

## Revista Tópicos Educacionais

## **ISSN: 2448-0215 (VERSÃO ON-LINE)**

# THE THEORETICAL GENESIS OF A TEACHING MODEL AT UNIVERSITY A GÊNESE TEÓRICA DE UM MODELO DE ENSINO UNIVERSITÁRIO

Walter Francis Walker Janzen 1

**Abstract:** This article, as its title indicates, deals with the essential concepts that should be taken into account in the design of a didactic model for the teaching of the basic sciences -or any other discipline- at university. According to the argument developed, man and his characteristics should constitute the primordial conceptual axis. For this reason, the text briefly develops an anthropological framework, an epistemological framework, and a theoretical framework where these concepts and the needs of the model are inserted in relation to man. The anthropological framework deals with the problem of man and the relationship between the anthropological and the pedagogical. In the epistemological framework, the nature of learning in the sciences and the characteristics of the scientific disciplines. Finally, in the theoretical framework, the conjugation of diverse elements linked to learning and some essential characteristics that the model being sought should have.

**Keywords:** Anthropos, Significant learning, Episteme, Didactic model, Dialogical relationship.

Resumo: Este artigo, como seu título indica, trata dos conceitos essenciais que devem ser levados em conta na concepção de um modelo didático para o ensino das ciências básicas -ou de qualquer outra disciplina- na universidade. De acordo com o argumento desenvolvido, o homem e suas características devem constituir o eixo conceitual primordial. Por esta razão, o texto desenvolve brevemente um marco antropológico, um marco epistemológico e um marco teórico onde estes conceitos e as necessidades do modelo são inseridos em relação ao homem. O marco antropológico trata do problema do homem e da relação entre o antropológico e o pedagógico. No marco epistemológico, a natureza da aprendizagem nas ciências e as características das disciplinas científicas. Finalmente, no quadro teórico, a conjugação de diversos elementos ligados à aprendizagem e algumas características essenciais que o modelo que procura deve ter.

**Palavras chave:** Anthropos, Aprendizagem significativa, Episteme, Modelo didático, Relação dialógica.

-

<sup>&</sup>lt;sup>1</sup>Fundación Educacional Intraeduc, Chile.

Introduction

The model is a space for possible explanations and directions that lead to the not surprising.

(Hanson; Cambridge, 2010)

The concept of model has been acquiring, in this last decade, a greater relevance in the interpretation of the character of scientific thought and activity. Today it is suggested that -in relation to what this concept has meant in science- its definition is incomplete with respect to the corresponding empirical references for which it is constructed. In reality, the models are simplifications or idealized representations of the systems that are supposed to exist in nature (DEL RE, 2000). A didactic model for the teaching of the basic sciences -which strictly speaking would not be a scientific model of those used in the factual sciences- would have to be, necessarily, a model in which those foundations corresponding to each one of the fields of knowledge and research of the new didactics of the basic sciences would be inferentially related. These necessary interrelations do not pose anything new: finding hierarchies of models, that is, models that subsume models or that are built from other models, is quite frequent in scientific praxis (GALLEGO, 2004).

When a model is constructed -which in reality, if we think about it, is nothing more than an entelechy-, we usually prioritize the efficiency and effectiveness of its functionality in temporal and productive terms and, in this rationalization, we usually also forget some considerations of the central object: the integrality of man in the context of such model. This integrality and its context suppose here the existence of certain elements that should always be taken into account at the time of its construction: the type of man available and his anthropological and pedagogical analysis; the epistemological foundations of the type of learning that the model seeks; the state of logical or operational development of the subject in question; the characteristics of significant learning; the cognitive structure of this student; the role of the teacher as mediator in the application of the model; the dialogical relationship and its connection with learning, and finally, the characteristics of the disciplines towards which the model is focused.

The discourse that follows explores each of these elements, taking as a reference point, obviously, the teaching of basic sciences at university.

### An anthropological framework.

Since the one who is educated is the human being and not another being - that man is an animal and something else is not in doubt - it is not uncommon to find it impossible to address the educational question without referring to Anthropos or human reality. The human and the educational constitute mutually-referenced signifiers-meanings, according to Fullat (2011).

