasing public interest. The fast-developing digitalization, the implementation of artificial intelligence and especially the generational characteristics of the learners determine the need for new approaches in teaching and learning tailored to individual needs. One of them is the competence approach, which represents one of the leading pedagogical concepts of the 21st century and is the basis for the formation of ecological competence. Its application in pedagogical practice is a serious challenge for both teachers and students – future Biology teachers. The article analyses on a structural and functional basis the components of environmental competence. A theoretical model for the formation of ecological competence in the discipline "Forms and methods of ecological education and upbringing in Biology education", included in the curriculum of Master degree students is presented. The model is aimed at updating the vision of the learning process in the relevant discipline, the main part of which is environmental education.*

Keywords: competence approach, environmental competence, environmental education

Introduction

The increasing environmental problems on a global scale have led to the need to change our attitude toward the environment, to form a new pattern of behaviour related to its maintenance and conservation. The human-nature connection is at a leading edge. It is an undeniable fact that the quality of environmental education for future generations is a key element in education for sustainable development. In this case, the

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quality and process of environmental education and upbringing should focus on the formation of environmental competence in the future Biology teachers. This competence is an opportunity to build bridges between environmental knowledge and effective actions based on this knowledge. Environmental disciplines are studied at higher education institutions, with focus on greening in education, i.e. introducing and validating environmental ideas, concepts and principles in different disciplines. The competence approach is defined as a fundamental for the modern educational paradigm. The expectations from the students – future Biology teachers, are to apply the competency approach in an educational environment and requires its integration in the process of training those who wish to gain qualification to work as teachers in the system of pre-school and school education. The relationship between competence and environmental competence is direct and meaningful. Environmental competence can be seen as an application of the competence approach in the context of ecology and sustainable development. It involves the development of specific competences that allow individuals not only to understand environmental problems and challenges, but also to actively and responsibly participate in their solution. These competences include, but are not limited to, systematic thinking, critical assessment, the ability to predict and plan for a sustainable future, and the ability to take specific environmental actions.

Methology

This article includes a review of literary sources related to the essence of the competence approach, the components of environmental competence and the relationships between them, analysis, synthesis and summary.

Objectives

The article aims at clarifying the essence of the competency approach, as fundamental in the formation of the ecological competence of future Biology teachers, to reveal on a structural and functional basis the content and dependencies between the individual components, to present a theoretical model for environmental competence in the training of future Biology teachers.

Competence approach – essence and basic concepts

Environmental competence is a leading concept in environmental education [1].

The formation of environmental competence of students requires a change in the principles and rules of study in universities, as well as the development of a new methodology of the educational process. At the heart of this new methodology lies the competence approach.

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The competency-based approach as an educational concept is associated with the lifelong learning strategy. It is an approach that 'focuses on the outcome of the educated, and this result is seen not as a collection of learned information, but as the ability of a person to act in different situations.' [2].

The content of the competence approach includes two main concepts – ***competency and competence***. In specialized literature, the two concepts are distinguished by content, but in practice they are used with the same meaning.

According to Ivanova et al., ***competencies*** in the field of an activity are considered as a complex knowledge, skills and behavioural patterns in a flexible plan. Competence is the willingness of the individual to effectively organize internal and external resources to achieve the goals and ability to solve a particular class of professional tasks [3].

According to Hutorskoy ***the competency*** 'includes the interrelated qualities of the personality (knowledge, skills, habits and modes of action), predetermined in relation to a certain range of objects and processes that are necessary for the quality performance of the activity.' The author believes that 'educational competencies are more of a matter of exclusively relating to the personality of the student and are manifested in the course of the performance of a particular set of actions' [4].

Mirabile defines ***competency*** as 'knowledge, habit, ability and characteristic associated with the performance of a high-level professional activity, such as problem solving, analytical thinking, leadership potential' [5].

While ***competency*** is seen as a pre-defined requirement for what an individual needs to know and can do to successfully perform a particular activity [6], under ***competence***, we must first understand 'an intellectual and personally determined social and professional characteristic of the personality' [7].

