

# THE PHENOMENOLOGICAL FACT OF THE SUBJECT AND THE OBJECT IN LEARNING

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## El hecho fenomenológico del sujeto y el objeto en el aprendizaje

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### Abstract

The present work aims to analyze from the point of view of the evolution and appearance of thought in the human being and its structure of knowledge, its different developments in the stages of humanity and its history. The fact of the subject and the object in the relationship of learning as a systemic and reflective form that is acquiring ways of meanings, until reaching an advance where thought seeks to reinterpret and decode the ideas of the world and man (object and subject) of a more structured way, based on a form of equilibration and adaptability taking into account the Piagetian theory, as well as the current thinking reality, of how people form the new knowledge and decodifications, their true meanings for this scientific-technical world, open to a new language and a new way of thinking in the world. The ontic characteristics of the human being allows seeing that is a being of options and that is open to different ways to acquire and decode knowledge, among which stand out at first: "culture and education"; it is the culture that enriches, the one that puts the different forms of transmission of knowledge, orally, in writing and in other ways in which our brain knows how to decode its realities from the primordial elements that only it knows.

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### Keywords

Adaptation, cognition, coordination, balance, learning process.

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### Resumen

El presente trabajo, tiene el objetivo de realizar un análisis desde el punto de vista de la evolución y aparición del pensamiento en el ser Humano y su estructura de conocimiento, sus diferentes desarrollos en las etapas de la humanidad y su historia. El hecho del sujeto y el objeto en la relación de aprendizaje como forma sistémica y reflexiva que va adquiriendo maneras de significaciones, hasta llegar a un avance donde el pensamiento busca reinterpretar y decodificar las ideas del mundo y del hombre (Objeto y Sujeto) de una manera más estructurada, con base a una forma de equilibración y adaptabilidad tomando en cuenta a la teoría Piagetiana, así como la realidad pensante actual, de cómo vamos formando los nuevos conocimientos y decodificaciones, sus verdaderos significados para nuestro mundo científico-técnico, abierto a un nuevo lenguaje y a una nueva forma de pensar en el mundo. Las características ópticas del ser humano nos hacen ver es un Ser de opciones y que está abierto a las diferentes formas para adquirir y decodificar el conocimiento, entre las que se destacan en un primer momento son: "cultura y educación"; la cultura es la que enriquece, la que pone las diferentes formas de transmisión del conocimiento, en forma oral, escrita y de otras maneras en las que nuestro cerebro sabe decodificar sus realidades a partir de los elementos primordiales que solamente ella conoce.

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### Palabras claves

Adaptación, cognición, coordinación, equilibrio, proceso de aprendizaje.

## Introduction

From the new trends in education around the world, where there are countries that do not present the traditional ways of performing the learning process, but instead have democratized the school, an assessment of the didactic processes where the protagonists are both the educator and the educating.

This is where the problem of abstract analytical logical thought appears, for which it is necessary to make a retrospective to the principles of the human being, as being that it is becoming rational; Where does this start to have memories, to have meanings and meanings that are well defined and decoded in order to face the everyday realities of the work of their existence?

The objective of this article is to analyze the significance realities that human beings have in order to reach knowledge and decode actions according to the needs, making education a tool for life.

The learning importance of the subject around the codification of the object is part of the thought evolution of the human being that has occurred for millions of years; the same that made this species call it (human-wise), since in human is presented the whole manifestation of the existence until reaching to knowledge and then to be a creator of culture where the process of education begins, which is transmitted from generation to generation up to the present day. The adventure perhaps started with a species (*Homo Habilis*), collecting information in order to make instruments, manipulate ideas, which helps to confront the most

adverse realities of everyday life; human has a pre-language that helps communicating his/her needs and make safe the species. According to Coopens (2014), it is only from there that human evolves biologically and culturally, because it gives the spirit of conquest, which achieves unimaginable prospects for humanity and that no one can stop.

The term *Homo sapiens-sapiens* refers to the rational human being in the evolutionary process, leaving traces that inform about the capacity of the thought evolution, until reaching an abstract and well defined forms with capacities of analysis, synthesis, composition of more structural reasoning to which the logic is subjected, and even the Mathematics, as the famous phrase of “Cogito-ergo-sum” of Descartes (2012a). It is the reality that shows the true path of the interpretation of the world, the shaping of ideas in the mind that transcends the mere primitive forms to structure critical thinking.



