

Dinámica transferencial de integración intradisciplinar de los contenidos biológicos en la carrera Agronomía

Transferential dynamics of intradisciplinary integration of the biological contents in the Agronomy course

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RESUMEN: El presente trabajo tiene como objetivo socializar un modelo didáctico dinámica transferencial de integración intradisciplinar de los contenidos biológicos en la carrera Agronomía. Se utilizaron métodos teóricos para la fundamentación de la modelación en su construcción. En su estructura holística se determinaron dimensiones, configuraciones y sus relaciones, revelándose la lógica didáctica que singulariza la integración intradisciplinar de los contenidos biológicos en la carrera Agronomía, legitimándose la transferencia como proceso que dinamiza la concepción didáctica propuesta.

Palabras clave: Integración de contenidos biológicos; Dinámica transferencial; Modelo didáctico; Agroecosistemas

ABSTRACT: The objective of this work is to socialize a didactic dynamic transferential model of intradisciplinary integration of biological contents in the Agronomy course. Theoretical methods were used for the foundation of the modeling in its construction. In its holistic structure, dimensions, configurations and their relationships were determined, revealing the didactic logic that singles out the intradisciplinary integration of biological contents in the Agronomy career, legitimizing the transfer as a process that energizes the proposed didactic conception.

Keywords: Integration of biological contents; Transferential dynamics; Didactic model; Agroecosystems

Introduction

One of the challenges facing humanity today is food production in view of the increase in poverty rates in the world and, in particular, in Latin America, requiring productive processes that moderate imports and achieve food sustainability.

In this framework, Cuba approaches food production as a national security issue in the Constitution of the Republic of Cuba approved in 2019, endorsed with the establishment of solid policies to

guarantee its availability: the State Plan to Confront Climate Change, the Food Sovereignty and Nutritional Education Plan.

These demands connote Agronomy and the training of its professionals in issues of vital political, socioeconomic and scientific importance. The basic sciences do not escape from such purposes, due to the direct incidence of their contents in the management of agricultural production systems, the main mode of action of the Agronomist Engineer.

The progress of basic training in the training of agronomists has been addressed by researchers, such as Lissabet (2018); Mena (2010). They point to insufficiencies in the performance of agronomists related to the mastery of basic sciences, and to the use of potentialities for the systematization of contents and their applicability to the profession.

Particularly from the biological contents, such insufficiencies have been corroborated internationally by Landis (2017), Paleologos *et al.* (2018); at the national level by Rodríguez and Jardinot (2018). These authors point out fissures in the approach to issues such as sustainability and ecosystem services to redesign agroecosystems, without viewing them as biological systems.

With this scientific approach, the research carried out in the Agronomy career of the University of Guantánamo is framed, which assumes as a problem the insufficiencies in the application of biological contents by future agronomists, which is limiting their performance in the solution of professional situations. As a result of the factual diagnosis, it has been possible to verify among the fundamental causes the insufficiencies in the teaching-learning process of Biology in the career, manifested in a limited didactic-methodological conception of the articulation and contextualization of the biological contents. Therefore, the objective is to socialize a didactic model of the transferential dynamics of intradisciplinary integration of biological contents in the Agronomy career.

Development

In this article we present a descriptive and interpretative qualitative analysis carried out at the University of Guantánamo. The theoretical methods used for the study of the dynamics studied were: historical-logical, analysis and synthesis, inductive-deductive directed to the construction of the theoretical foundations of the proposal; while the Holistic-dialectic, was used for the elaboration of the didactic model. Among the empirical methods used, the following stand out: observation, surveys, statistical techniques and documentary review, as well as socialization workshops and case studies.

The proposed didactic model assumes Ludwib Von Bertalanffy's General Theory of Systems and the Holistic-dialectic research method, which allows expressing the logic of the procedures followed in its construction, and understanding each dimension and its configurations, based on its holistic character. It is based on the Marxist-Leninist Theory of knowledge, and on the materialist dialectic of the unity of theory and practice; it is also based on the Historical-Cultural Theory, specifically the Zone of Proximal Development, the Theory of Meaningful Learning and the Law of Dual Formation.

