



Original article

Reinventing the teaching of Faunal Biodiversity Contents in the Cuban middle school

Reinventando la enseñanza de los Contenidos de Biodiversidad Faunística en la escuela media cubana

Reinventando o ensino dos Conteúdos de Biodiversidade Faunística na escola media cubana

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ABSTRACT

This article describes a didactic model for the treatment of faunal biodiversity content in the eighth grade Biology subject at the basic secondary educational level in the Cuban context. A qualitative methodology was followed, with an interpretive-hermeneutic approach. The modeled process was based on three subsystems: cognitive, didactic-methodological and axiological-environmental, made up of structural and functional components with

a systemic relationship, which allowed the formation of the student's environmental culture to be revealed as a resulting higher-order quality. In its development, theoretical methods were used such as analytical-synthetic, inductive-deductive modeling, systemic-structural-functional and among the empirical methods, document analysis, participant observation and interviews. The methodological organization of the faunal biodiversity content and its didactic approach stand out as results, based on integrating knowledge, skills and values, as well as the ways of meaning local faunal biodiversity by the students, as well as the practices of care, rational use and respect for the different forms of life that inhabit their immediate environmental reality. Finally, the quantitative and qualitative results obtained with the application of the expert evaluation method demonstrate the feasibility, applicability and relevance of the proposal.

Keywords: teaching; learning; biodiversity; content, model.

RESUMEN

El presente artículo describe un modelo didáctico de tratamiento de los contenidos de biodiversidad faunística en la asignatura Biología grado octavo en el nivel educativo Secundaria básica en el contexto cubano. Se siguió una metodología cualitativa, con un enfoque interpretativo-hermenéutico. El proceso modelado se sustentó en tres subsistemas: cognitivo, didáctico - metodológico y axiológico-ambiental, integrados por componentes estructurales y funcionales con relación sistémica, que permitieron revelar como cualidad de orden superior resultante la formación de la cultura ambiental del educando. En su elaboración se emplearon métodos teóricos como el analítico-sintético, inductivo-deductivo la modelación, el sistémico-estructural funcional y entre los métodos empíricos el análisis de documentos, la observación participante y la entrevista. Se destacan como resultados, la organización

metodológica de los contenidos de biodiversidad faunística y su abordaje didáctico, a partir de integrar los conocimientos, las habilidades y los valores, así como las maneras de significar por parte de los/as estudiantes la biodiversidad faunística local, al igual que las prácticas de cuidado, uso racional y respeto a las diferentes formas de vida que habitan en su realidad ambiental próxima. Finalmente, los resultados cuantitativos y cualitativos obtenidos con la aplicación del método evaluación por criterio de expertos demuestran la factibilidad, aplicabilidad y pertinencia de la propuesta.

Palabras clave: enseñanza; aprendizaje; biodiversidad; contenido; modelo didáctico.

RESUMO

Este artigo descreve um modelo didático para o tratamento do conteúdo da biodiversidade faunística na disciplina de Biologia do oitavo ano do ensino secundário básico no contexto cubano. Seguiu-se uma metodologia qualitativa, com abordagem interpretativo-hermenêutica. O processo modelado baseou-se em três subsistemas: cognitivo, didático-metodológico e axiológico-ambiental, constituído por componentes estruturais e funcionais com relação sistêmica, o que permitiu revelar a formação da cultura ambiental do aluno como uma qualidade resultante de ordem superior. . No seu desenvolvimento foram utilizados métodos teóricos como modelagem analítico-sintética, indutiva-dedutiva, sistêmico-estrutural-funcional e entre os métodos empíricos, análise documental, observação participante e entrevistas. Destacam-se como resultados a organização metodológica do conteúdo sobre biodiversidade faunística e sua abordagem didática, baseada na integração de conhecimentos, habilidades e valores, bem como as formas de significação da biodiversidade faunística local pelos alunos, bem como as práticas de cuidado, uso racional. e respeito pelas diferentes formas de vida que habitam sua realidade ambiental imediata. Por fim, os resultados quantitativos e qualitativos

obtidos com a aplicação do método de avaliação pericial demonstram a viabilidade, aplicabilidade e relevância da proposta.

Palavras-chave: ensino; aprendizagem; biodiversidade; conteúdo; modelo didático.

INTRODUCTION

Under current conditions, the accelerated socio-environmental deterioration, with particular emphasis on the loss of biodiversity as one of the environmental problems declared internationally, is causing great impacts on the functioning and balance of ecosystems and, as a consequence, has an unprecedented environmental crisis has originated worldwide, which endangers the very survival of the human species. It is from this perspective that special attention must be paid to the biodiversity that inhabits planet Earth as a resource of inestimable value from political, philosophical, socioeconomic, epistemic, ethical, cultural, but above all, educational perspectives to promote in the individual and the community a change of attitude in favor of the environment, raising awareness and reinforcing values, in a way that allows respecting it, knowing it, establishing a more responsible relationship with it and preserving it.

The previous reflections support the importance of seeking ways to improve the treatment of this topic in Cuban schools, especially in the teaching of biology at the basic secondary educational level, as a basically level of systematization of the essential contents already studied in Primary Education. . In this sense, as part of the curricular framework of the Cuban basic secondary school, the subject Biology, eighth grade, is included; In it, its contents are organized based on the study of the animal kingdom, from a

explanatory-integrative, evolutionary, ecosystemic, bioethical and declares within

its objectives the contribution to the scientific training of the student, based on the study of the objects, processes and phenomena associated with biodiversity and its interactions with the environment (García, 2022).

However, in a diagnosis carried out by the author in the 2021-2022 school year based on the observation of (12) teaching activities within the framework of the teaching-learning process of the eighth grade Biology subject, in three basic secondary schools in the Pilón municipality, in the province of Granma, Cuba, was able to verify some didactic and methodological difficulties among biology teachers. This is the case, for example, of the limited articulation between the system of conceptual, procedural and attitudinal contents to achieve in students the understanding, explanation, contextualized appropriation, consolidation and mastery of the various meanings of the faunal biodiversity of the environmental environment. where they live.