## Thought development and the relationship subject and object of knowledge in the human history

In the philosophy, the evolution of the human thought took at the beginning almost ten centuries to renew itself, from Plato and Aristotle (s. V BC) to Descartes and the English empiricism (S. XVI, AC). It is no stranger to the possible objection according to which during the Middle Ages there would have been philosophy. And then it would be worth mentioning Augustine of Hippo and Thomas Aquinas as the most exalted figures. Properly speaking, from a strictly philosophical point of view, the most prominent work during the Middle Ages—from the patristic to the 14th century—was without doubt logic. As Maldonado refers (2015) the next rotation of philosophical thought was in Kant and Hegel (XVIII and XIX century), as can be seen, the elapsed time is much shorter. Subsequently, Husserl, Wittgenstein and Heidegger constitute three singular milestones of renewal of philosophical thought, and the two first marks the philosophy of the twentieth century in favor or against. The authors who would follow, cover (independently of the philosophical appreciations and tastes) increasingly short and tight swathes of time.

Since the human being has had the capacity to think and reason, it gives him/her the forces that have been able to capture this historical world. There is a very specific question: are the ideas that make history or are the historical circumstances that produce ideas to its needs? Their reflection and response is made by each reader.

## Ancient times

All the answers that were given in humanity were channeled and systematized by the west on the physical and metaphysical realities, some of the times were erroneous and nevertheless they are counted as logical-critical thought and as knowledge.

Mythology is a conception of countersetting philosophy (logic) to a symbolic explanation of the world, this way of seeing reality implies a wide decoding of knowledge.

However, in relation to the myth in recent studies on its role and value, there is no intrinsic contradiction between myth and logos, but are two expressions of the same thing but with a different logic.

Myth: It is a comparative imaginative manifestation of the deepest questions of human existence. So also the myth has a rational nucleus that is discovered through the analysis of the symbolic language that is decoded by the subject and that create culture.

The first thinkers to be able to demystify the reality had to decode new knowledge; they held the idea of a primitive substance that was the basis of all the reality giving rise to the 5 fundamental elements (water-fire-earth-air-ether), born from the nature philosophers, as named by Aristotle in his metaphysical work.

This is the clearest relationship that can occur between object and subject of knowledge.

The same sages and thinkers saw in mathematics and geometry a special contribution to refute and argue the different lines of thinking and the work of the human being with ethics and morality.

Plato (2015), shows in his dialogues, Socrates as a very critical thinker with all the reality of his time, also attacked the behavior of the society. It was adjusted to the fact of logic and reason, but its inner voice, its "dæmon", kept it away from moral nihilism.

Plato's disciple sees in logical reasoning a measure of the ideal world and those innate ideas that we share in forms of reminiscence.

For Aristotle, the reality that surrounds people is not an appearance but a fullness to be investigated and known (cognoscente object). It often departed from the etymologies by attempting through logical analysis and a conscious crumbling of the concepts to get to the knowledge of things, so, it served like a tool of the cognitive criticisms and of the logic; Aristotle (2012) was its true creator, his theory of deductions, which was the first steps of a symbolic and mathematical critical reasoning, gained real importance.



The fact of the universal use made it appear a methodology for the abstraction of the knowledge, the deduction that goes from the general to the particular one; knowledge was structured on the basis of laws of the logic and of the Porfirio's tree. This system remained as a gnoseologic up to the modern age.

## Modern age

Sciences begin in mathematics and can only be refuted with evidence that is adhere to the laws of logic, this thought is more critical, and the cosmic image of the Pythagoreans was based on the number and the proportion, and they saw in the sphere the consummate form of the universe; since then, the astronomical sciences were studied, and the thoughts and the mathematics were giving consistency and an approach to the truth; Johannes Kepler, showed with her studies the new laws of the movement, that provided new knowledge to the previous ones and today are still being used.

From Descartes's (2012b) mathematical logic is developed Spinoza's mystical concept of the substance. His view was based that the only objective in nature was mathematics and that matter was a projection for him, the sciences were measurement and mathematics.