In the European qualifications framework for Lifelong learning (EQF) ***'competence'*** means the proven ability to use knowledge, skills and personality, social and/or methodological skills in work or study situations and in professional and personal development [8]. It is formed on the basis of cognitive features and personality's practical knowledge, which distinguish the person as competent in a specified area and give them the opportunity to effectively cope with various problematic situations.

In the report of the International Committee on Education of the 21st century at UNESCO, education is declared 'the hidden treasure' and Jacques Delors defines four pillars (principles) of education: • to learn to know; • to learn to do; • to learn to live along with others; • to learn to be, by essentially identifying basic global competencies [9]. According to Delors, 'learning to do' means not only acquiring professional competence, but also competence in a broader sense, namely learning to deal with problems in a different situation.

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The main objective of the discipline is the formation of the EC as a system of key competences in the education of students – future Biology teachers, such as ecological literacy, critical thinking, decision-making skills on environmental protection issues to be applied in their future professional realization.

Competence in the European education is briefly defined as a dynamic combination of knowledge, skills, abilities, ways of thinking, personal qualities, attitudes and values that determine a person's ability to successfully perform professional and/or educational activities [10].

Competence is an 'individual integrative feature of the individual which is expressed in the specifics of organizing and using the different knowledge and skills and allows effective solutions and behaviour in different situations. Competence is 'the ability to solve a task and do something', and 'a competent person has not only knowledge, but also applies it in a flexible way, which depends on his analytical, creative and practical skills' [11].

'***Competence***' associates with the result of the education – achievement of the goals that have been set, readiness of the learners, their adaptability to the social environment, while the concept of '***competency***' we accept as an integrated quality of the person, which manifests itself as a willingness and ability to carry out activities based on knowledge, skills and experience, formed in the process of education, upbringing and socialization, aimed at responsible and independent participation in a specific activity.

Environmental competence – a key competence of environmental education

Environmental competence is a category related to environmental awareness, environmental culture, environmental ethics and environmental behaviour, relevant values and thinking, and is a key competence of graduates. Specialists in this area define 'environmental competence' as:

– the ability of the individual to make decisions and act with the least harm to the environment;

– ability to responsibly solve life situations, to subordinate the satisfaction of their needs to the principles of sustainable development;

– ability to apply environmental knowledge and experience in professional and life situations, guided by the priority of environmental values and the non-pragmatic motivation for interaction with the environment;

– realization of personal involvement in solving environmental problems and responsibility for the environmental consequences of one's professional and domestic activities [12].

Environmental competence is multidisciplinary, integrated and sociocultural by its very nature. In terms of context, environmental competence is integrative as to knowledge, skills, abilities and an internal attitude, and at the same time a specific combination of different abilities of the subject's nature that forms the basis of professional conduct aimed at solving environmental problems' [13]. It is related to 'self-organizing,

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creativity and forming individuals that are personally oriented, capable of solving complex environmental problems, applying creativity and unconventional thinking'.

According to Popov, 'ecological competence manifests itself as a synthesis of intellectual and scientific components (cognitive and active, including general knowledge and skills), personality characteristics (values, abilities, traits, desire to perform any activity, etc.), and experience, which allows a person to use their potential to carry out complex tasks, to adapt to the constantly changing environment quickly and successfully' [14].

We can herein summarize: **The competency approach** in education is focused on the development of specific competences – a combination of knowledge, skills and relationships that allow individuals to act effectively in different situations and contexts. This approach emphasizes on the application of what has been learnt in real life situations and creative thinking development, problem solving and adapting. **Environmental competence,** featuring competences such as environmental culture, environmental awareness, environmental behaviour, environmental ethics, etc. - is the willingness to take responsibility for the relevant professional activities, by applying knowledge of the laws on environmental development (Fig. 1).