Added to the above is that biology teachers clearly show limitations in how to carry out the methodological organization of the contents related to wildlife and their respective didactic approach; situation that invites us to rethink a more holistic, interdisciplinary, ethical, systemic, systematic, integral, ecological and socioeconomic approach to teaching biodiversity (García and Méndez, 2017), to perfect this field of knowledge in a way that is more contextualized to reality. environmental.

These results are consistent with the work of García and Martínez (2010), when they report that biodiversity teaching practices in the school context are still limited to the transmission of programmatic content, where only biodiversity, species and ecosystems as more concepts, in isolation. This makes it difficult to develop awareness.

satisfactory environmental environment that means that the person themselves becomes an agent of change (Ayerbe and

Perales, 2020), to stop the loss of biodiversity.

For this reason, these results justify the need to improve and update the methodological treatment of the contents related to faunal biodiversity in the eighth grade Biology subject at the basic secondary educational level in the Cuban context, in a way that allows for developmental learning. and formative in the students, being coherent with the advances of the biological sciences and their didactics in recent decades, the general aims and objectives of Cuban education, the objectives of the basic secondary educational level and the objectives of the degree, so particular. The above implies, therefore, profound modifications, not only of a curricular nature in the subject, but in the entire mechanism of the teaching processes (De La Cruz and Pérez, 2020), to ensure that biology teaching is no longer solely for learn about life, and become a science that teaches how to live and act for the sustainability of life (García, Sánchez and García, 2020).

Taking into account the significance of the problem raised and the education needs detected to promote the learning of biological content, the objective of this research was to describe a didactic model for the treatment of faunal biodiversity content in the eighth grade Biology subject in the basic secondary educational level, for the formation of the environmental culture of the students. In this way, the intention of this work is not to theoretically contrast its possible success against other existing didactic proposals, but rather to describe the modeling process followed and show some results derived from it in the Cuban educational context, all of which would allow a comprehensive approach. of the current challenges in teaching biodiversity at the basic secondary educational level.

MATERIALS AND METHODS

The methodology used in the research was qualitative in nature from the interpretive-hermeneutic approach. This allowed an in-depth epistemological study to be carried out in a specific context (Taylor and Bodgan, 1998). The research was carried out in three Basic Secondary Schools belonging to the Pilón municipality, in the Granma province, Cuba, with the participation of 13 biology teachers with more than 15 years of experience. The process of modeling the teaching-learning process of the contents of faunal biodiversity was carried out as an approach to teaching its system of knowledge and practices, to contribute to the formation of the student's environmental culture. Specifically, we worked on Unit 2 Characteristics of animals, unity and diversity, of the eighth grade Biology program at the basic secondary educational level, to perfect its didactic approach and the organization of the aforementioned contents.

To corroborate the feasibility and relevance of the designed model, the evaluation method was used by expert criteria through the Delphi method, which, as Reguant & Torrado (2016) points out: "consists of a technique for obtaining information, based on consulting experts in an area, in order to obtain the most reliable consensus opinion of the group consulted" (p.88). The application of the method by expert judgment was applied using five stages: 1. Definition of the objective of application of the evaluation method by expert judgment; 2. Selection of experts; 3. Selection and application of the methodology; 4. Assessment of the results of the application of the method. In this sense, the non-parametric test was applied for K samples related to the judgments made by the experts.

In the investigative process, theoretical methods of knowledge were also used: historical-logical, analytical-synthetic, inductive-deductive and ascent from the abstract to the concrete for the assessment of the information obtained, as well as the

modeling and the systemic-structural-functional, which allowed us to argue the main relationships that are revealed between the subsystems of the model, from an ideal representation of the formation of environmental culture in the student, in which new qualities are perceived among the subsystems and components that make it up.

Among the methods of the empirical level of knowledge, a survey of selected experts was used as an instrument, which was structured in eight item questions and two development questions, the method by expert criteria to assess the relevance of the model, as well as the documentary review. of the study program and methodological guidelines of the eighth grade Biology subject at the basic secondary educational level in the Cuban context. Descriptive and inferential statistics techniques were also used for the treatment, interpretation and assessment of the results of the application of the methods belonging to the empirical ones.

RESULTS

Epistemic bases on which the didactic model is based

The proposed model represents, from the pedagogical sciences, the integrated result of an abstraction process that started from the main factual regularities obtained in the diagnosis, the author's experience as a biology teacher and the critical evaluative analysis of the program and book. of text of the subject Biology eighth grade at the basic secondary educational level to determine when, where and how the didactic approach to the contents related to faunal biodiversity is carried out.

In its construction we start from the consideration that different fields of knowledge interact in the didactic process and that each one offers different ways of reading and understanding the complex process of teaching and learning biology (Ruiz, Hernández and Norway, 2023). Its

design derives from the urgency of preparing the biology teacher to achieve didactic-biological-environmental integration, in a way that allows the formation of environmental culture in the student; topic whose treatment is still insufficient, from the teaching of eighth grade Biology at the basic secondary educational level in the Cuban context.

Consequently, the proposed didactic model is based on philosophical, axiological, sociological, psychological and didactic foundations, which are relevant and necessary and account for its multidimensional nature. In this way, the didactic model designed as a theoretical construction is based on the epistemic bases of the foundations of Educational Sciences, by specifying that from the Marxist-Leninist Philosophy, its categories are taken into consideration: cause-effect, essence. -phenomenon, the general, the particular and the singular, content-form, activity and the relationship between the concrete and the abstract of the materialist-dialectical theory of knowledge for the interpretation and transformation of society.

From the philosophical point of view, it is based on the postulates of Marxist-Leninist theory, by assuming the materialist dialectical approach in the analysis of the essential relationships that occur in the interaction with the productive and investigative processes and the role of the activity. in it, based on the assumption of Marxist postulates about the relationship between science, technology and society in the development of education, as a result of the social nature of said processes. From this philosophical platform, the relationships between the different components of the modeled process are addressed, as an axis of articulation and integration between the subsystems, moving from

general to the singular. In this way, its logical structure serves as a guide and foundation for the historical-social conditions of the Cuban context.