The starting point for the understanding of the proposed model is the explanation of the dialectic contradiction between the apprehension of biotic integrity and the conformation of the bioagricultural professional sense. The new relationships revealed in the theoretical construct are the result of the scientific reinterpretation of the relationship between the integration process and transfer, seen as a process.

In this sense, the stages of integration as a process specified by Mena (2010) are recognized, manifested in the relationship between the categories deconstruction-reconstruction-resignified reconstruction; which allows assuming this process from the relationship of the categories comprehension-generalization-concretion, in the didactic model that is defended.

For its part, the modeling of dynamics is based on the logic of transfer as a process proposed by Bloom (2007), with its stages (recognition, comprehension, analysis, abstraction and transformation) and increasing levels of learning. All this through the mechanisms of transfer: associations, analogies and applications, but in an interrelated manner, recognized in the contribution of a transferential relationship organism-ecosystem-ecosystem ecosystem as the support of the modeled dynamics. Analyzing these assumptions allowed the resignification of the categories emerged from the epistemological and praxeological systematization, such as:

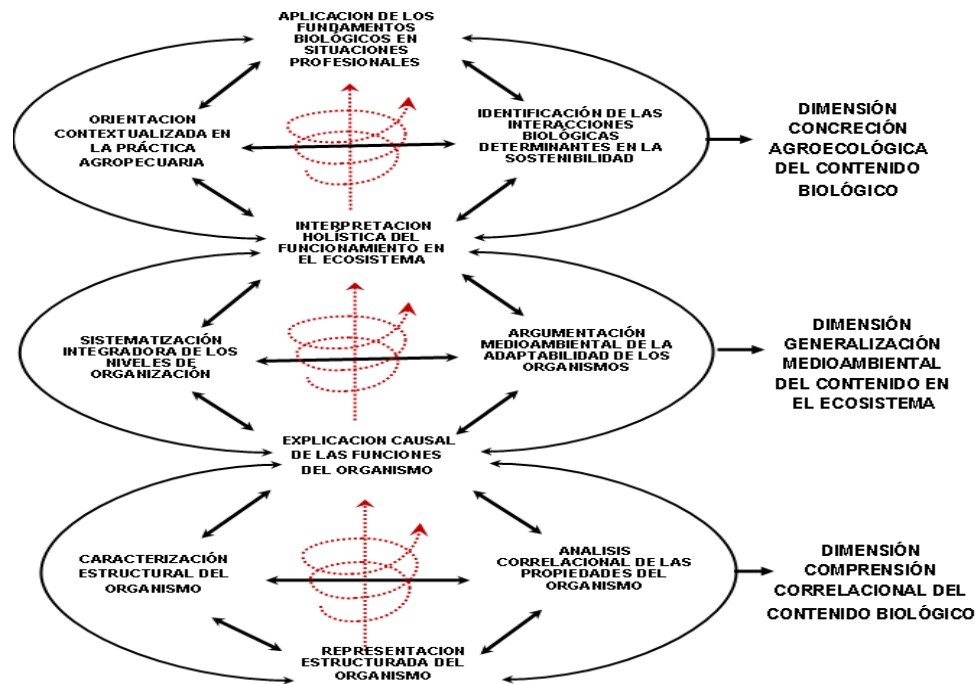
Intradisciplinary integration of biological contents: understood as the systemic and experiential process that from the science-profession contradiction that characterizes the discipline as an organizational level of the teaching-learning process, generates an integrated teaching of biology in the Agronomy career, leading to the successive transit from fragmented biological contents to integrated disciplinary contents of greater scope, resulting from the transformation of the same in depth and breadth, propitiating their application in professional situations.

The transferential dynamics of the integration of biological contents: understood as the process that favors the intradisciplinary integration of biological contents through its appropriation based on the transferential relationship organism-ecosystem-agroecosystem, through the representation and causal explanation that promotes interpretations of the functioning of the living organism in the

ecosystem, for the application of the biological contents in professional situations, with a professional bioagricultural sense that mobilizes its modes of action. (Figure 1).