The relationship between competence approach and environmental competence is direct and meaningful. Environmental competence can be seen as an application of the competence approach in the context of ecology and sustainable development. It involves the development of specific competences that allow individuals not only to understand environmental problems and challenges, but also to actively and responsibly participate in their solution. These competences include, but are not limited to, systematic thinking, critical assessment, the ability to predict and plan for a sustainable future, as well as the ability to take specific environmental actions.

Figure 1. Environmental competences – categories and interconnections [16, extended]

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Environmental competence is an integral part of professional competence - an invariable characteristic of the professional and personal qualities of the teacher, reflecting not so much the level of knowledge as his social and moral position. The competence of a teacher is manifested mainly in his ability to manage the educational process in terms of environmental education, knowledge and work with the curricula and regulatory compliance.

L. M. Mitina introduces the professional competence of the teacher as a balance between knowledge about the subject, teaching methodology and didactics, skills and habits (culture) for pedagogical communication, as well as techniques of self-development, self-improvement and self-realization [15]. The professional pedagogical competence of future teachers includes: knowing, interpreting and applying the guidelines laid down in curricula and educational standards in practice; being able to optimize the potential of learners so as to update their abilities in the classroom; being able to assess the learning activities that have been carried out [16].

Results and Discussion

Components of the environmental competence – content and interconnections

Environmental competence includes several components, of which fundamental are the cognitive /knowledgeable, informational-experimental/ motivational-valued /axiological/, and operational /practical-applied/ [17]. I. Siaska also defines the reflexive-assessment component as fundamental, which, according to the author, is expressed in 'the ability to correct his own behaviour and actions in the environment, to predict their consequences and be responsible for this on the basis of self-reflection, self-regulation and development of environmental self-awareness [18].

Apart from the three key components, Lukyanova also sets the fourth regulatory one. It ensures the absorption and application of a system of environmental provisions, laws, regulations, rules of activity and behaviour of each individual as a citizen and a specialist in particular [19].

In terms of structure, with regard to the environmental competence, Shapran gives a definition of the motivational-valued, cognitive-functional and personality-reflexive component, namely 'a set of personality traits that are of importance to the environmental activity – cooperation, humanity, responsibility, communication, empathy, optimism, emotional stability, reflection, etc.' [20].

Based on our own teaching experience and the content of the environmental competence of the future Biology teachers, we believe that one more component should be defined. It refers to the ability to identify, formulate and follow specific objectives related to environmental protection and sustainable development. As a result of the analysis, we summarize the following components of environmental competence: target, cognitive/knowledge-based, motivationally-valued, operational, professionally-reflexive (Fig. 2).

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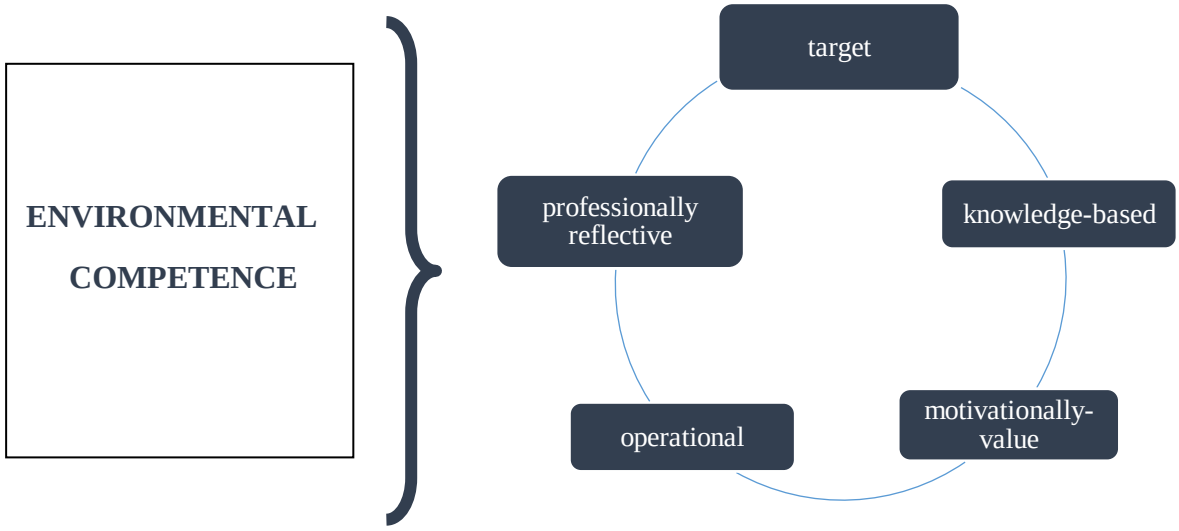

