

MENDIVE

REVISTA DE EDUCACIÓN

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Biological diversity and its treatment from environmental problem tasks

La diversidad biológica y su tratamiento desde tareas problemáticas ambientales

Diversidade biológica e seu tratamento a partir de tarefas de problemas ambientais

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ABSTRACT

Latin America and the Caribbean is a region particularly vulnerable to threats related to the loss of biological diversity. The objective of this article is to strengthen the treatment of biological diversity and its protection from the implementation of a set of environmental problem tasks from the biological disciplines that are received in the Bachelor of Education, Specialty Biology, depending on transform the modes of action of students towards the care and protection of life. Research methods were used, among

which the historical-logical, documentary analysis, observation of classes and the pedagogical test stand out, which allowed to verify the initial state of said process. As results, a proposal of environmental problem tasks is Offered That Contribute to the appropriation of knowledge, skills, values and attitudes in relation to the subject. As conclusions it can be argued that the treatment of biological diversity and its protection has not been worked with the necessary systematicity in the training of professionals, the implementation of environmental problem tasks contributes to transforming the modes of action of students towards care and protection of life.

Keywords: process; training; biological diversity; problematic tasks.

RESUMEN

América Latina y el Caribe es una región particularmente vulnerable a las amenazas relacionadas con la pérdida de la diversidad biológica. El objetivo del presente artículo es fortalecer el tratamiento a la diversidad biológica y su protección, a partir de la puesta en práctica de un conjunto de tareas problemáticas ambientales desde las disciplinas biológicas que se reciben en la carrera Licenciatura en Educación. Biología, en función de transformar los modos de actuación de los estudiantes hacia el cuidado y protección de la vida. Se utilizaron métodos de investigación entre los que se destacan el histórico-lógico, el análisis documental, la observación a clases y la prueba pedagógica, los que permitieron constatar el estado inicial de dicho proceso. Como resultado se ofrece una propuesta de tareas problemáticas ambientales que tributan a la apropiación de conocimientos, habilidades, valores y actitudes en relación con la temática. Como conclusión se puede plantear que el tratamiento a la diversidad biológica y su protección no ha sido trabajado con la sistemática necesaria en la formación de profesionales; la puesta en práctica de tareas problemáticas ambientales tributa a transformar

los modos de actuación de los estudiantes hacia el cuidado y protección de la vida.

Palabras clave: proceso; formación; diversidad biológica; tareas problemáticas.

RESUMO

A América Latina e o Caribe é uma região particularmente vulnerável às ameaças relacionadas à perda de diversidade biológica. O objetivo deste artigo é fortalecer o tratamento da diversidade biológica e sua proteção a partir da implementação de um conjunto de tarefas de problema ambiental das disciplinas biológicas que são recebidas no Bacharelado em Educação, Especialidade em Biologia, dependendo de transformar os modos de ação de alunos para o cuidado e proteção da vida. Foram utilizados métodos de pesquisa, entre os quais se destacam o histórico-lógico, a análise documental, a observação das aulas e a prova pedagógica, que permitiram verificar o estado inicial desse processo. Como resultados, é oferecida uma proposta de tarefas de problema ambiental que contribuam para a apropriação de conhecimentos, habilidades, valores e atitudes em relação ao assunto. Como conclusões pode-se argumentar que o tratamento da diversidade biológica e sua proteção não tem sido trabalhado com a sistematização necessária na formação dos profissionais, a implementação de tarefas de problema ambiental contribui para transformar os modos de ação dos alunos no cuidado e proteção da vida.

Palavras-chave: proceso; treinamento; diversidade biológica; tarefas-problema.

INTRODUCTION

It has been scientifically proven that the loss of biological diversity deteriorates the balance of nature, observing how the increase in the extinction of endemic species in certain regions causes serious effects on the economic and social development of our peoples and endangers health and current life and future generations (Berdayes *et al.*, 2018).

In this context, it can be said that all the beings that make life possible on the planet are included in what is called biological diversity. However, some of them that are vital for the development of man and other species are in danger of disappearing. The preservation and conservation of these species is not achieved without a global action, that is, an action in which everyone participates, as countries and citizens (Berdayes *et al.*, 2018).