Meanwhile, in the theoretical construction of the model, the General Systems Theory was assumed as a fundamental methodological tool to model the teaching and learning of biodiversity content from a systemic approach and as an open system, in which the following components are considered: , structure, principle of hierarchy and functional relationships (subordination and coordination), the characteristics of the system: border, context or environment, entropy, totality, synergy, homeostasis, recursivity and autopoiesis, as well as the systemic-structural-functional method of investigation.

In correspondence with what was addressed, the didactic model is didactic in nature because it responds to the system of relationships between objective, content, method, medium, organizational form and evaluation of the teaching-learning process of teaching biology and assumes didactics, its laws, categories. In this same line, it expresses a conceptual symbolic representation of the teaching-learning process of the eighth grade Biology subject at the basic secondary educational level in the conditions of Cuba; Its purpose is to function as a mediating scheme between the contents related to faunal biodiversity and the nearby environmental reality.

As can be seen, the model is classified as didactic, as it assumes the fundamental category of training as part of the qualitative change that is intended to be achieved in the eighth-grade student. Hence, the formation of environmental culture cannot be achieved if the necessary relationship between man-nature and society-education is not understood as a social phenomenon. In this way, the didactic model that is proposed responds to the transformations that are carried out at the Basic Secondary educational level,

with the purpose that the student learns by doing in the environmental environment and develops his operational cognitive process and knowledge regarding the contents of faunal biodiversity in a contextualized manner.

In the psychological order, the proposed model is based on the Historical-Cultural Approach (Vygotsky, 1987), manifested in the theory on the social situation of development, taking into account the relationship between the cognitive and the affective and the consideration that learning is a social process closely linked to the development of the subject. No less significant are the anthropological and ethnographic foundations, which allow us to interpret the cultural practices and traditions of the people and the behavior of human groups in the face of the biological diversity that inhabits the educational and community environment.

In the sociological order, it is based on the theoretical references of Classical Sociology, which allow us to explain the multilateral interaction of society with nature and the varied influence of the environment on human activity, from the learning processes, the conditioning social environments in which educational processes are developed, as well as the dynamics of different institutions and social groups. In this conception of the didactic model, systematicity in teaching activity is a necessary condition to achieve the comprehensive formation of the student's personality, at the level of teaching and learning.

Modeling, for its part, is the scientific activity of building models, an essential scientific and academic activity, which involves expressing, using, evaluating and reviewing models (Couso 2020), to which it is added that depending on its role in the teaching and learning process is a process of abstraction that fulfills a fundamental function of studying and discovering new qualities, relationships, principles or laws of the object of study.

Study; As a method, it becomes a research instrument of a theoretical material nature that encourages reaching the result identified as a model and in correspondence with its foundations, components and scope, it becomes models: theoretical, educational, practical, methodological, pedagogical or didactic, among others.

Specifically, the proposed didactic model constitutes a theoretical-formal construction, of a systemic nature, which in a simplified way represents the structure and dynamics of the teaching-learning process of eighth grade Biology at the basic secondary educational level, based on the relationship dialectic between the contents related to faunal biodiversity and the nearby environmental reality, to promote the formation of the student's environmental culture.

Consequently, another of the concepts highlighted in the modeling process is biodiversity, which is one of the structuring concepts of biology (Castro and Valbuena, 2007). In this sense, we understand that the term biodiversity is the synthetic way of calling biological diversity that is used to refer to all manifestations of life on Earth. In particular, faunal biodiversity is understood as the result of the evolutionary process that is manifested in the existence of the diversity of animals that inhabit and develop in nature in close interaction with the rest of the biotic and abiotic components of the environment.

Next, the didactic model is described as a scientific result which has followed a deductive path, as part of the determination of the subsystems and components that make it up; in this case, the general; It goes through the determination of the structure and functions of the system and of each component, the particular; and from these to reveal the emergent qualities of the dialectical interaction between them, that is,

the singular. In this way, three subsystems interact in the modeled process: the cognitive subsystem, the didactic-methodological subsystem and the axiological-environmental subsystem. In the organization of the subsystems and components, the requirements of the training objectives for the basic secondary educational level, expressed in the study plan and their relationship with the objectives of Environmental Education and the eighth grade Biology subject at this level, are taken into account.

In this sense, the essential objective of the proposed model is to establish a way to improve the teaching-learning process from the eighth grade Biology subject at the basic secondary educational level, based on the treatment of biodiversity content in a contextualized manner, which allows design pedagogical tools for meaningful learning and the transformation of the learner's modes of action with a sustainability focus.

Thus, it is worth noting that the subsystems represented in the modeling process have a systemic, participatory approach and are made up of interrelated components that provide homeostasis and the necessary synergy that determine their dynamism. These are determined from a critical-evaluative analysis of the bibliographic sources consulted, from the reflection of the main regularities emanating from the diagnosis and from the author's experience in the treatment of biodiversity content in the Cuban middle school.

Likewise, the three subsystems in their uniqueness manifest functional coordination relationships between the components and express specific functions; In their interaction they establish a particular system logic with a dialectical relationship of subordination with respect to the system as a whole and juxtaposition as an expression of the recursiveness of an open system. Hence, the hierarchy that the didactic - methodological subsystem exercises over the cognitive and axiological subsystems -

environmental, is given in that this constitutes the starting point to energize the direction of the teaching-learning process of the contents of faunal biodiversity in the subject Biology eighth grade at the basic secondary educational level.

The subsystems are represented by components which, in their dynamics, enable the relevance and effectiveness of the modeled process; They are determined from the theoretical deficiencies presented by the teachers who teach the eighth grade

Biology subject at the basic secondary educational level with respect to the treatment of content related to faunal biodiversity. These express their meaning in the relationships with the whole, with the process and in turn with the environment. Hence, the relationships between them reflect a new theoretical interpretation, as an epistemic manifestation that arises between them, and allows describing and explaining - on the basis of the principle of gradual derivation, as an expression of its functioning as any system and that allows it to be interpreted. , design and adjust it, according to the theoretical-methodological relationships that support it.