Figure 2. Components of environmental competence [19, adapted version]

The target component - includes developing and following of specific and measurable objectives of great importance to the environmental protection and sustainable development; setting of environmental goals/aimed at waste reduction, increasing resource efficiency, biodiversity conservation, etc./; personal and public objectives/ participation in environmental initiatives/; strategic planning/establishing action plans for achieving the objectives set/; progress measurement and monitoring/regular monitoring of the progress in reaching the objectives/; responsibility and commitment/ taking responsibility for achieving the environmental objectives and demonstrating commitment to their implementation.

The cognitive/knowledge-based component - covers knowledge from scientific, psychological-pedagogical, social and environmental areas of necessity for understanding and solving environmental problems, as well as for the sustainable interaction with the environment; evaluation and application of this knowledge in everyday life and at work.

The motivationally-valued component focuses on the internal incentives, values and beliefs that motivate individuals to be beneficial by their actions to the environment and sustainable development. The motivationally-valued component is of fundamental importance for the stimulation of individuals and communities to change their habits and act in line with the needs of the environment and the principles of sustainability.

The operational component relates to the ability of individuals to apply what they have learnt in specific, practical situations with regards to environmental protection and sustainable development.

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The data element of this component includes a set of skills and actions that allow people to effectively engage with environmental initiatives and adopt sustainable practices in their daily lives. This component is the criteria for the level of professional knowledge, skills and relationships, i.e. the level of environmental competence [17]. The operational element includes methods, tools and techniques needed for the environmental competence of students. The operational component includes the following skills of the future Biology teachers - to analyze and evaluate a specific environmental situation; to acquire skills and attitudes for achieving success in students, independent living, interpersonal and intercultural communication, decision-making, empathy, responsibility for their own actions; to follow the rules of ecological behaviour and maintain the balance in nature.

A professionally-reflective component refers to the ability to self-analyze and evaluate personal and collective actions in the context of environmental protection and sustainable development. Personal reflection affects one's own inner world and the whole range of individual characteristics, recognition and understanding of which can be realized, by helping the teacher to identify the paths of self-development and self-improvement.

Yu. Boichuk outlines a particular pedagogical type of reflection. The researcher defines pedagogical reflection as 'the teacher's consciousness of himself as the subject of activity: their own characteristics, abilities, how it is perceived by students, parents, colleagues, administration. At the same time, this is the realization of one's goals and structure of activity, the means for its optimization' [17].

Theoretical model for the formation of ecological competence

The main Bachelor program within the course of training of students - future Biology teachers, includes disciplines from different study cycles - humanitarian, mathematical, of natural science, psychological-pedagogical, social, economic, and methodological. Each cycle has a mandatory and variable part. The main content components for the formation of environmental competence include the humanitarian and natural science disciplines, by which basic environmental competencies are formed.

In the next – Master's degree program, the cognitive activity of the students is aimed at expanding, broadening and upgrading the acquired basic knowledge, skills and relationships within the course of study of the methodological cycle and developing of specific pedagogical and intellectual skills on the problems of environmental education and upbringing of students - goals and tasks, educational content, organizational forms and methods for their achievement. The discipline 'Forms and methods of environmental education and upbringing in Biology' is aimed at developing an ecological culture, ecological behaviour and environmental awareness in their mutual connection in order to protect, improve, manage and reasonably use the natural resources, as well as to protect the environment and ecological balance. The main objective of the discipline is

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to develop ecological competence within the training, as a system of key competences such as ecological literacy, critical thinking, decision-making skills on environmental protection issues so as to be applied in their future professional realization [21].