The Earth Summit, held by the United Nations in Rio de Janeiro in 1992, recognized the global need to reconcile the future preservation of biological diversity with human progress, according to criteria of sustainability promulgated in the International Convention on Biological Diversity, which was approved in Nairobi on May 22, 1992, a date later declared by the UN General Assembly as International Biodiversity Day. With this same intention, 2010 was declared the International Year of Biological Diversity by the 61st session of the United Nations General Assembly (CITMA-CIGEA. 2019. National Environment Education Strategy).

In Nagoya, Japan, the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets were drawn up by the United Nations (Contreras *et al.*, 2018).

There are several definitions given on biological diversity in different documents, strategies and resolutions raised at the

national and international level (Armiñana, R. 2017).

Bio means life; diversity means variety. Therefore, biological diversity or biodiversity includes the variety of living organisms in a given habitat or geographical area and the ecological complexes of which they are part. It is essentially composed of three levels (Armiñana, R. 2017):

- Diversity or genetic variety within the same species (intra specific variety).
- Diversity or variety of species within ecosystems.
- Diversity or variety of ecosystems and / or biomes in the biosphere (the part of the earth's crust in which life is possible).

In Cuba, the increase in sea surface temperature, the frequency and intensity of meteorological events on the coasts, as well as the increase in sea level, increase the risk of loss of biodiversity. South of Havana, 2.5 m of coastal land is lost per year, with the consequent loss of vegetation and associated diversity of marine fauna. Tropical cyclones, which have occurred with greater frequency and intensity, constitute the events associated with climate change that most affected its marine and coastal biodiversity in recent decades (Fragoso, AJ *et al.*, 2017).

The ecological wealth of the Cuban archipelago must be known to all its inhabitants in order to achieve the care and protection of life in all its manifestations (Cruz, D. *et al.*, 2017).

For these reasons, it is necessary to rethink the contents of the teaching of Biology at school and its influence on the formation of citizens who will have to make decisions and act in a world marked by climate change (Lugo Blanco *et al.*, 2017).

Cuban higher education and, specifically, pedagogical higher education, is involved in

the search for new alternatives that achieve the preparation of a teacher in training who learns to learn and learns to teach and educate (Díaz, 2016).

When talking about the teacher of the Bachelor of Education career. Biology learning related to the Environment and the protection of biodiversity reach a special dimension, precisely because it is these graduates who have the task of transforming the modes of action of current and future generations of Cubans towards the care and conservation of life.

In the analysis of the historical evolution of the treatment towards biological diversity and its protection in the teachers in initial training of the Biology career, the moment in which the Bachelor of Education was stipulated in different specialties is taken as a starting point, a situation that it had different adjustments, in correspondence with the historical context in which it was developed (National Career Commission, 2016).

It corresponds to the study plan A the genesis of environmental training and the treatment of biological diversity with an orientation to specialization and its protection. Its designation is due to the fact that it gives the first guidelines, organizational and methodological steps for the incorporation of environmental education in the study plans and, therefore, in the development of environmental training and the treatment of biological diversity in the training of the education professional.

Subsequently, study plan B is put into effect, where indications are offered for the development of environmental education in the educational system, which gradually acquired connotation. Thus, in 1979 the First National Seminar on Environmental Education was held, in Havana, considered the first momentous action, from which a

deployment of work in this direction took place.

On the other hand, the treatment towards biological diversity was conceived in the subjects directed to its study, but it was insufficient and formal. Greater attention was paid to the objectives of the programs, which were limited to promoting love for different groups (in some, from an aesthetic perspective), their care and protection, a trend that did not exceed the intention that prevailed as tradition in the Cuban pedagogy.

The treatment of the contents of biological diversity, studied mainly in the Biology and Geography majors, with greater depth in the first, did not favor the important relationship and integration of the contents, an expression of the scarce inter-subject relationships between the biological subjects that prevailed in the stage and the poor interdisciplinary treatment, necessary in environmental training. When arguing the importance of groups, their utilitarian significance and nature were emphasized, without considering other alternatives that would motivate and make the issue more meaningful.