The problem arises when trying to clarify the concept of man because it becomes an obstacle when trying to clarify the concept of education, and the concept of man is not a question that has ever been defined by anyone, not even those who have dedicated themselves to the subject in a specific way: after reading Buber's exhaustive essay (1992) no one could give a final definition of  $Man^2$ . However, the meaning of the educational process is clarified when one obtains rigor in the concept of the human being. For this reason, only an anthropology of education can relate a Philosophical Anthropology to educational processes. Anthropology and Pedagogy constitute an enriching circularity. The constitutive features of the human being allow us to have a more precise and complete idea of the educational processes. The term Anthropos is Greek and means "human being". The word Paideia ( $\pi\alpha\iota\delta\epsilon\iota\alpha$ ), also Greek, is usually translated as Education, but it has more of a sense of a commitment to Culture, in a playful way. This surrender makes possible the social engender of man; all research around the human leads inexorably to educational issues.

When dealing with the subject of man, the amount of acceptances and concepts poured on him are opposed both today and in Socrates' time: "[...] who is knowledgeable about human perfection? (PLATO, 2018, 20 a, b); in such an anthropological crossroad, Anthropology asks for help from Pedagogy: the human being is perceived as a task. The how, what and who of Anthropos is a doctrine that is not given to it, but constitutes its fundamental task.

The human being manifests itself as problematic; Philosophical Anthropology takes up the problem, and Educational Sciences, including the Cultural Anthropology of Education and Educational Technologies, seek to frame their projects within the biosocial reality.

In this context, the essence of the anthropological remains open to pedagogy. But also, an analysis of the educational process necessarily refers to an anthropology that

<sup>&</sup>lt;sup>2</sup> This obviously refers to the species, not the genus.

reflects beyond any possible experience or phenomenon. There is no way of thinking about education without reference to its "Why". Whenever one educates, one educates someone and for something. To educate without anthropology immediately ceases to be education, transforming it into vulgar training. To teach is to transmit linguistic symbols: mythical, religious, artistic, scientific, historical. To educate is to beget the human and pedagogy has only one central theme: What is Man? Any meditation on education implies a lucubration of the image of man; any educational practice starts from a conscious or unconscious anthropological representation. The educative practice demands an anthropology. This contains the progressive liberation of man, since he, by manufacturing culture, is partly liberated from natural necessity. Anthropos is the functional unit involved in educational praxis.

In an organization such as the University, there is an explicit reference, an Anthropos model established a priori in a selection process. The constitutive features of the "graduate student" are defined by his or her training in the curriculum and those of the teacher in his or her requirements for incorporation into the system.

The prototype student who enters the University is a woman or man who has voluntarily entered it and whose academic background at the entrance levels is normally barely sufficient to continue his or her studies at the university level. For this reason, the formative role of the University will seek - and must do so if it wishes to increase its prestige as a trainer of professionals - to optimize in it the socialized, active Anthropos, capable of establishing a continuous and flexible level of inter-subjective communication, capable of working in a team and exercising leadership, able to generate his or her own strategies of action and evidence of values that not only integrate him or her to other university levels of decision making but also to the working world of our particular society, as an integral being.

The teacher must be a professional specialist (Engineer, Accountant, Auditor, Administrator, Systems Analyst, etc.) or a Professor of State with specific mention and academic degree (Master, Doctor). The University will expect the teacher to be a mediator in the objectives of his or her role as a trainer for the student. This must necessarily be part of his or her anthropological "project".

### The required epistemological framework.

From epistemology, the learning of basic sciences is an empirical scientific knowledge (like Physics or Chemistry) because it confronts and analyzes experience, perceptions and sensations, a formal or axiomatic scientific knowledge (like Mathematics) and also a metaphysical knowledge because it transcends phenomenology and deals with what changes.