From it for the first time throughout the history of critical thinking, he straightened analytical thinking about his own spirit. From Descartes's method realities are seen differently, since he proposes that there is no nucleus of knowledge. The image of knowledge is characterized by a continual sequence of perceptions and reflections, for him all perceptions are subjective (Asimov, 1999 p. 20).

From Descartes, creator of analytical geometry, many philosophers have also been mathematicians, fact that have helped to give an interpretation of reality, of the world from the intellectual and real truths to reach a "pre-established harmony".

The value of experience is taking shape and Locke in his writings on education and pedagogy shows that understanding is forming, and that knowledge and criticism are only acquired from experiences in the form of sensory perception, this shows a new way of reaching knowledge.

But the limits of reason are recognized and their conditions are analyzed, from which arises the new idealism, where the thought becomes critical for the first time; it is to try to unify the rationalism and the empiricism so that the knowledge can decode the reality. In the *Critique of Pure Reason* the last step is shown, the object of it:

All knowledge that occupies a reasoning... not of the objects but of our knowledge of the objects, as this is possible *a priori* analytical, that is, decoded by the reason and through the synthetic judgements of knowledge, we assure that they are a reality knowable to the intellect and becomes a truth (Kant, 2012, p. 204).

With this term is understood as previous thought all experience and that neither can be demonstrated nor refuted with it, to which it is called transcendentalism. It is also necessary to remember that with Kant, a new logic and new postulates and categories of thought are given.

Since the earliest times, logic has traveled throughout a safe path, it can be seen from the fact that since Aristotle's time it has not taken a single step backwards. What is even more remarkable about the logic is that so far it has also not been able to take a single step forward, and therefore it seems to be all but completed and complete (Kant, 2012, p. 234).

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Leticia Correa, it helps demonstrating that the thought and its development is a capacity of the human being, and says:

Addressing the development of thought from a philosophical standpoint means transcending the biological, psychological, and cultural categories that have been conventionally established to understand the way a person knows. Thus, it is to define how the knowledge of the reality influences my knowledge and vice versa, seeking to build goal knowledge and a consciousness that allows the transformation of this reality (Correa, 2012, p. 74).

Nowadays, the comparison between the computer and the brain is among the clearest images for all and yet it lacks of evidence. In a new step of knowledge has been raised the question of whether it is human understanding the one that possesses access to the world of ideas or if on the contrary, the only true world is that of things. So Bertrand Russell, who at first defends a platonic idealism, leads a radical turn towards realism and new logic. This new realism was founded by G.E. Moore and deepened by Russell joined to the Cartesian line by saying:

Mathematics is the only useful key to open knowledge. True, logic is now developing in a new intellectual sphere. According to rationalists, only statements about relationships can be made and not about things itself... The world is composed of sensory data logically linked to each other. The sensory data of different objects would constitute the spirit of the observer, the sensory data of an object observed by several people, would be the reality of a matter – unprovable (Russell, 1969, p. 124).

Ludwing Wittgenstein belongs to the same group; he is professor in Cambridge and looks at logical thinking from the language. It makes seeing that there are languages that lack syntax, that is, logical concatenation in its phrases and that provide a differentiated expression on the world, and do not have less possibilities of combination than the common languages that are spoken in Europe and America. In his work *Tractatus* he presents a reality about the fact of knowledge and its form of codification:

The judgments are the functions of the truth on concrete statements, that is, logical derivations of the facts; logic nothing says about the reality, because I can never capture it, its nature is altogether tautological= it is limited to express something that is already defined but in a different way (Wittgenstein, 1946, p. 58).

Among the main theories about knowledge, this thinker finds the admission that the statements are realities that reproduce other realities of equal structure, the same object without experiencing any mutation offers a totally different image if are contemplated differently.

A few years ago, the mathematical logic made a real advance of the specialists, today it belongs to the world of cybernetics, of the symbolic and fixed language of the affirmations. The logic of thought is a function requirement of this time. The logic language according to Husserl (2015), lacks of interest; the substance and depth of the meaning of words do not mean anything, which cannot be translated into the binomial principle (with binary signs 0 and 1), because it does not even exist; the boundaries of both phenomenology and functional mathematical thinking are visible, so both spheres need reciprocal complementarity in order to decode and situate in reality.