As features of this stage corresponding to study plans A and B, in relation to the treatment of biological diversity, we can highlight the lack of harmony between the logic of the profession and the logic of science, no systemic development with dependence on the preparation and motivation of the teacher, the insufficiency and formality with which the orientation towards biological diversity was conceived in the subjects directed to its study (Lugo Blanco *et al.*, 2017).

In study plan C, biological diversity contents were integrated in disciplines, which favored its treatment with a higher level of integration, expression of the characteristics of the new plan, designed on the basis of a curricular, systemic, multifunctional and

multidisciplinary conception, in function of achieving greater rigor and comprehensiveness in teacher training, to assess problematic situations of their specialty and solve the problems of the school and society, which was not always achieved in all its magnitude.

As the main feature of this stage, it can be stated that the use of procedures that involved the teacher in initial training in environmental problems and, especially, biological diversity, was not enough. The treatment of biological diversity was closer to a more integrated study, with a higher level of inter disciplinarily, of theory-practice relationship, although the required results were not achieved in relations with the community.

For the new study plan D, the improvement program related to details about environmental education for sustainable development in Pedagogical Higher Education and pedagogical schools was carried out, where it was diagnosed that there are potentialities for the treatment of biological diversity in the initial training of the professional, expressed in: the conception of curricular strategies, among which is that of environmental education for sustainable development; in the presence of its own and elective curriculum that provides flexibility for the incorporation of new content according to particularities of the training context and in the existence of a main integrating discipline Investigative Labor Training, which allows starting from the practice with a professional approach to the student issues of environmental education for sustainable development, as well as Field Practice as an integrating discipline of the natural and social environment that favors education towards the protection of biological diversity from the educational polygons (National Career Commission, 2016).

The inclusion in the bibliography of updated materials with an ecosystem approach, which can facilitate the preparation of teachers and

teachers in initial training, on topics related to treatment of biological diversity.

The disciplines of the curriculum do not have explicitly incorporated the contents on environmental issues.

It is significant to note that, generated by the increase in the environmental crisis itself, the attention by the ministries to the treatment of environmental issues in universities, constitutes a priority issue for the comprehensive training of graduates and especially in Higher Pedagogical Education.

At the present time, the implementation of the new study plan E is in force, which proposes the training of teachers by disciplines and the duration of the careers in four years.

For this new study plan, the improvement of environmental training is proposed from the curricular strategies of the biological disciplines in the linking of the contents, although it is important to highlight that there is a greater intention towards the treatment of biological diversity and its protection, declared from the general objectives in the professional model.

In the formation of the professional of the Biology career there is an intention in the treatment of biological diversity; However, there are still weaknesses in this sense that justify the proposal of research aimed at raising the level of knowledge, skills, values and attitudes in relation to the subject.

The objective of this article is to strengthen the treatment of biological diversity and its protection from the implementation of a set of environmental problem tasks from the biological disciplines that are received in the Bachelor of Education career. Biology, in order to transform the modes of action of students towards the care and protection of life.

MATERIALS AND METHODS

The research was carried out in Higher Education in the formation of students of the Biology career. The structuring of the content system related to biological diversity encourages the formation of knowledge, skills and values that constitute the basis for the study of these contents at different levels. We worked with a sample made up of 22 teachers in initial training and 11 teachers who teach the biological contents in the career.

The methodological conception used in this research is the comprehensive investigative approach, which is based on the dialectical-materialist method, which made possible an analysis of the environmental training process and, specifically, the treatment of biological diversity and its protection. In the initial training of teachers, to know their relationships with other objects and the determination of the human being in the transformation of the problem identified on said object.

This general method was accompanied by the application of theoretical level methods: the induction-deduction method allowed the work with the theoretical-methodological references and the making of inferences about the treatment of biological diversity in the processing and interpretation of the results that allow to reach conclusions in relation to the subject.

The historical-logical method made possible the study of the evolution of the term biological diversity and its contextualization in the training of professionals.