Figure 1

Didactic model of the transferential dynamics of intradisciplinary integration of biological contents in the Agronomy course



Source: Own elaboration

Didactic logic structuring the model: its configurations and dimensions

For the elucidation of the proposed didactic model, we start from the Dimension of correlational understanding of the biological content, making explicit its movement from the dialectical relationship established between the structural characterization of the organism and the correlational analysis of the properties, which is synthesized in the structured representation of the living organism, allowing to dynamize the causal explanation of its functions.

The configuration structural characterization of the organism, initiates the movement of the dimension, is the expression of a process that allows the determination of the qualities of the components of the living organism and the interrelationships that make it unique. It starts from the understanding of the structure as the inner form of organization of the organism as a system, from the unity of stable connections between its components, and the laws that govern these connections (Jardinot, 2020).

In this way, (Jardinot 2020, p. 42) points out that the student learns to recognize organizational patterns as “the configuration of the relationships between the components of the organism to determine its essential characteristics”. Example: the patterns of cellular organization. Appropriating these patterns presupposes the integration of the contents from the establishment of associative and analogical relationships, that is, shared similarities among the components, the determination of the characteristics that distinguish the organism from associations between the previously learned components with the new ones, and determining the regularities of the organizational patterns. The above allows the student to recognize that the structural is the basis of biological diversity based on its genetic resources, which is evidenced in the classification of structures, their modifications and applications.

From this perspective, the structured characterization of the organism simultaneously leads to the correlational analysis of its properties, understanding property in a biotic system as an attribute or essential quality of someone or something (Jardinot, 2020).

The relationship between the structural characterization of the organism and the correlational analysis of its properties is synthesized in the structured representation of the organism, defined as the process of analysis and synthesis of the essential characteristics of the organism that, in successive mental approximations, makes it possible to update the cognitive schemes of the students, in order to correlate the components of the system by recognizing and contrasting the new representations with their experiences and previous knowledge.

In this way, the representations of the organism allow the student to create a mental representation of the organism based on the perception of the organism, and then operate on it through associations that correlate and mobilize their cognitive processes. This deconstruction of the representations of the organism will make it possible to deepen the anatomofunctional study and to specify essential features of the organism.

The mediating and dynamizing character of representation is thus signified by reorienting the structural characterization and the correlation of its properties in the biotic system, understood by (Jardinot 2020, p. 14) as “the set of organized and interrelated elements that presuppose the fulfillment of certain functions, which guarantee the existence of the corresponding structural level”.

All this connotes the relationship of the structured representations of the organism with the causal explanation of the functions of the organism, a higher order configuration defined as a process of interrelation between the structure of the biotic system, directed to the approach of the students to the appropriation of the structure-properties-functions causality relationships in the organism.

In this case, functions are understood (Jardinot, 2020, p. 16) as “the external manifestation of the properties of any object in a given system of relations”, which will allow him to conclude through associations that the functions of the organism are analyzed from the various properties manifested by its structure, in interaction with the environment.

The relationships between these four configurations make explicit, as a resulting quality, the dimension of correlational comprehension of the biological content, which becomes a process that expresses the first approach to the biological content through associations based on similarities, contrasts, contiguities of the diversity of components, properties, functions, the organization of the content and the regularity of the relationships between them in a totalizing way. It is based on structural recognition, from the characterization of the organism and the correlational analysis of its properties, as well as the projection of the properties that dynamize the causal explanation of the functions of the organism.

In line with the above, we assume the definition of understanding given by (Wiltrock 1990, p. 7), who defines it as “...a structural or conceptually ordered representation of the relationships between the parts of the information to be learned and between that information and those ideas and our base of knowledge and experiences”.

Consequently, correlational understanding of content is understood as the process aimed at the schematic representation of the living organism, the determination of the distinctive features of its components, the correlation of the properties of the components of the system and the establishment of crossroads of associations in the living organism, determining the most relevant ones.