The proposed teaching model has the following characteristics:

- It is based on the result of the systematization of experiences of biology teaching in Cuba, the programming axes, the guiding ideas as maximum generalizations of biological content and diagnosis.
- It is aimed at structuring and methodologically organizing the treatment of faunal biodiversity content at the basic secondary educational level in the Cuban context, for the formation of the environmental culture of the students.
- Reveals the systemic nature of the interrelationships between the subsystems and components that make it up, becoming an organizer of the theoretical structure

and the viability of the practice of the teaching-learning process of faunal biodiversity content.

- It is conceived based on the logic and dynamics between the components that intervene in the teaching-learning process of eighth grade biology and the dynamics of their interrelationships that will be the object of modeling.

The proposed didactic model has the advantage that:

- It constitutes a conceptual-methodological entity that fulfills an intermediary function between the assumed theoretical assumptions and scientific practice in the field of Biology teaching.
- Considers the direct link of the contents of faunal biodiversity in the eighth grade Biology subject, the environmental environment and environmental problems.
- It takes as its center the biological teaching excursion as a form of organization of the teaching of biology, based on the study of the objects, processes and phenomena that occur in nature and the interactions of organisms with the environment.
- It contributes to meaningful learning and, consequently, to an internalization of said learning, to the development of skills, habits, capacities, values and responsible modes of action of students in the environmental environment with a focus on sustainability, as an expression of the environmental culture achieved.

In this way, the didactic model allows solving the dialectical contradiction between the fragmented nature of the faunal biodiversity content in the eighth grade Biology subject at the basic secondary educational level and the necessary character

integrated of the teaching-learning process with the nearby environmental reality. Hence, this perspective proposes that the selection of content does not have a single answer, but on the contrary, there will be multiple possible answers depending on the map of knowledge, conceptions and values of each teacher (Bermudez and Ocelli, 2020a).

Based on the previous arguments, the first subsystem of the model has been identified with the name cognitive, which refers to the process that ensures the knowledge,

skills and values that the student must appropriate to establish links between the content system and the preceding concepts, background and facts, laws, chemical, biological, geographical processes and natural phenomena that occur in nature, all of which would stimulate the student's interest and motivation to understand, explain and interpret faunal biodiversity and its related problems. with conservation as a need, aspiration and social requirement. This is relatively independent of the previous ones, but subordinate to the methodological didactic subsystem as the highest hierarchy.

Specifically, the subsystem has the function of guiding the knowledge system around the contents related to faunal biodiversity as a transversal axis of the modeled process, from the characteristics of the objectives and the grade at the basic secondary educational level. It is made up of three components: apprehension of knowledge about faunal biodiversity, characterization of biodiversity with a social anthropological approach and contextualization of environmental reality. These components relate to each other in a coordinated manner and, in turn, their own hierarchical relationships are revealed.

The component designated as apprehension of knowledge about faunal biodiversity refers to the knowledge that the student must

possess the categorical system related to the concepts of biodiversity, conservation, introduced, invasive, migratory and endangered species, which are necessary for the understanding of the contents taught in the eighth grade Biology subject. For its part, the component designated as characterization of faunal biodiversity with a social anthropological approach, refers to the process of diagnosing the environmental reality of the territory, based on paying special attention to the features that characterize and typify the communities, from different aspects, such as: physical, natural, socioeconomic, educational components, customs, age-social composition, cultural practices,

economic activity, experiences and experiences, popular knowledge, religiosity, myths, local traditions, local history, among others. aspects that allow the behavior of human groups in the environmental environment to be interpreted through the ethnographic method.

Consequently, the component designated as contextualization of environmental reality refers to the learner's confrontation with contradictions that can be generated in the different contexts of action; It is an expression of the links with the natural environment where it lives and develops. In this way, the direct link with the environmental reality through the cognitive and the affective will allow the student to discover what the relationship between the being and the ought to be in the environmental environment should be and to apply the theory of knowledge, as a condition necessary for teaching and learning to acquire value, significance and personal meaning for the student. When dealing with contextualized learning, it is necessary to consider the natural environment, the context and the socio-historical cultural environment in which the learner lives and develops.

The dialectical relationships that occur between the components of the cognitive subsystem are of complementarity and collaboration, given to recognizing that, to the extent that the student appropriates the knowledge related to the biodiversity of his immediate environmental reality, a significance of this knowledge is produced in him from the conceptual, theoretical-practical and affective point of view motivational, and in turn, the importance of this prior knowledge for the understanding and explanation of the phenomena and processes that occur in nature, which facilitates the transition towards new qualities of the process.

Then, from the dynamics resulting from these relationships between the components of the cognitive subsystem, the appropriation of knowledge of local faunal biodiversity becomes a resulting quality, which refers to the mastery that

the eighth-grade student must acquire of the diversity of endemic and native species. representatives of the fauna of the educational and community environment, as well as the values, experiences of social practice, attitudes, awareness of environmental problems and the effective and meaningful internalization of the necessary conservation of biodiversity in general.

In close relationship with the cognitive subsystem is the didactic-methodological subsystem, considered the second subsystem, which expresses the dynamic element of the teaching-learning process of the eighth grade Biology subject at the basic secondary educational level, to perfect the organization. and methodological structuring of the contents related to faunal biodiversity based on interdisciplinary relationships. This subsystem is the highest in the model and has an impact on the rest of the subsystems. Its main function is to guide, orient and direct the methodological organization of the contents. The following are part of this subsystem: the methodological structuring of the faunal biodiversity content, the organization of the faunal biodiversity content and the concretion of practical biological activities in the environmental environment.

In this sense, the component recognized as methodological structuring of the contents of faunal biodiversity is conceptualized as the determination of the elements that make up the didactic direction that teachers develop, from the objectives, content, methods and procedures, which have as most external expression of the organizational forms of the teaching-learning process of eighth grade Biology.