Empirical methods such as observation, which allowed verifying the current state of the problem from the exploration of reality in the different contexts where the student interacts.

The documentary analysis was used in order to know the treatment of the subject under investigation in the normative documents of the educational level. The pedagogical test was used to diagnose the students and verify the pedagogical problem. Descriptive statistics and percentage analysis were used to process the information.

RESULTS

In the investigative process, through the use of different methods and techniques, an initial measurement and a final measurement were carried out, after the proposal was applied, to corroborate the relevance of the scientific product.

The diagnostic study begins with the definition of the variable treatment of biological diversity and its protection in the Bachelor of Education career. Biology.

It is assumed that the treatment of biological diversity and its protection in the context of the career is a succession of stages aimed at perfecting the appropriation of knowledge, skills, values and attitudes towards the care and protection of living beings, in coordination with the Direction of the process by the teaching group, taking into account the economic, political, social, ecological components and the accumulated experiences, with the leading role and commitment of all the subjects involved in the pedagogical process, in terms of sustainable development.

To characterize the variable treatment of biological diversity and its protection in the context of the career, it was necessary to operationalize the variable under study in two dimensions: the cognitive-procedural dimension and the process direction dimension. After the initial measurement has been carried out, the results of the

dimensions are presented by the different instruments.

The historical study carried out revealed the need to improve, in the direction of the process, the contextualization of the knowledge system for the integral formation of students.

The bibliography does not always explicitly recognize the application of the knowledge system in favor of the comprehensive preparation and performance of students in life.

In the documentary analysis of the program and methodological orientations of the different disciplines, it was possible to see a tendency to treat the content in a traditional way and away from the reality that today presents the treatment of biological diversity and its protection.

In 83.7% of the sampled classes, the contents related to the treatment of biological diversity work in a fragmented way and lack an update in relation to this topic, being evaluated as fair and bad.

In 79.5% of the classes observed, the conception of actions aimed at treating biological diversity and its protection is limited.

87.7% of the students' responses show little preparation in topics related to biological diversity and its protection.

Table 1- Initial measurement results

Dimensions	Indicators	AND	B	R	M
Cognitive Procedural	The teacher in initial training knows about the definitions of biological diversity, problems associated with its loss and the causes that originate it at a global, national, regional and local level; endemic and autochthonous species and in the different management categories; the species introduced in Cuba and their impact on ecosystems; beliefs and myths related to biological diversity and different forms of <i>in situ</i> and <i>ex situ</i> conservation; the relationship of other environmental problems with the loss of biological diversity and the laws, resolutions and strategies of the State Council for their protection.	-	26.3	47.3	36.4
	The teachers in initial training identify and characterize problems related to biological diversity in areas surrounding the institution, in the community and the teaching polygons of the Field Practice, in relation to the level of affectation of flora and fauna and the causes that it provokes.	-	25.6	39.4	38.8
	Teachers in initial training explain the implications of the loss of biological diversity on the health and well-being of human beings.	-	42.1	36.8	21
	Teachers in initial training plan, organize, execute and control actions from the different contexts where they interact, as an expression of their modes of action, in relation to biological diversity and its protection.			36.8	53.19
	Teachers plan, organize, execute and control the Teaching-Learning Process of the disciplines they teach, in order to intentionally and systematically treat biological diversity and its protection.	-	26.3	33.4	43.8
Process direction	Teachers plan, organize, execute and control from the Teaching-Learning Process of the			46.8	53.19

disciplines that impart problem situations, as well as tasks and problematic questions in relation to the treatment of biological diversity and its protection.					
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The use of these methods made it possible to identify the weaknesses related to the variable under study. For this it was found:

- Limited didactic preparation of the teachers, which does not favor their protagonism in relation to the treatment of biological diversity and its protection in the training process of the career.
- The traditionalist approach is manifested in the treatment of the contents related to the treatment of biological diversity and its protection, limiting the comprehensive training of students.
- Limited knowledge and little development of skills in relation to the treatment of biological diversity and its protection are manifested in the students.