The model is a complete theoretical system for the formation of ecological competence based on the integration of the natural science, humanitarian and psychological-pedagogical knowledge. The purpose of the model presented is specified in the tasks: formation of a system of ecological, social and psychological-pedagogical knowledge, validation of norms, rules and value model of behaviour, practical skills for applying theoretical knowledge, decision-making and responsibility for one's own actions.

The definition of environmental competence requires a versatile approach that includes various aspects of knowledge, skills, attitudes and behaviour associated with the environment. Several key approaches have a great importance in the model: competence, interdisciplinary, action-based approaches.

Competence approach: It focuses on identifying specific competences necessary for the sustainable interaction with the environment. This includes cognitive skills (understanding of environmental processes and impacts), practical skills (ability to apply sustainable practices), affective skills (values, attitudes, and motivation to act), and metacognitive skills (reflection and critical thinking).

Interdisciplinary approach: This approach emphasizes on the integration of knowledge from various scientific areas such as Biology, Ecology, Chemistry, Geography, Social studies and Economics. The aim is to create a comprehensive understanding of environmental problems and the interconnectedness between nature systems and human activities.

Action-based approach: Encourages active participation in environmental activities and projects as a means of developing environmental competence. Practical experience allows future Biology teachers to apply theoretical knowledge to real situations and develop their skills and attitudes. The presented model is revised, extended and adapted for the needs of the author's research; a variant of a model elaborated by Shlyund [22].

The model includes the following modules in which the relevant components of environmental competence are integrated – target, cognitive, motivational, technological and effective. The correlation between them is given in Table 1.

The basic principles of environmental competence, which include purposeful ideas and values, supporting the development of a responsible attitude and building an environmentally friendly model of behaviour are namely: systematic thinking, adaptability and active lifelong learning, sustainability, responsibility and ethics.

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Table 1. Theoretical model for environmental competence of students – future Biology teachers [22, revised and extended]

<table>
<tr><td colspan="6">TARGET MODULE</td></tr>
<tr><td colspan="6">TARGET COMPONENT
Main objective: formation of ecological competence of students - future teachers of biology</td></tr>
<tr><td colspan="3">Principles
Systematic thinking
Adaptability
Active lifelong learning
Sustainability
Responsibility and ethics</td><td colspan="3">Approaches
Competence approach
Interdisciplinary approach
Action-based approach</td></tr>
<tr><td colspan="6">Tasks</td></tr>
<tr><td>Formation of a system of ecological, social and psychological-pedagogical knowledge</td><td>Promoting values, rules and standards</td><td>Practical skills for applying theoretical knowledge</td><td>Decision-making and responsibility for your own actions</td><td>Take responsibility and commit to achieving the goals set</td><td>Participation in environmental initiatives</td></tr>
<tr><td colspan="6">CONTENT MODULE</td></tr>
<tr><td colspan="6">COGNITIVE COMPONENT</td></tr>
<tr><td colspan="3">Criteria for establishing environmental competence</td><td colspan="3">Indicators for the formation of environmental competence</td></tr>
<tr><td>Ecological literacy</td><td>Ecological culture</td><td>Ecological ethics</td><td>Implementation of sustainable practices</td><td>Level of environmental knowledge</td><td>Adopting environmental values</td></tr>
<tr><td>Knowledge of environmental concepts</td><td>Environmental knowledge and awareness</td><td>Respect to life in all its forms</td><td>Innovation in problem solving</td><td>Participation in environmental initiatives</td><td>Manifestation of ethical behaviour</td></tr>
<tr><td>Understanding human relationship with the environment</td><td>Responsible behaviour and practices</td><td>Understanding nature as an interconnected system</td><td>Practice sustainable practices such as</td><td>Critical thinking and awareness</td><td>Ability to solve environmental problems</td></tr>
</table>