This component takes into account the system of biological generalizations that has as its central axis the integrity of nature based on the integrated dialectical pairs: unity-diversity, interactions-dynamism and structure-function, the knowledge system as an expression of the sciences and the sources of knowledge, the system of skills and habits, and the system of relationships with the world based on the

experience of the creative activity of the student (feelings, interests, values, behaviors, convictions), as well as the attitudes with a high load of affectivity, which requires procedures and methods for its construction.

Consequently, the component designated as the organization of faunal biodiversity content explains the process by which the biology teacher organizes the knowledge system to achieve the significance and deepening of the content from an integrative, ecosystemic, evolutionary and bioethical explanatory approach. oriented to sustainable development.

Consequently, the component designated as the realization of practical biological activities in the environmental environment, reveals the process through which the biology teacher takes into account the stages or steps of the teaching excursion (preparation, planning, orientation, development or execution, presentation of the results), in order to stimulate the student's approach and recognition of the biodiversity in general and fauna in particular, to promote the appropriation of knowledge and the development of habits, capacities, values, skills and the formation of attitudes that allow them to be actively involved, leading and transforming in the environment. This practical biological activity is energized by the motivation of the student under the guidance of the teacher.

These practical activities can be planned using different didactic functions, mainly for the introduction and presentation of a new unit, to expand and deepen new content with a view to a seminar, to apply or systematize already formed biological content; They can precede a laboratory practice, among others. You can also use problem methods such as: problem exposition, partial search and heuristic conversation, which constitute the basis of the investigative method of problem teaching.

At this point, the dynamic that is established between the components of the second subsystem becomes the resulting

quality of the scientific-environmental updating of the biology teacher, which ensures the methodological preparation to face the treatment of the contents of faunal biodiversity in accordance with the transformations that are carried out at the basic secondary educational level in the Cuban context, in a way that allows contributing to the formation of the student's environmental culture. Therefore, the relationships established between the elements that make up the components of the didactic-methodological subsystem are of coordination and complementarity, which in their dynamics enable the relevance and effectiveness of the teaching-learning process of the contents of faunal biodiversity in the eighth grade Biology subject at the basic secondary educational level.

Closely related to the didactic-methodological subsystem is the

axiological-environmental subsystem considered as the third subsystem, which takes into account the understanding of faunal biodiversity from an ethical perspective, consistent with respect for all forms of life, in the understanding that each species plays an important and unique role in the plot of life. The above implies, therefore, the need to change the ethical behavior of the student in the environment and for him to see himself as an integral part of nature in general and of the particular environment where he lives and acts, which allows an orientation behavior regarding what to expect and how to behave in the educational and community environment.

This subsystem is made up of the components: Ideological-normative orientation, projection of ethical-environmental behavior and critical-reflective assessment of faunal biodiversity, which, although they are relatively independent, have a close relationship and degree of hierarchy. In this way, the ideological-normative orientation component is characterized by being the nuclear element of the subject's consciousness, the prism through which he understands and interprets the reality of

the community and its environmental environment as a condition for its transformation. The ideological vision of biodiversity, on the part of the student, constitutes a guide for his activity and the establishment of relationships with the biological content, which determines his attitudes towards the environment.

The projection component of ethical-environmental behavior reveals the system of ethical relationships that are established between human groups and the biodiversity that inhabits natural spaces, as well as the specific norms that guide action in the face of specific circumstances that, when assimilated Based on knowledge and behavior in daily practice, students' habits regarding the biodiversity that surrounds them can change. It involves specific rules, which serve as a guide to guide action in the face of specific circumstances that, when assimilated on the basis of knowledge and behaviors in daily practice, can change the habits of learners.

Consequently, the component designated as critical-reflective assessment of biodiversity refers to the process of analysis and elaboration that moves from the collective to the highly personalized about the learning process itself, generating an active and non-adaptive posture in the student. in the learning process of biodiversity and the problems surrounding conservation. The student's assessment of the biodiversity of his environmental reality is a reflection of the significance that its components have for him, which underlies his needs, motives, feelings and his emotional world. Hence, the relationships that occur between the components of the axiological-environmental subsystem are of complementarity and collaboration.

From the dynamics of these systemic relationships that are established between the components of the third modeled subsystem comes the significance of educational-environmental influences, recognized as the essential quality of the process that emanates from the combination between the cognitive-instrumental and the affective-evaluative,

deficiencies and potentialities, which makes the contents related to biodiversity gain for the learner, from a personal perspective, a certain meaning and that enhances the establishment of relationships between what is known and what is new to be known; that enhances personal satisfaction.

Among the subsystems that constitute the model, an indissoluble integration and unity is manifested, given their systemic relations of coordination and complementarity that are established between the cognitive, didactic-methodological and axiological-environmental subsystems. Therefore, from the dynamics of the systemic interaction established between them, a resulting quality of order emerges.

superior, which has been identified, when modeling the process as, the formation of the student's environmental culture. It arises as a result of the general functioning of the resulting modeled process and the synergy of interaction between the subsystems, and is not contributed by any of them independently.

As a result of the systemic interaction between the cognitive, didactic-methodological and axiological-environmental subsystems and their components, relationships of subordination and complementarity are established; Likewise, they reflect a new theoretical interpretation, as an epistemic manifestation that arises between them and allows us to describe, explain and predict higher stages of development of the subsystems; In this way, the synergy is manifested, expressed in the formation of the student's environmental culture as a totalizing quality of higher order, which emerges as a result of the general functioning of the modeled process and which is not contributed by any of the components in particular; Autopoiesis, for its part, manifests itself by generating the self-development of the system based on the principle of unity between the cognitive and the affective, typical of every system. Therefore, the relationships expressed above, in their entirety, confer stability to

the process modeled as an expression of homeostasis.

At this point, the formation of the student's environmental culture is then conceived as the process of assimilation of knowledge, the development of skills, habits, feelings, abilities, motivations and attitudes that allow reorienting practical, communicative, axiological activity (or evaluative) and self-regulate behavior in the environment, to address the environmental problems present in the educational and community context, from a systemic and sustainability approach.