Wittgenstein in his approach does not reject the ostensive definition, because he values its contributions as a training technique to learn the meaning of the words, so he prefers to call it (ostensive teaching of words); what he is rejecting is the understanding of it, as the means through which the linguistic terms come to have meaning. As far as the ostensive definition is concerned, it says that this, understood as a mere naming of objects, is not enough, it is not sufficient on its own to instruct someone about the use or meaning of a word. For him, the ostensive definition can only be understood by someone who knows the denomination of the term, that is, someone who knows the function that meets the word in the game of language:



Figure 1  
Symbols of logic and mathematical reasoning

**Símbolos**

∈	:	Se lee pertenece.
∉	:	Se lee no pertenece.
=	:	Igual.
≠	:	Diferente.
→	:	Se lee entonces.
↔	:	Se lee si y solo si.
∀	:	Se lee para todo.
∧	:	Se lee "y".
∨	:	Se lee "o".
>	:	Significa es mayor que.
<	:	Significa es menor que.
⊂	:	Se lee incluido.
⊄	:	Se lee no está incluido.
∩	:	Se lee intersección
∪	:	Se lee unión

$$\Rightarrow \int \frac{du}{\sqrt{u^2-1}} = \int \frac{dx}{x} \Rightarrow \int \frac{du}{\sqrt{u^2-1}} = \ln cx \quad (4)$$

Sea  $u = \sec \theta$ ,  $\Rightarrow du = \sec \theta \tan \theta d\theta$ ;

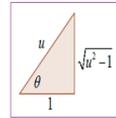
$$\Rightarrow \int \frac{du}{\sqrt{u^2-1}} = \int \frac{\sec \theta \tan \theta d\theta}{\sqrt{\sec^2 \theta - 1}} = \int \frac{\sec \theta \tan \theta d\theta}{\sqrt{\tan^2 \theta}} = \int \sec \theta d\theta,$$

$$\Rightarrow \int \frac{du}{\sqrt{u^2-1}} = \int \frac{\sec \theta (\sec \theta + \tan \theta)}{\sec \theta + \tan \theta} d\theta = \int \frac{(\sec \theta \tan \theta + \sec^2 \theta) d\theta}{\sec \theta + \tan \theta},$$

$$\Rightarrow \int \frac{du}{\sqrt{u^2-1}} = \int \frac{d(\sec \theta + \tan \theta)}{\sec \theta + \tan \theta} = \ln(\sec \theta + \tan \theta)$$

$$\tan \theta = \sqrt{u^2-1}$$

$$\int \frac{du}{\sqrt{u^2-1}} = \ln(u + \sqrt{u^2-1}) \quad (5)$$



Se sustituye (5) en (4):

$$\ln(u + \sqrt{u^2-1}) = \ln cx \Rightarrow u + \sqrt{u^2-1} = cx,$$

$$\Rightarrow \frac{y}{x} + \sqrt{\left(\frac{y}{x}\right)^2 - 1} = cx \Rightarrow \frac{y}{x} + \frac{1}{x} \sqrt{y^2 - x^2} = cx \Rightarrow y + \sqrt{y^2 - x^2} = Cx^2.$$

Source: Dolciani Bernini

Referring to the symbols and the codes to form the new knowledge, in the field of a computerized culture, Andrés Hermann helps locating in a very appropriate context:

This means that in the computerized societies the speeches not only represent codes and symbols that allow the dialogue between subjects, but it allows the naturalization and legitimation of contents and knowledge that are in function of a dominant class exercising control (Hermann, 2013, p. 240).

**The knowledge process as a form of culture from the constructivist perspective**

Jean Piaget's theory on knowledge has changed the conception of how to obtain and organize information in the daily learning.

For Piaget (1963), cognitive development assumes much more than the addition of new facts and ideas to an information store, the birth to maturity for the thinking processes change from very radical way, albeit slowly, because is continuous; people strive to impose a sense of the world. How to continue learning? Piaget identified four principles (bio-

logical maturation, activity, social experience and equilibrium) the first three are examined to then stop in equilibrium.

*Maturation.* Is the exhibition of biological changes that are genetically programmed from conception; very little can be done in this aspect of cognitive development, except to ensure the nourishment to the child and the care needed to be healthy.

*Activity.* With physical maturation increases the ability to act and learn about the environment. When a child's coordination is reasonably developed, he or she can discover the principles of balance when playing with a swing. It is probable to modify his/her thinking processes, at the same time as acting on the environment, that is, when he/she explores, tests, observes and at some point organizes the information.