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Ability to make decisions and solve problems	Lifelong learning and adaptability	Developing a deep emotional connection with nature.	Environmental values and respect for nature	Communication and distribution of environmental ideas	Opportunity for critical thinking
Ability to critically analyze and evaluate information	Cultural diversity and global thinking	Developing ethical solutions to environmental problems	Ability to critically evaluate environmental information	Ecological behaviour	Ability to cooperate
MOTIVATIONAL MODULE					
MOTIVATIONALLY-VALUED COMPONENT					
Personal values - justice, respect, responsibility	Internal and external motivation	Emotional engagement	Concern for future generations	Setting significant goals in line with environmental values	Integration of environmental beliefs into a system of values
TECHNOLOGICAL MODULE					
OPERATIONAL COMPONENT					
Methods of establishing ecological competence					
Observations, visualization, creative projects, discussions, debates, project methods, seminars, excursions, creating a problem situation, case study					
THE RESULTING MODULE					
PROFESSIONALLY- REFLECTIVE COMPONENT					
As a result of the training on 'Forms and methods of Ecological education and upbringing in Biology education', students are expected to: • Be able to understand environmental problems with different levels of complexity; • Be able to apply the acquired knowledge to the environment; • Be ready to participate in discussions on Nature conservation issues; • Find ways and techniques to form communicative skills in students, critical and constructive thinking, to effectively search, extract, select and evaluate the information relevance from different sources; • Apply innovative methods and use appropriate means and materials for self-preparation and realization of educational activity; • Develop creative thinking and motivation for self-activity; • Acquire in student's skills and attitudes for success, independent living, interpersonal and intercultural communication, decision-making, empathy, responsibility for their own actions, for					

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critical and creative thinking, etc.;
- Demonstrate skills to present and to be supportive in the acquisition of presentation skills;
- Organize, coordinate and supervise the activities during the teaching process, to develop teamwork skills, to be motivated to participate in scheduled activities and independent learning, to be educated in a spirit of tolerance and outstanding of their civil position;
- Have the knowledge and to apply constructive collaborative approaches with the purpose of guiding students towards autonomy in learning through the acquisition of key skills;
- Be able to form an ecological environment;

Conclusion

The environmental competence of the students – future Biology teachers is an integrated system of environmental knowledge, decision making skills on environmental protection issues being applied in their future professional realization. Value attitude to the problems of the environment, building a new, environmentally friendly model of behaviour, manifested in different situations, responsibility for the consequences resulting from teachers' own activity, either for themselves or for the whole society. We can say that it has a complex character and comes as a result of their overall pedagogical training. Knowledge, skills, behaviour, motives and values, as well as the results of their own pedagogical activity, are constantly correlated with the target, cognitive/knowledge-based, motivationally-valued, operational and evaluatively-reflexive components of environmental competence. The model proves the need to apply the competency approach in the formation of ecological competence, being the basis for future Biology teachers to acquire environmental competences such as critical and constructive thinking, creative thinking and motivation for independent work among students, teamwork. The competency-based approach has a significant role in the development of environmental competence by providing a comprehensive and integrated training and development framework. This approach emphasizes the need to combine knowledge, skills and relationships that enable individuals not only to understand environmental problems, but also to actively and responsibly participate in their management and addressing. Environmental competence covers a wide range of aspects – from systematic thinking and understanding of ecosystems to ethical and valuable considerations with regards to our attitude against nature and the application of sustainable solutions in everyday life.

The development of environmental competence is particularly important in the context of contemporary challenges related to climate change, biodiversity loss and sustainable management of natural resources. Through a competent approach, education systems can prepare individuals not only to understand the complexity of these problems, but also to be proactive participants in resolving them, which is substantial to achieving a sustainable future for our planet.

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In conclusion, the competence approach provides an effective toolkit for integrating environmental competence into educational and public practices, thus helping to form responsible and informed citizens, ready to contribute to sustainable development and environmental protection.

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