Based on the previous results, a set of environmental problem tasks are proposed that allow the appropriation of knowledge, skills, values and attitudes in relation to the treatment of biological diversity and its protection.

After applying the proposal of environmental problem tasks from the biological disciplines of the basic curriculum of the career, the measurement instruments were applied again, obtaining the following results.

93.6% of the teacher state in the direction of the process the importance of dealing with the contents related to the treatment of biological diversity and the implementation of environmental problem tasks as a fundamental link in the implementation of these contents.

84.2 of the classes visited intentionally deal with environmental problems and specifically, the treatment of biological diversity.

In the final pedagogical test it was found that 86.4 of the students know about the definitions of biological diversity, problems associated with its loss and the causes that originate it at the global, national, regional and local levels, the endemic, autochthonous species and in the different management categories, the species introduced in Cuba and their impact on ecosystems, the beliefs and myths related to biological diversity and the different forms of *in situ* and *ex situ conservation*, the relationship of other environmental problems with the loss of biological diversity and the laws, resolutions and strategies of the State Council for its protection.

Table 2- Results of the final measurement

Dimensions	Indicators	AND	B	R	M
Cognitive Procedural	The teacher in initial training knows about the definitions of biological diversity, problems associated with its loss and the causes that originate it at a global, national, regional and local level, the endemic and autochthonous species and in the different management categories, the introduced species in Cuba and its impact on ecosystems, beliefs and myths related to biological diversity and the different forms of <i>in situ</i> and <i>ex situ conservation</i> , the relationship of other environmental problems with the loss of biological diversity and the laws, resolutions and strategies of the Council of State for their protection.	23.5	62.3		
	The teachers in initial training identify and characterize problems related to biological diversity in areas surrounding the institution, in the community and the teaching polygons of the Field Practice, in relation to the level of	26.4	70.2		

	affectation of flora and fauna and the causes that it provoke.				
	Teachers in initial training explain the implications of the loss of biological diversity on the health and well-being of human beings.	18.9	69.3		
	Teachers in initial training plan, organize, execute and control actions from the different contexts where they interact, as an expression of their modes of action in relation to biological diversity and its protection.	23.8	62.7		
Process direction	Teachers plan, organize, execute and control the Teaching-Learning Process of the disciplines they teach, in order to intentionally and systematically treat biological diversity and its protection.	-	84.2		
	Teachers plan, organize, execute and control from the Teaching-Learning Process of the disciplines that impart problem situations, as well as tasks and problematic questions in relation to the treatment of biological diversity and its protection.	72.9	23.8		

The table above shows the results in levels obtained in the dimensions evaluated, after applying the proposal of environmental problem tasks. The percentages reflect the location of a greater number of teachers in initial training evaluated at that level in the evaluation of the dimensions. It was found that, in each case, the values increased by one level after the proposal was put into practice, obtaining positive results in this regard.

After the analyzes carried out, in the initial and final measurement, and the results obtained with the application of the instruments, the relevance of the proposal is shown.

Proposal of environmental problem tasks to educate towards the protection of biodiversity from the biological disciplines

For the implementation of the problem tasks, each of the components of the didactics of Higher Education is addressed.

Professional problems

The need for teachers in initial training in the study of biological diversity at the genetic, species and ecosystem level for the development of an environmental culture, as well as the formation of values, attitudes and standards of behavior in the different social environments, in correspondence with the duty to be a citizen and the demands of the object of his profession.

The diagnosis and characterization of the school, the group and the family and community environment where the adolescent or young person develops, in relation to the environmental problem and the need to address the weaknesses and strengths identified in this direction.

Purpose: the process of environmental training, with an emphasis on biological diversity and its protection.

Objectives: contribute, through environmental problem tasks, to the appropriation of the contents in relation to biological diversity and its protection at the genetic, species and ecosystem level.

Diagnose, in pre-professional practice, the strengths and weaknesses of students in relation to the care and protection of living beings.

The contents are structured by the system of knowledge, skills, values and attitudes.

Knowledge

- The definition of biological diversity.
- The levels of biological diversity.
- The causes that are causing its loss at different scales (global, national, regional and local).
- The classification system that is used to name the different species.
- Conventions and events held, nationally and internationally, to address the issue of biological diversity.
- The study of biological diversity at the genetic level.