From the metaphysical point of view, the construction of the world is based on knowledge, on feeling, deciding and doing as well as on the dialogical relationship<sup>3</sup>. If we take into account Fullat's taxonomy (2011), physics and chemistry are empirical sciences because they deal with reality, and mathematics is a formal science because it deals with the axiom and coherence of language. Mathematics differs from the other two sciences in that it is an ideal science, from the point of view of the idea, eminently deductive, while the factual sciences such as physics and chemistry are inductive. On the other hand, education (which encompasses in a broader framework the conceptualizations of learning and teaching) is framed within the social sciences, at the frontier of empirical scientific knowledge and metaphysical knowledge. In this way, metaphysics turns out to be the basis for learning the empirical sciences, such as physics and chemistry, and also the ideals, such as mathematics.

The learning of the sciences generates episteme<sup>4</sup>, never doxa. Although intuition may eventually lead us to the solution of a problem in science, we cannot properly say that through it we are exercising scientific knowledge, but rather that we are giving our opinion about it.

Through this learning, we build the particular world; the perception of the world, of its laws of functioning and of the principles involved in its dynamics; it allows us to immerse ourselves in a new world and opens new visions about the causes. The teaching of basic sciences is a social science that uses communication and information of the scientific as a bridge through which man goes from the idea to the world; because man is separated from the world is that he needs this bridge to dominate it.

\_

<sup>&</sup>lt;sup>3</sup> From the metaphysical point of view, the dialogical relationship is closer to the dialogue that Goethe proposes between man and nature. From pedagogy, it is the relationship between the I and the You of Buber.

<sup>&</sup>lt;sup>4</sup> The episteme is knowledge, wisdom; the doxa, is simple opinion. The Greeks were very clear about the difference.

It is first theoretical reason and later practical reason that, sequentially, lead

us to understand basic sciences and later to know them. This learning tries to understand,

criticize and change the world as a result of the application of this knowledge. In this first

intellectual contemplation, theory tries to see things as they are and its criterion of

decibability about what is true is the empirical proof in the teaching exercise. In this

context, praxis and krisis<sup>5</sup> contribute to the evidence based on theory. The ordering of

ideas around the perception of the world is also a function of learning the sciences; it is

the kosmos<sup>6</sup> in the kaos. Here practical reason comes into play; how the use of this

knowledge attempts to change the world -and in fact does so- with all its techniques and

instrumental modifications.

The learning of the sciences is a temporal knowledge, its temporality has to

do with its structure, with an explanatory purpose of the past, with the understanding of

an eventual future and also with its incidence in the technique, (and through it with its

concretion in the world).

Now then. A learning of this nature entails epistemological obstacles, which

within the broader classification of a social knowledge, are nothing more than

"circumstances that make this scientific knowledge difficult and can influence its

objectivity" (SIERRA BRAVO, 1984, p.66).

Indeed, as the three main elements involved in all knowledge are the object,

the subject and the process of knowledge, the epistemological obstacles that can be

distinguished a priori in the exercise of teaching the basic sciences are related to their

dependence on one or more of these elements:

1. The object of education is the social. A diverse, complex, changing, and sensitive

reality; a characteristic that affects this education and the objectivity of its analysis. Both

in its learning stages and in its cognitive processes and methodological events.

2. The subject: he (teacher) constitutes one of the distinctive features of the educational

process; the cognitive subject is part of the known object because he is an element of the

social object.

<sup>5</sup> Krisis as a confrontation is an important factor in problem solving.

<sup>6</sup> The Greek kosmos is opposed to kaos: it is order versus disorder.

Tópicos Educacionais, Recife, v. 26, n.2, p. 20-34, jul./dez. 2020.

3. The process of knowledge: the more specific obstacles in this case can occur at one or

more of the levels of dialectical interaction, language and/or mediation.

In the dialectical interaction between the subject and the object, the subject is

modified by the object on which he teaches, and this in turn is modified by the second.

Pre-notions or conceptions based on a superficial experience and knowledge

of the social can have a significant influence from the object to the subject, just as the

latter can also interpret the object from the prenotion developed in the course of his or her

previous teaching experience.