All this allows the explanation of the causal relationship structure-properties-functions in the organism, leading to the understanding of the relational materiality of living systems, its cognoscibility and biotic integrity, conducive to the environmental generalization of the functioning of the organism.

This means that a causal explanation of the functions of the organism also requires a deepening of the incidence of environmental factors modulating the intensity of the processes that determine its functioning in the ecosystem.

Dimension Environmental generalization of the content in the ecosystem

The starting point is the understanding of the systematization of the levels of organization of matter as the configuration that accounts for the reflective process about the interactions between the complexity of the levels of organization of matter and the action of environmental factors, which allows the student to reconstruct the biotic integrity.

Thus, the levels of organization of matter are specified as a representation of the organization of the Universe, made up of dynamic systems in continuous development, located in hierarchical levels of increasing complexity. All this presupposes an increase in the complexity of the causal structure-properties-functions relationships.

It is about the integration and reconstruction based on the functioning of the organism in its environment from the properties that emerge from the relationship of its components, so the student must explain the influence of bioclimatic factors on the levels of organization of matter; specify their hierarchical interrelationship and generalize in the system of relationships that occur in the ecosystem as a biological system. This reconstruction is carried out by means of successive analogies of the functioning of the organism, which allow it to reveal the relationships with the environment, making explicit the emerging properties, and by way of regularity the dependence on the environment as a condition of life.

In this way, the systematization of the levels of organization of matter will be assimilated by the student in relation to the environmental argumentation of the adaptability of organisms. This configuration accounts for the deductive process and the reconstruction of arguments that allow the student to recognize, in environmental changes, the cause, complexity and impact on the functioning of the organism in its ecosystem, allowing the student to contextualize its cognitive and experiential references in the diversity of ecosystems.

At this stage of the integration process, the importance of analogies between biotic phenomena whose causes have shared similarities is emphasized for the selection of species that, due to their genetic diversity, are the best adapted to the edaphoclimatic conditions. Adaptations are based on

variations, mutations, hereditary transmission in a genotype-environment relationship, which facilitates species adaptations in a natural way.

In this way, the student will be able to interpret adaptation as the correspondence with the environment of the structure and functions of the organism, as well as its behavior. The student will be able to distinguish the genotype-environment relationship through analogies of the variations experienced by organisms in ecosystems, as well as to establish analogies between different environmental conditions that generate variations in populations and lead to the adaptability of the species, which guarantees its growth, development and reproduction.

In this way, the dialectic relationship between the configurations systematization of the levels of organization of matter and environmental argumentation of the adaptability of organisms is evidenced, as the relationship of interdependence between the levels of organization of matter leads to the exchange of substances, energy and information with the environment, and simultaneously the action of abiotic factors of the physical environment modify these levels regulating the biological performance and the adaptability of populations in the ecosystem.

In view of the above, the causal explanation of the functions of the organism is enriched by incorporating its relationship with the environment, thus allowing a holistic interpretation of its functioning in the ecosystem. This configuration is understood as a logical, meaningful and contextualized process, expression of the understanding of the functioning of the organism as a whole from the diversified environmental conditions of the ecosystem as a sustainable biological system.

The starting point is the understanding of the functioning of the organism, according to (Jardinot 2020, p. 8) as “the result of the dynamic integration of its different components, structures, properties and functions; in a single whole that responds in an integral manner to a given stimulus or change in the environment”. Explanations and arguments of the functioning of the organism are required, based on integrative approaches to its biological responses, according to the characteristics of ecosystems.

In this way, the student will be able to reconstruct the functioning of the organism in different ecosystems from the genotype-environment relationship, that is, to specify how the genetic potential is expressed before the incidence of environmental factors, seeing the organism as a

unique whole in interaction with its ecosystem. To achieve this interpretation, modifications in the action of environmental factors on ecosystems are analyzed analogically.

The relationships between these four configurations make it possible to make explicit a new movement of the modeled dynamics, which results in a second level of essentiality given by the environmental generalization dimension of the content in the ecosystem. This is conceived as the process in which the student, starting from the properties of the ecosystem, explains the relationships of the biotic and abiotic components, comparing the adaptive responses generated by the changes in the physical environment and by the biotic relationships, as well as their effect on the growth, development and reproduction of the species, which allows establishing the regularities of the functioning and explaining it in different contexts with new factors.