In this way, the relationships that occur within and within the components of the model reveal

regularities that allow explaining the behavior and transformation of the contents of faunal biodiversity from a higher level of essentiality. Among them are:

- The systemic nature between the objectives, contents, methods, teaching aids, organizational forms and evaluation of the teaching-learning process of eighth grade Biology. The unity of teaching and education in the study process of Biology.
- The dialectical relationship between the didactic principles of the teaching of Biology, among which are essentially considered: the sequence of assimilation of the study material based on systematization and accessibility, the unity of scientific character and affordability, teaching and the linking of education with life, the environment and society.
- The intentional nature of the systematization of faunal biodiversity content towards the fulfillment of the general training objectives of the basic secondary educational level, of the subject and of the degree.

Once the systemic relationships established between the subsystems and structural components of the proposed model were described, it was subjected to evaluation by a group of specialists based on the established stages. In this way, the main objective was to know the degree of acceptance of the theoretical contributions made by the selected experts, as well as to verify the feasibility and relevance of the designed model and to infer judgments and reach conclusions for its improvement.

First, a group of experts were selected where value judgments were considered to obtain a consensus of informed criteria. In this sense, a population of 35 possible experts selected from the

professional and research activity they carry out, as well as the knowledge they have of the subject matter under study. Thus, for the selection of the experts, the following conditions were taken into account: having a degree in Education in the specialty of Biology, being a doctor or master with a thesis in the area of Biology or its teaching, having the teaching category of professor and/or Senior or assistant researcher in the branches of biology or its teaching, accumulate more than 15 years of teaching or research experience in the branches specified above, have accumulated experience in the treatment of faunal biodiversity content at the basic secondary educational level.

To process the results of the survey applied to the selected experts, the procedure of calculating the arithmetic mean of the expert's knowledge or information coefficient (K_c) and the argumentation or substantiation coefficient (K_a) was used, based on the sum of both and their division by two [$K = (K_c + K_a)/2$]. In this way, those whose competence index ranges between 0.6 and 1 were selected as experts. As a result of the statistical processing of the data, it was determined that the average competence coefficient of the experts is 0.91; Therefore, they can be consulted to make evaluative judgments about the modeled process. The final sample was made up of the 30 experts, taking into account their Kendall competence

coefficient (k) evaluated as high. The average professional experience of the selected experts turned out to be 23 years.

On the other hand, at this stage, the calculation of Kendall's coefficient of agreement (W) and its statistical significance were determined, using parametric and non-parametric techniques. For this, the statistical package SPSS (Statistical Package for Social Sciences) was used, version 22.0 for Windows. The non-parametric test for K related samples was applied in which the judgments are assessed.

issued by experts. In this case, when 30 experts were consulted, an estimation error of 1% is introduced, so it can be stated that the decisions made, based on the calculations made, were highly reliable and valid. By obtaining a coefficient of agreement with a value of $W=0.746$ and taking into account that the associated probability $p=0$, so $p<0.01$, it can be concluded with 99% reliability and confidence that there is agreement between the criteria. issued by experts.

The application of the preferred methodology begins with the preparation of the survey questionnaire to carry out the evaluation by the experts of the proposed teaching model. To do this, first, a copy of the model is sent individually and anonymously to each expert, via email, in order to submit for their consideration, the key indicators established to obtain their assessment criteria. In this way, each expert was asked to evaluate the aspects submitted for their consideration, based on a scale of five categories: very suitable, suitable, quite suitable, slightly suitable and not suitable.

Once the application of the survey was completed, each of the aspects noted in the questionnaire was evaluated individually, for which each expert was requested to issue, based on categorizing the indicators to be evaluated established by the author, their opinions, criteria, achievements and insufficiencies present in the designed model, both in its theoretical and practical conception. In this direction, three rounds

of consultations were carried out with experts to assess the results obtained as feedback on the proposal.

The indicators submitted to the experts' judgment to validate the effectiveness of the proposed model were the following: Theoretical foundation of the model and its didactic nature; relevance and formative functionality of the model; timeliness and novelty of the proposal; linking the contents treated in the model with respect to the training objectives of the educational level, the degree and the subject; impact of the proposal on student learning and modes of action in the environmental environment.

In the first round of consultation, the main points and suggestions of the experts were: delving into the epistemological foundations of the model, specifically in the relationship between the components; organize the assessment of the relevance and feasibility of the results, in addition to suggesting assessing the conceptualization of the subsystems and components with a higher level of essentiality; deepen the foundation of the systemic approach, explaining the relationships of the subsystems; reveal more precisely the uniqueness based on the distinctive aspects it has.

Once the criteria, recommendations, points and suggestions offered by the experts were confirmed regarding the didactic model presented as part of the first round of consultation based on the established indicators, this was redesigned to present it to a second round of consultation, which expressed the assessment of the model with respect to reconceptualizing and restructuring some of the components of the cognitive subsystem to achieve greater theoretical argumentation and uniqueness in the teaching-learning process of eighth grade Biology.

Finally, the third round of consultation was aimed at evaluating and determining the final consensus of the subsystems and components of the modeled process. Hence, based on the statistical processing of the assessments provided by the

experts, the corresponding frequency tables were constructed and the absolute frequencies, the accumulated absolute frequencies, the accumulated relative frequencies, and the distribution were determined and analyzed. inverse normal, the cut points and the degree of consensus expressed regarding the assessment of each aspect.

In this way, the application of the methodology allowed establishing a balance between the level of complexity of application, processing of the statistical data obtained, without sacrificing the validity of the judgment derived from its application, as well as achieving a comprehensive and broader image of the possible evolution of the result analyzed by the experts selected based on their scientific-technical qualification, years of experience and professional experience.

The results obtained with the application of the evaluation method by expert criteria allowed us to critically assess the articulation of the subsystems and components of the designed teaching model, which denotes the functionality, feasibility and relevance of the modeled process in order to contribute to training. of the environmental culture of the students. Hence, the elements submitted for consideration were evaluated as quite adequate by the experts consulted, which means that there was acceptance regarding the modeled process.