Language is a vehicle of meanings, which in the case of the teaching of basic

sciences is specific, theoretical and formal. This constitutes an obstacle not only from the

understanding of its contents, but also from the communication and the approach of the

dialogical relationship.

The mediation of the teacher and his or her interaction with the modification

of singular phenomena, generated by the object of education (particular social group),

requires overcoming the deceptive appearance of these singular phenomena in order to

achieve the correct perception of an efficient mediation.

A possible theoretical framework.

Within this theoretical framework, some conceptualizations associated with

that of the model should be reviewed first.

Models are currently used as a methodology for research and interpretation

of reality, both in the factual and social sciences. In themselves, they can be considered

as methodological resources. The theory serves as a basis for the elaboration of the

formalized models, since they have a high level of abstraction. For the rest, the concept

of model itself is an abstraction: "The model, from the orientation in which we will use

the term, is a theoretical elaboration that allows us to ignite reality" (MEDINA, 1982,

p.75). In this, there is consensus among all the authors who have dedicated themselves to

the subject.

Given the complexity of the teaching-learning process, the model should be

considered as a "selective representation of the essential elements of it, which allows us

to describe and explain it in depth" (MEDINA apud CHAPANIS, 1982, p.75). According

to this author, the selection of the elements that make up a model must respond to a

Tópicos Educacionais, Recife, v. 26, n.2, p. 20-34, jul./dez. 2020. Disponível em: < https://periodicos.ufpe.br/revistas/topicoseducacionais/>

detailed analysis of its incidences in the didactic act: given the complexity of the teaching

process that facilitates the formative learning of the student, the essential elements of the

model must be selected to achieve efficiency in its execution.

The resulting simplicity of a model, which obviously always represents a

multiplicity of notions and which could be interpreted as a structure that does not cover

everything that the educational act means, could be attenuated if it is treated systemically.

Most of the authors who deal with the subject agree in specifying three

elements that are inherent to the elaboration of a model and that must always be present:

1. Determination of the goals to be achieved.

2. Selection of the means to achieve them.

3. Control of the achievements.

These elements are interdependent and cannot be posed or treated in a

watertight way. Therefore, one cannot agree more with Medina (1982) than

Every teaching model is framed within a specific social environment that conditions the choices made by the educator. The conception of

society and of man conditions the ends that the instructional process has to reach. The educational authority elected in that society proposes a set of objectives defined in the fundamental laws and developed in

complementary norms, which guide and sometimes reduce the instructional-educational activity. In addition to the influence of the social structure, the teaching-learning process is influenced by the

climate created by the immediate educational community, characterized by the expectations of parents and their conception of man and society,

and by the decisions of the model we propose (p. 77).

Almost 40 years have passed and the statements made above are still fully

valid.

In the third element mentioned above, the control of the achievements

obtained, the concept of evaluation becomes relevant at the time of constructing the

model: evaluation is the verification of how the teaching-learning process has been

carried out, providing the rigorous knowledge that authorizes us to propose the

corrections and proactions that are considered opportune.

The evaluation allows, through the continuous feedback, to keep the didactic

and methodological systems permanently updated. Without it, there is a lack of

appropriate orientation about the behavior of the model and of the necessary information to innovate in a timely manner.

Although it is true that the evaluation fulfills diverse objectives in consonance with the qualification - of great importance in the University -, the formative aspects and the diagnosis, it should also be considered the criteria conception of W. James Popham<sup>7</sup> originally raised in 1978. It is a criterion because what interests us is to evaluate how each student acquires the self-proposed objectives and those indicated by the teacher, reasoning selected and adequately sequenced, trying to establish with precision the criterion that classifies the set of most perfect aspects and achievements that the student has to reach.

The rubric is an excellent instrument to evaluate the objectives according to the criterion.

But, to verify the evolution experienced by the student it is necessary to start from a diagnostic evaluation that informs about the personal, environmental and individual features. The formative evaluation implies making a suitable assessment during the whole teaching-learning process, whose purpose is to educate the student by means of the reasoned exposure in all the instances of his educational process, evidencing the successes and errors in order to intensify the first ones and to avoid the second ones. Both diagnostic and formative evaluation should be explicitly expressed in the model.