General skills

- Identify the most general features related to biological diversity, as well as the physical spaces where it is affected.
- Explain the manifestations of the problems related to the loss of biological diversity at the different scales at the global, national, regional and local levels and their repercussions on human life, as well as their fundamental causes and consequences.
- Characterize certain physical spaces where biological diversity is affected, at the genetic level.

General skills allow the transition to the development of professional pedagogical skills, which for this stage are proposed the following: observe, diagnose, characterize and communicate.

Observe the facts related to impacts on biological diversity

- Determination of the object of observation.
- Preparation of the observation guide.
- Fixation of the features and characteristics of the object observed

in relation to the objectives, in different contexts of action.

- Processing of observation results.
- Results analysis.

Diagnose / characterize problems related to biological diversity in community settings and at the level of knowledge of their students, in their pre-professional practice.

- Definition of operations of the phenomenon to be characterized (translate in terms of variables).
- Identification of the variables defined in each particular case.
- Selection of the research technique.
- Elaboration of the instruments, based on the technique.
- Instrument application.
- Processing of the results obtained with the application of the instruments.
- Results analysis.

Value system: civic responsibility, cultural and professional identity, pedagogical ethics, environmental awareness, respect and love of diversity.

Attitudes: expressed in all those actions that teachers in initial training can carry out, in order to protect biological diversity and help new generations to acquire social values and a deep interest in the Environment, which encourages them to actively participate in their protection and enhancement.

METHODS

The proper selection and organization of the methods is vital to guarantee the proposed goals. In this sense, it would be necessary to combine dissimilar variants (expository, joint elaboration and independent work), together with problem-solving methods, which enable the elaboration of environmental problem tasks.

The combination of them favors the dynamics of the process and the fulfillment of the objectives.

Media

Textbooks related to the topic of biological diversity in Cuba, tabloids, articles with an ecosystem approach, digital media such as cell phones and laptops, which guarantee access to the internet and information search sites, which allow a more up-to-date preparation in relation to the theme.

Shapes

The environmental problem tasks will be oriented in the conferences and socialized in the practical classes and in the seminars. This planning, organization, execution and control will depend on the intentions of the teacher; that is, when he deems appropriate and in accordance with the content of the discipline he is teaching, guide the task and later socialize it.

Evaluation

It will be done systematically.

Problem tasks are proposed in the biological disciplines that are worked on in the base curriculum of the grade.

1. Teachers in training, who are studying for a Bachelor of Education, in the specialty Biology-Chemistry, study life in all its manifestations. However, when asking what they understand by biological diversity, they manifest different criteria, since they usually refer to the different species of animals and plants that surround them, be they birds, trees, fish or insects, without referring to intrinsic diversity, which is It manifests itself in the traits that are expressed in individuals and that are transmitted from parents to children, as well as the differences in the places where these species live, on land or in

the sea, in a forest or in a desert, in a river or deep in the ocean.

a. What is meant by biological diversity? Come up with your own definition.

b. What are the levels of biological diversity and the causes that are causing its loss at different scales, global, national, regional and local?

c. What is the classification system used to name the different species?

d. Mention some international conventions that have been held to address the issue of biological diversity.

e. Is there citizen awareness in Cuba about the loss of biological diversity as a national problem and the responsibility that this has?

2. Most of the living beings in the world are represented by insects, followed by fungi and bacteria, while vertebrates only occupy a small portion of it. In the world, up to the present there are 1.75 million species and it is estimated that 12 million have yet to be discovered, figures that would cast doubt on how science can study and know all the living beings that coexist on the planet.

a. How is the biota made up on the planet?

b. What are the five kingdoms where living things are grouped?

c. What general characteristics do the organisms represented in each of the kingdoms present?

d. What are the main categories for the classification system of living things?

e. Find out what new classifications are currently being proposed to group organisms.