In this way, the experts consulted considered with 99.0% confidence that the subsystems and structural components that make it up allow the didactic and methodological improvement of the contents of faunal biodiversity in the eighth grade Biology subject at the basic secondary educational level in the Cuban context, all of which demonstrates the quality of the proposal, in its theoretical and methodological conception, by evidencing consensus on its need, usefulness and viability, as well as the effectiveness that it could present in practice. In this way, the suggestions offered by the experts do not essentially question the quality of the teaching model;

On the contrary, they have value for continuous improvement within the framework of teaching the contents of eighth grade Biology.

In this same line, there is consensus in stating that the didactic model establishes, on the one hand, the stability of the system, the logic of the functional coordination relationships and, in turn, a relative independence, since they determine its structure, its order. , its organization, and, on the other hand, determine the mobility, the functioning of its subsystems and components as a system, which implies a certain degree of obligatory nature of those relationships of a causal nature, necessary and stable for the formation of the environmental culture of the student. . Aspects consistent with the results found by Oliva (2019), when he maintains that school models serve both the design of the curriculum and the teachers to make decisions about their own progression, or the sequencing of classroom activities.

In this way, the experts also expressed consensus by stating that the didactic proposal is of interest for education in biology and natural sciences in particular, and that linking it with the formation of environmental culture will allow a more comprehensive approach to the current challenges in teaching biodiversity as a fundamental part of conservation strategies at the local, regional and global levels. The above contrasts with the contributions obtained by Bermudez and Occelli (2020b), when they maintain that the evolutionary and ecological approaches serve as guidance for the organization of biological content and that the study of living beings is perceived as a thematic core to be considered now. from the first educational levels according to the criteria of García *et al.*, (2021).

Likewise, they are also consistent with the contributions found by Castro, *et al.*, (2021), when they maintain that biodiversity is a problem of knowledge that is too broad and inextricable, which demonstrates, precisely, the multiplicity of ways of assuming this epistemological

problem, as well as with the criteria of De La Cruz & Pérez (2020b), when They point out that this way of conceiving

Biodiversity allows us to demonstrate a certain level of depth in terms of the ability and capacity to relate concepts and content that students up to this grade have handled in their school career.

DISCUSSION

In general, when analyzing the results of the application of the proposal, it was found that it was accepted by biology teachers at the basic secondary education level, who understood it with great ease and contributed to enrich it with their recommendations. In this sense, significant progress is shown in relation to the interest, motivation, satisfaction, disposition, creativity, self-confidence and awareness of the pedagogical group to direct the teaching-learning process of faunal biodiversity content in a contextualized manner and through of the establishment of interdisciplinary relationships, in relation to the determination of the knowledge system, the professional pedagogical skills and the values required to educate in the conservation of biodiversity.

Consequently, the teachers consider that the modeled process has an extraordinary methodological value for the improvement of the teaching-learning of the contents of faunal biodiversity in the Cuban middle school, since it made it possible to enrich and perfect the conceptual theoretical apparatus of the eighth grade Biology subject. and the methods and methodological procedures to promote the significant appropriation of the contents by the students, so the results obtained show adequate professional growth of those involved and improvement in learning by the students.

In this sense, the reflective appropriation of didactic, biological and environmental knowledge was also achieved among teachers, which enabled them to integrate said knowledge for the development of a conception of environmental education oriented towards sustainable development based on potentialities offered by the contents of the eighth grade Biology subject at the basic secondary educational level and the nearby environmental reality, in correspondence with what is established by the Ministry of Education, within the framework of the third improvement.

Consequently, progress was shown in the quality of the methodological activities developed in the departments, in addition to the different avenues of methodological work, since biology teachers were able to demonstrate the environmental knowledge acquired as part of the theoretical preparation received, all of which contributed to the mobilization and implementation of the didactic resources necessary to improve their environmental pedagogical performance.

In this way, they appropriated the necessary tools for the choice of production methods and procedures, forms of organization and teaching media to direct the treatment of faunal biodiversity content in a contextualized manner and the appropriate derivation and formulation of training objectives of the level. basic secondary and undergraduate education, to develop in the student the knowledge, skills, values and standards of conduct in relation to the biological diversity of the educational and community environment, as well as the care and protection of nature, as a contribution to enrichment of the didactic theory of the aforementioned educational level.

Furthermore, the reflective appropriation of didactic, biological and environmental knowledge was achieved, which enabled the integration of said knowledge for the development of a conception of environmental education oriented towards sustainable development based on the potential offered by the contents of the eighth grade Biology subject at the basic

secondary educational level and the nearby environmental reality. Finally, significant progress was shown by teachers in the quality of the methodological activities developed in the departments, in addition to the different avenues of methodological work, since they were able to demonstrate the environmental knowledge acquired as part of the theoretical preparation received. , all of which contributed to the mobilization and instrumentation of the didactic resources necessary to improve their environmental pedagogical performance to contribute to the formation of environmental culture in the student.

At this point, some fundamental generalizations derived from the research carried out are presented as conclusions:

In the systematization carried out of the didactic model for the treatment of faunal biodiversity content at the basic secondary educational level, the theoretical and methodological foundations are revealed in which the systemic and sustainability approach is assumed, based on the analysis of the main contributions of various disciplines, including philosophy, sociology, psychology, didactics and pedagogy.

The model, from its didactic nature and as a theoretical construction, allowed the contents of faunal biodiversity to be integrated as a system, based on the logic of the relationships established between the cognitive, didactic-methodological and axiological-environmental subsystems. Therefore, from the dynamics of the systemic interaction of the subsystems and the complementary relationships that are established between the described components, the formation of the student's environmental culture emerges as a totalizing resulting quality.

In general, transformations could be observed in the didactic-methodological order in biology teachers, which allow us to assert the feasibility and applicability of the proposed model based on the fact that significant advances are shown in relation to interest, motivation, satisfaction, disposition, creativity, understanding, self-

confidence and awareness to efficiently direct the teaching-learning process of faunal biodiversity content in a contextualized manner and through the establishment of interdisciplinary relationships.