It is recognized as a process of reconstruction of the essential content through the establishment of analogical relations of the functioning of the components of the ecosystem in interaction with the diverse bioclimatic conditions, which takes place in the dialectic of the systematization of the levels of organization of matter, the environmental argumentation of the adaptability of organisms and the holistic interpretation of the functioning of the ecosystem, as a new stage of the process of intradisciplinary integration of the biological content.

In the environmental generalization, the student should make analogies by consequence, similarity and limitation, taking into account: the influence of the variations of physical factors in the development of species, the interactions of biotic components that generate diverse responses and adaptations to the ecosystem.

This dimension accounts for the generalizing character of the functioning of the organism in the ecosystem, making it possible to contrast the organic functioning in diverse ecosystems from the explanation of the physiological processes that govern the growth, development and productivity of organisms in their interaction with the environment.

Among the various ecosystems, a special place is occupied by the agroecosystem, which has become the context in which agronomists operate. For a holistic interpretation of the functioning of the organism in the agroecosystem, it should be considered as a particular ecosystem, where at least one living component of agrarian interest is incorporated, and where its utility is based on the human utility to produce goods and services. The agroecosystem is designed and regulated by man to channel the maximum of energy towards obtaining food and other products with optimal

productive results. All this shows the need to deepen in the holistic interpretation of the functioning of the organism from a concretization of the biological contents in the singularities of the agroecosystem.

Dimension Agroecological concreteness of biological content

Consideration of the enrichment of the holistic interpretation configuration of the functioning in the ecosystem from the synthesis of a new relationship between the contextualized orientation of the biological contents in the agricultural practice and the identification of the biological interactions determinant in the sustainability of the agroecosystem, which dynamizes the application of the biological foundations in the solution of professional situations. All this accounts for another movement in the process of integration of contents, which is expressed in the agroecological concreteness of the biological content.

In this sense, the contextualized orientation configuration in agricultural practice is understood as an intentional process that promotes the link between biological contents and agricultural production from the biological yield-agricultural yield relationship, re-signifying the professional output of the contents. This relationship is argued as a premise in the biological foundation required by the agronomy professional for an adequate design, selection and application of agricultural management, so as to enhance the sustainability of productions.

In the contextualized orientation, the teacher should link the contents of the biological and basic specific subjects, promoting teaching situations in which biological and agricultural processes are related from their theoretical and empirical relationships. In this way, the student will be able to evaluate, from the genetic and physiological contents received, the possibilities of increasing agricultural diversity.

To establish these relationships, the student should take into account the following biological contents essential for agricultural production: biological diversity, biological interactions between the components of the agroecosystem, recycling of nutrients and organic matter that allows an optimal balance, sources of variation and methods of genetic improvement, reproduction and hereditary transmission for the multiplication and conservation of individuals, the interrelation of the resources of the physical environment with biotic factors, which determines the growth and development to increase biological yields.

In this way, the contextualized orientation in agricultural practice favors the appropriation of the essential biological contents in agricultural activity, which requires the identification of the biological interactions that determine the sustainability of the agroecosystem. The configuration accounts for the process of analysis of the biological interactions among the components of the agroecosystem and of these components with the environment to support the sustainability of the agroecosystem based on the biotic balance.

Students will base their analysis on the construction of biological content, enriching its application with the recognition of biological interactions as a basis for agricultural diversification aimed at promoting native interactions and beneficial synergies in agricultural production systems.

It will be possible to deepen the importance of the biological contents received for the sustainability of the agroecosystem, understanding this as the durability of production systems, their capacity to maintain themselves over time and in the face of shock situations, the preservation of renewable natural resources used for agricultural production, as well as the inputs necessary for production and the technological, social, economic, political and cultural resources (Sarandon and Flores, 2014).