3. Since the first civilizations of the world, a material called, paper, sheet or folio has been used for dissimilar questions. What many people ignore is that this material is made from substances of plant origin. One of the current problems is related to trees; each species of tree in the rainforest contains four or five species of insects that are unique to it. 100 years ago there were 15,000,000 km² of tropical and temperate forests; currently, there are 9,000,000 left and these disappear at the rate of 150,000 km² a year. For every 10 trees that are cut down, one is planted and, therefore, some experts predict that 19 species are becoming extinct every hour, 456 a day and 167,000 a year, many of them unknown to science.

a. How has the loss of biological diversity in the world behaved in recent years?

b. What are the existing threat categories for Cuba on biological diversity and what elements are found in each one of them?

c. What are the main effects caused by threats to biological diversity in Cuba?

d. Carry out a study of how the wooded area of Cuba has behaved since its discovery to the present day and give your opinion on it.

4. Cubans today enjoy living on one of the islands with the greatest ecological wealth, due to its high endemism worldwide. However, the effects caused by threats to biological diversity in Cuba and the national trends of some of these effects, such as processes affecting biological diversity, due to their significance and national relevance, are not known.

a. How does habitat fragmentation or loss occur in ecosystems and landscapes?

b. What are the invasive species of flora and fauna introduced in Cuba?

- c. What are the current impacts of climate change on the biological diversity of Cuba?
- d. What are the measures adopted to reduce the expected impact of climate change on biological diversity in Cuba?
- e. Investigate some of the species of terrestrial flora and fauna found in the different management categories in the province of Pinar del Río.
5. Fungi and man have evolved at the same time since the beginning of human history. These organisms have traditionally been used as food, to generate new foods and beverages, to cure diseases and have even been used in religious festivals and ceremonies due to the hallucinogenic properties of some species; however, most people are unaware of the positive or negative effect of these organisms on other living beings and on human life.
- a. How were mushrooms used by prehistoric cultures?
- b. In what places can these organisms be found?
- c. What are the negative effects of these organisms on agriculture and man?
- d. How important are these organisms in nature, in the economic-social sphere and from the point of view of environmental sanitation, as biological control agents and as bio fertilizers?
- e. Come up with ideas on how you would motivate your high school students to achieve greater ownership of the content related to mushrooms.
6. When you look around the fields of Cuba, depending on whether it is a beach, a key or a mountain, you will find a group of fungi, algae, plants and animals peculiar to those environments; however, one might wonder why these animals and plants are here, while others such as tigers, elephants or giraffes are missing.
- a. How did the ancestors of today's biota come to these lands and where do they come from?
- b. How is the current biota with respect to the biota that existed on the island, before the arrival of man?
- c. What relationship does evolution have with the formation of some species that currently exist on the island of Cuba?
- d. Since when does the Cuban biotas exist?
- e. Conduct a study on the species that are endemic and indigenous, as well as the species that are exotic or foreign.
7. When talking about bacteria, the term is mostly associated with diseases and other negative aspects, without knowing that many industries depend in part or entirely on bacterial action for the production of food and substances that favor the quality of life.
- a. How important are bacteria in agriculture and in the environment, from the fixation of molecular nitrogen?
- b. In what habitat can this group of organisms be located?
- c. How important are they for man from the economic and social point of view?
- d. How important are airborne bacteria?
- e. Do you think that in your training as a teacher and as a citizen you need to know about bacteria? Why?
8. Did you know that bacteria contribute to maintaining the ecological balance in the seabed, being the first manifestations of life

in this environment, arising between five hundred million and six hundred million years ago? Most of the works on the distribution and abundance of these microorganisms deal with heterotrophic bacteria. In Cuba, one hundred and thirty species and more than forty marine genera have been registered, which are investigated to find out what role they play within the different ecosystems.

a. Explain how bacteria contribute to maintaining ecological balance on the seabed.

b. Why bacteria are considered good indicators of environmental quality?

c. What effect do bacteria such as *Sauripa*, present on the skin of tunic fish, cause?

d. Investigate how indigenous bacteria are used in the country in order to eliminate levels of contamination from oil spills.