Regarding the didactic implications of this work, it must be noted, first of all, that the biology teacher at the basic secondary educational level has a necessary didactic-methodological tool that serves as guidance for the organization of the contents of faunal biodiversity in the eighth grade Biology subject, in a way that allows perfection in the mobilization and instrumentation of didactic resources for the environmental education of the student from the teaching of Biology and to give a systemic treatment to the target categories, content, method, forms of organization, means of teaching and evaluation, in a way that allows obtaining superior results in the conduct of the process that it directs for the formation of the environmental culture of the student.

Finally, it must be pointed out that, with a view to future lines of work, some prospective research is suggested: the replication of the design of the proposed didactic model in rural schools in order to carry out a comparison with the urban context, on the other hand address the teaching of faunal biodiversity content from a comprehensive and broader view of the concept, which includes the importance of paying attention to emotions in teaching local wildlife, cultural, social or economic diversity, but not restricted to school environment, but extended to the community, to stimulate the direct contact of the student with the organisms in his environment, also the attention to education for its conservation and sustainable use of biodiversity and how its loss affects the environmental balance of the planet and the stability of the ecosystems where fauna lives, such as of environmental priorities, currently recognized in international policies and in the 2030 Agenda for Sustainable Development.

REFERENCES

- Ayerbe López, J. y Perales Palacios, F. J. (2020). «Reinventar tu ciudad»: aprendizaje basado en proyectos para la mejora de la conciencia ambiental en estudiantes de Secundaria. *Enseñanza de las Ciencias*, 38(2), 181-203, 204
<https://doi.org/10.5565/rev/ensciencias.2812>
- Bermudez G.M.A. y Occelli M. (2020). Enfoques para la enseñanza de la Biología: una mirada para los contenidos. *Didáctica de las Ciencias Experimentales y Sociales*, 39, 135-148.
<http://doi.org/10.7203/DCES.39.16854>
- Castro, J., Valbuena, E., Escobar, G., Roa, R. y López, L. (2021). Multidimensionalidad de la biodiversidad. Aportes a la formación inicial de profesores de biología en Colombia. *Tecné, Pisteme y Didaxis: TED*, (50), 131-148.
<https://doi.org/10.17227/ted.num50-11978>
- Castro, J. y Valbuena, E. (2007). ¿Qué biología enseñar y cómo hacerlo? Hacia una resignificación de la biología escolar. *Revista TEA*, (22), 126-145.
- Couso, D. (2020). Aprender ciencia involucra aprender ideas potentes de la ciencia: la modelización ayuda a la explicación- predicción de fenómenos. En Couso, D., Jiménez Liso, M.R., Refojo, C., y Sacristán, J.A. (Coords) (2020), *Enseñando Ciencia con Ciencia*. FECYT y Fundación Lilly. Madrid: Penguin Random House.
- De La Cruz, L. y Pérez, N. (2020). El saber escolar en biodiversidad en clave para resignificar su enseñanza. *Praxis y Saber*, 11(27), e11167.
<https://doi.org/10.19053/22160159.v12.n28.2021.11167>
- García, J. y Martínez, F. (2010). Cómo y qué enseñar de la biodiversidad en la alfabetización científica. *Enseñanza de las ciencias*, 28(2), 175-184.
<https://www.raco.cat/index.php/Ensenanza/article/view/199611/353385>
- García, O. (2022). Aportaciones de la excursión docente en la Biología octavo grado a la educación para la Conservación de la Biodiversidad. *RAC: revista angolana de ciências*. 4(1), e040104.
<https://doi.org/10.54580/R0401.04>
- García, O., Sánchez, M. y García, R. (2020). Aporte de un procedimiento didáctico para mejorar el conocimiento de la biodiversidad en Secundaria básica. *Bio-grafía. Escritos sobre la Biología y su enseñanza*, 13(25).
<https://doi.org/10.17227/bio-grafia.vol.13.num25-11575>
- García, O. y Méndez. (2017). Hacia una resignificación de la enseñanza del contenido del concepto de biodiversidad en biología Roca. *Revista científico-educacional de la provincia Granma*, 13(1), 158-170.
<https://revistas.udg.co.cu/index.php/roca/article/view/1221>
- García-Barros S., Fuentes Silveira M. J., Rivadulla-López J. C. y Vázquez-Ben L. (2021). La adaptación de los animales al medio. Qué aspectos consideran los estudiantes de Primaria y Secundaria. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias*, 18(3), 3106. doi: 10.25267/Rev_Eureka_ensen_divulg_cienc.2021.v18.i3.3106
- García-Rodeja Gayoso, I., Silva García, E. T. y Sesto Varela, V. (2020). Competencia de estudiantes de

secundaria para aplicar ideas sobre el funcionamiento de los ecosistemas. Enseñanza de las Ciencias, 38(1), 67-85, 86.

<https://doi.org/10.5565/rev/ensciencias.2733>

Oliva J.M. (2019). Distintas acepciones para la idea de modelización en la enseñanza de las ciencias. Enseñanza de las Ciencias 39(2), 6-24.

<https://doi.org/10.5565/rev/ensciencias.2648>

Ruiz Gutiérrez, R., Hernández Rodríguez, M.C y Noruega Solano, R. (2023). Modelo didáctico para la biología. Bio-grafía, 16(31).

<https://doi.org/10.17227/biografivol.16.num31-19850>

Reguant-Álvarez, M., & Torrado-Fonseca, M. (2016). El método Delphi. REIRE, Revista d' Innovació i Recerca en Educació, 9(1), 87-102. DOI: 10.1344/reire2016.9.1916

Taylor, S. J. y Bodgan, R. (1998). Introduction to qualitative research methods: A guidebook and resource. Nueva York: John Wiley & Sons, Inc.

Vigotsky, L. (1987). Historia del Desarrollo de las Funciones Psíquicas Superiores. La Habana: Editorial Científico-Técnica.

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