From the perspective of the student's protagonism in his evaluation process, it is necessary to make him participate in the evaluation of his work through the use of appropriate criteria that help him in his self-evaluation. "In this way, self-evaluation and heteroevaluation contribute to a contrasted evaluation of the teaching-learning process and its results" (MEDINA, 1982, p.99).

One of the factors that influence the learning process of the students is the level of intellectual development in which they find themselves. This is the issue that must now be addressed.

According to Piaget (2001), logical or operational periods are characterized by the fact that people present a logical reasoning where relevant relationships or associations abound and non-relevant ones are scarce.

-

<sup>&</sup>lt;sup>7</sup> This author has worked extensively in the field of evaluation and three of his most important developments were published in 1990, 1997 and 2013. In the latter year, Popham proposes the "trans-formative evaluation"

The period of operative intelligence or logical intelligence begins at the age of 7; it is in this period that the child will be trained to handle mental operations: internalized action that transforms a state A into a state B, maintaining constant or invariable at least one characteristic, with the possibility of returning again to the initial state. From the definition we can emphasize the concept of internalized action; this indicates that we speak of imagined actions. Transformation is a concept common to all types of operation and indicates that to operate a state is to convert it into another as a product of this operation. Reversible action, it is a concept that refers to the fact that the result of a direct action can be annulled or complemented with that of an action in opposite sense. Invariant or notion of conservation, is an expression that indicates that the child is capable of performing reversible actions mentally, originating the notion of conservation. In this period, we find the periods of concrete operations and formal operations.

The period of the concrete operations, marks the characteristics of the children between 7 and 12 years old; the preoperative thought is overcome and new schemes begin as notion of conservation, development of the mathematical logic with concepts of number, relations, quantities and arithmetic operations.

The period of the formal operations is generated and corresponds to ages between 12 and 18 years with a thought based on abstract or formal operations. It has two independent features with a deep relationship. On the one hand, it is the moment in which insertion into the adult world takes place with all the problems that this entails, and on the other hand, it is the period in which individuals begin to be able to manage hypothetical deductive thinking, characteristic of the sciences, which demands full integration. In this period (as in the others) language plays a predominant role, since the possible is constructed using it, in the fundamental sense.

At 18 or 19 years of age, this student is already a university student.

This level of development is what will allow this student to understand scientific thought and reason about complex problems. Here, the subject uses the logic of propositions as a type of verbal logic. In addition, the use of hypothetical-deductive reasoning requires refining the instruments of deduction provided by propositional logic operations, the use of disjunction, conjunction, conditional, etc. If one considers that mathematics is not only a self-sufficient and self-constructive science (autopoietic in fact), but also the obligatory language of the factual and social sciences, such as physics, chemistry and geography, it is possible to understand that the extension of this reasoning

also involves the treatment of the above-mentioned sciences, in terms of the states of development of which Piaget spoke.

In the process of student learning, to achieve effective learning is to achieve significant learning; Ausubel (2009), states that significant learning involves, in one direction, the acquisition of new meanings and that in the opposite direction, these new meanings are the product of significant learning.

The essence of the process of meaningful learning lies in the fact that the ideas expressed symbolically are substantially related to what the student already knows.

Meaningful learning presupposes as a first condition that the student manifests an "attitude towards meaningful learning", in other words, a disposition to substantially relate the new material to his or her cognitive structure, that is, the material he or she is learning is potentially meaningful to him or her, in that it is especially related to his or her knowledge structure in an intentional way.

Otherwise, regardless of how much potential meaning is inherent in the proposition, if the student's intention is to memorize, both the learning process and the learning outcomes will be mechanical and meaningless.

The second condition is that the learning task must be "potentially meaningful" and clearly relateable, substantially intended, to an obvious cognitive structure. Both conditions must be present for meaningful learning; one alone is not sufficient and does not allow for the achievement of learning in students.