*Social transmission.* Development also relates to the people around so learning from others is an influence. Without the baggage of knowledge created, people will have to reinvent knowledge that the cultures already possess. What people can learn from social transmission varies depending on the stage of cognitive development in which they are located.

*Balance.* Although assimilation and accommodation are invariant functions when present throughout the evolutionary process, the relationship between them is changing so that intellectual evolution is the evolution of this assimilation/accommodation relationship.

According to Piaget (1963), the balance process of assimilation and accommodation is established in three more complex levels:

1. Balance is established between the subject's schemas and the external events.
2. Balance is established in the own schemas of the subject
3. Balance translates into a hierarchical integration of differentiated schemes.

But there is a new concept of importance in the balance process: What happens when balance set in any of those three levels breaks? That is, when either external schemes or schemes contradict with each other. There would be a cognitive conflict that is when the cognitive balance is broken. The organism permanently seeks the equilibrium and seeks answers, raises questions, investigates, discovers,... etc., until getting to the knowledge that makes it return to the cognitive balance again.

These four principles operate together in order to influence the cognitive development of every human being. As a result of his first biological research, Piaget concluded that all species inherit two basic tendencies or functions:

**The first is towards the organization.** Human beings are born with the tendency to organize their thinking processes in psychological structures or systems to understand or relate to the world. Simple structures are continually combined and coordinated to improve and be more effective.

Very young children can look at an object or catch it when it is at their fingertips, but they do not coordinate both actions at the same time. However, when developing they can organize these two behavioral structures into a coordinated top-level structure of looking, reaching and taking the object. Of course they can also take those same structures separately (Ginsburg, 2013, p. 129).

Figure 2  
Coordination between subject and object of knowledge

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Source: own elaboration

Piaget called these structures “schemes”, and in his theory they are the maximum blocks of thought building; that is, organized systems of action or thoughts, that allow making mental representations, to think about the objects and events of the world.

But any knowledge organization, whether it is natural thinking or highly elaborated scientific theories, implies a transformation of the universe to which we have access... what was once a miracle or contingency now becomes a causality problem, what was mystery or metaphysics now becomes a resolute but still undecided question, in a nutshell the foreigner is now the neighborhood nearby and we see in him some problems, contradictions and inconsistencies that were not distinguished before (Greco, 1967, p. 270).

“Nothing is more serene, more organized than the cognitive space of a five-year-old child, if the school does not torment him in excess” (Gadamer, 1982, p. 210). A year or two later the specific demands begin to appear, and the difficulties will also begin.

Heinz Von Foerster (2002), cybernetics professor at the University of Illinois USA, performs the studies of organization of logical knowledge by means of the theory of J. Piaget. And he mentions that: sensory-

motor interactions and also central processes: cortical-cerebellum-spinal, cortical-thalamic-spinal and other neural junctions, are conceived as something of essentially circular or more exactly recursive nature. The recursion goes into these considerations each time a creature's feelings are explained by his/her movements ( $s_j S(mk)$ ), and his/her movements by the feelings ( $mk M(s_j)$ ). When these two explanations are taken together, they form "recursive expressions", that is, expressions that determine the states —movements, sensations— of the system — the creature — in terms of these same states ( $s_j S(M(s_j)) SM(s_j)$ ;  $mk M(S(ml))$ ). What is referred to as "objects" (what faces ahead) in an epistemology that excludes the "lineal-open" observer, appears in an epistemology that includes the "circular-closed" observer as collateral for stable behaviors, or if using theory terminology of recursive functions, as "guarantee of the own functions. This can be seen in Piaget (1978) on the Recursive fact on page 63 of "Balancing cognitive structures".

Obs. O  $\rightarrow$  Obs. S  $\rightarrow$  Coord. S  $\rightarrow$  Coord. O  $\rightarrow$  Obs. O  $\rightarrow$  etc...