9. In the course of your career, you have questioned the importance of knowing the role of each macroscopic or microscopic organism within ecosystems; for example, microalgae, which include marine organisms, mostly unicellular and with plankton life (phytoplankton), with photosynthetic action on other marine organisms. To date, some four hundred and forty species of microalgae have been identified in Cuba; some of them may have direct action on their ecosystems and other secondary effects on man.

a. How important is the photosynthetic activity of phytoplankton?

b. What negative effects can they have on other organisms?

c. Identify some symbiotic relationships that occur between microalgae and other organisms.

d. Make a conclusion where you expose some ideas about what knowing about microalgae

contributes to you in your civic and professional training.

10. Pathogen city is the ability of a parasite to cause damage to a host. It is an attribute of numerous species of bacteria and an expression of the diversity of these prokaryotes in nature. It would be significant to ask if the importance of knowing the bacteria and their negative action is in the interest of farmers, science researchers or all those who may be the object of their action.

a. What phytopathogenic genera are the ones that most affect the infection of economically important crops?

b. What bacteria affect animals, whether they are economically important, domestic, or pet?

c. What infectious diseases of animals can infect man through bacteria?

d. What are the most important pathogens that affect man?

DISCUSSION

The results obtained with the application of the exposed methods and the bibliographic search on the subject show the need to deepen it, due to the contribution to the treatment of biological diversity and its protection in the teachers in initial training of the Biology career, which will be reversed in the new generations.

The authors recognize the importance of treating biological diversity and protecting it in raising awareness of these problems. All the beings that make life possible on the planet are included in what is called biological diversity. However, some of them that are vital for the development of man and other species are in danger of disappearing. The

preservation and conservation of these species is not achieved without a global action, that is, an action in which everyone participates, as countries and citizens (Lugo Blanco *et al.*, 2021).

The Cuban educational system and, specifically, Pedagogical Higher Education have achieved important achievements in the treatment of issues related to the care and protection of the Environment, and the treatment of biological diversity, explicitly reflected in the Professional Model of this career, and established in guidelines 133 and 146 of the Social and Economic Policy of Cuba.

According to the research consultation carried out by other authors who have studied the subject such as: Armiñana (2017); Berdayes, Ravelo, Armas (2018); Contreras, Pérez López, Hernández (2018); Cruz, Martínez, Fontenla, Mancina (2017); Frago, Santos, Aguiar (2017); Lugo Blanco, Álvarez Yong and Estrada Rodríguez, C. (2017); Santos, McPherson, Villalón, Marimón, Fernández and Merino, T. (2016) it was found that there are some coincidences with the results obtained by having contact points related to:

- The design of problematic tasks in the treatment of the contents concerning the biological diversity and its protection.
- Attention to several key factors such as the preparation of teachers in the disciplines they teach, the accurate diagnosis of the difficulties presented by teachers in initial training in relation to environmental issues and the methodological work developed by the career.
- The implementation of the scientific product, based on the treatment of the contents related to biological diversity and its protection must be conceived in a gradual and systemic way, so that it contributes to the appropriation of knowledge and skills

in teachers in initial training, who later they revert to values and attitudes.

The novelty of the research lies in the implementation of environmental problem tasks, which promote reflective, creative and developer learning in teachers in initial training of the career, which allows establishing a relationship between the logic of science and logic of the profession and enrich their comprehensive training as citizens and as future teachers in the exercise of the profession.

Biological diversity and the functioning of ecosystems provide essential goods and services for human health, such as: nutrients, air, clean water and control of pests and diseases transmitted by vectors. Biological diversity is essential for the regulation of the immune response and is the basis of traditional medicine. Many of the major prescription drugs contain components derived from plant extracts; Biodiversity is the foundation for sustainable livelihoods in today's world.

The systematization carried out found that biological diversity has been debated from different approaches, mainly aimed at the search for knowledge and solutions to mitigate the damage caused by humanity.

The actions proposed for the design of problematic tasks in the treatment of the contents related to biological diversity and its protection allow its contextualization, helping to solve problems that society faces.

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Author declares not to have any conflicts of interest.

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The author has participated in the writing of the work and analysis of the documents.



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