Whether or not the learning task is potentially significant, intentional, and substantially related to the student's cognitive structure, depends on two main factors: both the nature of the material to be learned, and the student's cognitive structure. That the nature of the material is of logical significance means that the subjects of study have logical significance.

With respect to the cognitive structure of the student, it can be said that the acquisition of meaning as a natural phenomenon occurs in specific human beings and not in humanity in general. Therefore, in order for meaningful learning to really occur, it is not enough that the new material be intentional and relateable to the corresponding ideas, it is also necessary, that such content exist in the cognitive structure of the student. Hence, the potential significance of learning material varies not only with educational background, but also with factors such as age, I.Q., occupation, and membership in a particular social and cultural class.

That the material has a logical meaning, means that it shows sufficient intentionality and sufficient substantial relationability (material with ideate symbols equivalent to the students' cognitive structure), maintaining the same meaning of the idea. The types of significant learning (Ausubel, 2009) are learning of representations and of propositions. The first one deals with the meanings of the ideas expressed by groups of words combined in propositions or sentences. The second, of the logical structure of the assertions. The third type of significant learning is concept learning.

Concepts (unitary or categorical generic ideas) are represented with isolated symbols in the same way as unitary referents. The effectiveness of significant learning as a means of information processing and storage mechanism of the same, can be attributed largely to its two distinctive features: the intentionality and the substantiality of the relationship of the learning task with the cognitive structure of the learner.

Another factor that influences the students' learning process, besides the level of intellectual development and the achievement of significant learning, is also its realization, not only individually, but also in a socially significant activity that plays for them a consciousness generating role (VYGOTSKY, 2012), where the individual consciousness is the one that is built from the outside, through the relationships with others in a process of interiorization, as a process of transformation of external actions into psychological functions.

Unlike the development of instincts, the thinking and behavior of the students in question are not induced from the inside, but from the outside by the social environment. The tasks that society imposes on this "young adult" when he or she enters the cultural, professional, and civic world of adults undoubtedly become an important factor in the emergence of his or her conceptual thinking. If the environment does not make new demands on him, nor stimulate his intellect by providing him with a series of new goals, his thinking does not manage to reach the higher stages or reaches them with much delay.

Conceptual thinking or concept formation can be scientific or spontaneous; the formation of spontaneous concepts arises from the person's own reflections on his or her daily experience. The scientific one, originates in the highly structured and specialized activity of the classroom and imposes logically defined concepts on the individual. Vygotsky (2012), maintains that scientific concepts, far from being immediately and uniformly assimilated, actually undergo a substantial development that depends on the level of the subject's general capacity to understand spontaneous concepts; by opening

up, "upwards", towards a greater abstraction, they prepare the way for scientific concepts

in their development "downwards", towards a greater concreteness.

There are two forms of learning responsible for the formation of concepts.

One is systematically organized learning in an educational context, and the other is

spontaneous, less elaborate learning, which is more of an obstacle in the formation of

concepts.

Vygotsky expresses that interpsychological external relations become

internal mental functions, and intrapsychological ones, in an internalization of the

communicative function, becoming an internal and individualized mental function. These

relationships are of a dialogical type, both internal and external.

In the educational field, the teacher acts as a mediator of the learning process

of the students, with relations of a dialogical type, complemented with the internal

dialogues of the students and the external ones that are produced in the interaction,

converting these dialogical relations, by means of the communicative function, into

internal and significant mental functions for the students and the expression of the

thoughts in a linguistic form, thus becoming communicative, as a function of learning in

relation to others.

A minimum reflection conclusion

Actually, no model that attempts a didactic model for teaching science should

leave aside the fundamental aspects related to the characteristics and roles of man in

teaching and learning. And also, for the teaching of any other discipline, because although

the primary interest of this discourse has been the teaching of basic sciences at the

University, the model can be used in other disciplines.

Once the concepts that bring us closer to the model that is needed have been

set out, the minimum requirements that it should have - according to what has been argued

- are to be found in the theoretical-structural, anthropological and epistemological

aspects.