With this objective, the student should identify biological interactions and understand that the components of agroecosystems and the relationships among them are fundamental to design and manage sustainable agroecosystems. To this end, the following biological interactions will be addressed: competition, allelopathy, herbivorism, predation, parasitism and mutualism. These contents are connoted as biological fundamentals in the solution of professional problems.

In this sense, the dialectic relationship that exists between the identification of the biological interactions that determine the sustainability of the agroecosystem and the contextualized orientation that precedes it stands out, inasmuch as the richness and relevance of this identification depends on the depth of the contextualized orientation in the agricultural practice of the biological contents received by the student. In turn, as the student deepens in the identification of biological interactions in different agroecosystems, elements for their sustainability can be contributed, modifying the initial contextualized orientation.

As a result of the dialectical relationship between these configurations, the holistic interpretation of the functioning of the organism in the ecosystem is enriched from a better contextualized orientation of the biological contents in agricultural production, thus dynamizing a new

configuration, the application of the biological foundations of agricultural production in professional situations. This higher order configuration is understood as the process of generalization and practical concretization of the biological content in professional situations.

Accordingly, students will have to face situations, modeled or real, related to professional problems, which require the mastery of biological contents. The aim is to distinguish the biological contents that make it possible to base the biological-agricultural performance relationship in the management of management, recognizing it as a professional output of these contents in their modes of action.

In summary, from the interrelation established between the above configurations, a new level of essentiality of the modeled dynamics emerges that accounts for the agro-ecological concretion dimension of the content, understood as the process that relates biological and agricultural contents from the biological interactions that determine the sustainability of the agroecosystem and from the biological yield-agricultural yield relationship, through the application of the biological foundations of agricultural production that support the design and management of agro-ecosystems.

This higher level of integration is characterized by the mastery of those essential biological contents, theoretical and practical, that explain, in a coherent manner, the biological basis underlying agricultural processes, that typify them according to the characteristics of the agroecosystem, and that make their sustainability possible. It is important that students recognize them as the biological foundations of agricultural production.

Among these fundamentals, the following stand out: the structure of the biological components and their spatial and temporal distribution, the properties of the biological system in its individual performance or as a component of the agroecosystem, the dynamics of biological processes in agricultural processes, and the predominance of families of agricultural interest.

Thus, the appropriation of a conception of biotic integrity is consolidated by revealing in an integrated manner the relationships between the different interactions: biological, environmental, technological and social, which characterize agricultural production systems. In the formative order, it means the formation of feelings of love for the profession and responsibility in the treatment of species in their agroecosystem. It is a conscious and intentional process aimed at strengthening the professional bioagricultural sense.

In this way, the dimension favors the formation of an oriented vision of the profession that places the future agricultural engineer at the center of professional relationships. It is achieved to the extent that the student integrates and supports the biological content, revealing new scopes for its application in productive systems with a significant and transcendent relationship.

Based on the analysis of the didactic logic of the proposed model, the establishment of the foundations of the biological contents in the agronomy course of studies is considered as a distinctive feature of the transfential dynamics of intradisciplinary integration. This is reinterpreted as a process of abstraction-concretion of the essentials of the biological content in the training of the agronomist, based on the relationship established between the integrated simplification of the biological content, its internalization and the application of the essential content, which guarantees the logic and sequence from an integrative explanatory approach, which enables the agronomist in training to be professionally flexible in the face of the demands of solving professional situations in any ecosystem.

Returning to the didactic logic of the proposed model, the system of relationships that allows understanding the transformations of the process can be synthesized as follows:

- Deconstruction of the biological content based on structure-properties-functions associations of the organism.
- Contextualized analogical reconstruction of biological content in the ecosystem.

Professional re-signification of the biological content from its applicability with an agroecological perspective.

Conclusions

The relational system between dimensions and configurations reveals, as its essential regularity, the dynamizing character of transfer in the intradisciplinary integration of biological contents. This has as its essence the conformation of a conception of biotic integrity and of a bioagricultural professional sense, in order to enhance the application of biological contents in professional situations.

The pertinence and feasibility of the pedagogical model is connoted from the results of the application of the socialization workshops and the case study.

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