In the theoretical field, the model should highlight a detailed analysis of its

impact on the educational act. Its structure should be articulated in such a way that a

systemic interdependent analysis of its most generic parts can be carried out:

determination of the goals to be achieved, selection of the means to achieve them and the

way to control the achievements obtained. The explicit nature of its types of evaluation,

with special emphasis on diagnostic and formative evaluations - which are rare in positivist models of scientific environments- and evaluation instruments that show an openness towards constructivism, is indispensable. Also, the modes of self- and hetero evaluation, as a way to involve the student in his own learning. Their plans and programmes should induce hypothetical deductive thinking, propositional or diffuse logic as a type of verbal logic and the fine-tuning of the instruments of deduction. In the teaching methodology of their subject programmes their learning tasks should be potentially meaningful, i.e. they should be oriented towards meaningful learning. Furthermore, their activities should also be planned as socially significant, so that they play a consciousness-raising role in the student.

Regarding the epistemological, the model should be able to resist the attacks of a diverse, complex, changing and sensitive reality, so that it is not affected by its installed capacity for objective analysis. The model's programmes should also include the dialectic interaction of language and mediation.

In relation to the anthropological domain, both the subject programmes and the programmes of connection with the university environment should plan the activities in such a way that the student can effectively become an active, socialized Anthropos, capable of establishing a level of inter-subjective and flexible communication, capable of working in a team and exercising leadership, capable of generating his or her own strategies of action and demonstrating values of humanity. That the University does not turn him into a scientist who does science just for the sake of doing science, detached from the world and its needs.

As long as the contingent paradigm in science education continues to maintain the premise that to teach science it is enough to know science and that the teaching profession is only a matter of vicarious learning, the transfer of knowledge will continue to suffer from multiple problems.

For this reason - and others that can already be inferred - the praxis of a didactic model for the teaching of the basic sciences must necessarily and inferentially relate those models corresponding to each of the fields of knowledge and research of the new didactics of the sciences, because only in this way will science education continue; otherwise, only information will continue to be transferred.

#### References

AUSUBEL, David y otros. *Psicología Educativa*. *Un punto de vista cognoscitivo*. Mexico: Trillas, 2009.

BUBER, Martin. ¿ Qué es el hombre? México: FCE, 1992.

DEL RE, Giuseppe. Models and analogies in science. *International Journal for Philosophy of Chemistry*, Vol. 6, N. 1, pp. 5-15, 2000.

FULLAT, Octavi. *Homo Educandus: Antropología Filosófica de la Educación*. Puebla: UIA, 2011.

GALLEGO, Rómulo. Un concepto epistemológico de modelo para la didáctica de las ciencias experimentales. *Revista electrónica de Enseñanza de las Ciencias*, Vol. 3, N° 3, Bogotá, 2004.

HANSON, Russell. Observation and Explanation: A guide to Philosophy of Science. Patterns of Discovery. An Inquiry into the Conceptual Foundation of Science. Cambridge: University Press, 2010

MEDINA, Antonio. Elaboracion de un modelo didactico: base para la realizacion eficiente

de la tarea docente. *Revista Española de Pedagogía* Año XI. Nº 155, pp. 75-103. Junio-Septiembre, 1982

PLATO. Apology. Lisbon: Logos Editions, 2018.

PIAGET, Jean. The psychology of intelligence. London: Routledge, 2001.

POPHAM, W. James. Criterion Referenced Measurement. New Jersey: Prentice Hall, 1978

POPHAM, W. James. What's wrong –and what's right – with rubrics? *Educational Leadership*. Vol. 55. N° 2, pp. 72-75, 1997.

POPHAM, W. James. (Coord.) Evaluación trans-formativa. El poder transformador de la evaluación formativa. Madrid: Narcea, 2013.

SIERRA BRAVO, Restituto. Técnicas de investigación social. Teoría y ejercicios. Madrid: Paraninfo, 1984.

VYGOTSKY, Lev. Thought and Language. Cambridge, USA: MIT Press, 2012.

Recebido em setembro de 2020. Aprovado em outubro de 2020.