This is a report for the observer of an interaction between a subject (S) and an Object (O) or a set of objects. The symbols used in this expression mean:

Obs. S: "Relative observable to the action of the subject"

Obs. O: "Relative observable to objects"

Coord. S: "Inferential coordination of the actions or operations of the subject"

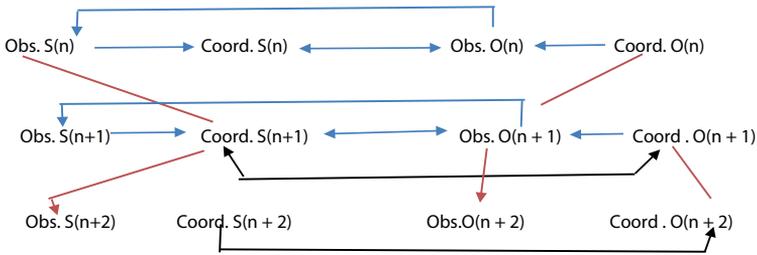
Coord. Or: "Inferential coordination between objects"

If compressing the preceding symbolism even more, composing all that is observed, that is, Obs. O and Obs. S, in a single variable and composing the coordinating operations executed by the subject, that is, Coord. S and Coord. O, in a single operator "Coord". This signifier transforms, recomposes, modifies, etc., the forms, the arrangements, the behaviors, etc., observed in a given movement, initially called  $Obs_0$ , the primary argument, in others observed at another time  $Obs_1$ . The result of this operation is expressed by means of the equation:  $Obs_1 = COORD (Obs_0)$ .

It is possible that some rational structure is lost in this understanding, but on the other hand some easiness has gained to express the progression of events.



Figure 3  
How knowledge is obtained



Source: Von Foerster.

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By allowing the operator COORD operate on the preceding results is obtained:

$$Obs_2 = COORD (Obs_1) = COORD (COORD (Obs_0))$$

And after  $n$  phase:

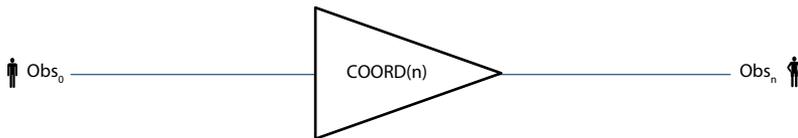
$$Obs_n = \underbrace{COORD (COORD (COORD (\dots (Obs_0))) \dots)}_{n \text{ times}}$$

Summarizing:

$$Obs_n = COORD(n) (Obs_0).$$

With this observation is suggested that the functional sequence is:

Figure 4  
The function of the observer and the type of coordination



Source: own elaboration

Growing without limits ( $n \rightarrow \infty$ ):

$$Obs \rightarrow \lim_{n \rightarrow \infty} COORD(n) (Obs_0)$$

$$Obs_\infty = COORD (COORD (COORD (COORD (COORD (\dots))))))$$

It can be observed that:

1.- In the independent variable  $Obs_0$ , the primary argument has disappeared, which can be considered as a sign that the simple connection between the independent variables has been lost in an infinity of recursions, and that such expressions take a different meaning.

$Obs_\infty$  COORD (COORD (COORD (COORD (COORD.....

2.- Since  $Obs_\infty$  expresses an infinite recursion of the operators COORD on the operators COORD, all infinite recursion in the interior of this expression could be replaced by  $Obs_\infty$ :  $Obs_\infty$  COORD (COORD (COORD (COORD (COORD.....

3.- Thus,

$Obs_\infty Obs_\infty$

$Obs_\infty$  COORD ( $Obs_\infty$ )

$Obs_\infty$  COORD (COORD ( $Obs_\infty$ ))

$Obs_\infty$  COORD (COORD (COORD ( $Obs_\infty$ )))

Note that under this form the *horror infinitatis* of the expression has disappeared, all COORD expressions are infinite and a new feature has emerged, namely the dependent variable  $Obs_\infty$  and also, the “dependent self” or “self-defining “or also” auto reflective “; thanks to the COORD operator.

If there are values  $Obs_\infty 1$  that satisfy the equations, these values are called, eigenvalues  $Obs_\infty 1 - Obs_2$ ; or own functions, own operators, following the control of the  $Obs$ ; These eigenvalues are indicated by putting the first letter in capital letters.

Note in the expressions of the form  $Obs_\infty$ :

1. That the “eigenvalues” are discrete, although the domain of the primary argument  $Obs_0$  is continuous. This is because any infinitesimal disturbance  $\pm$  from the “eigenvalue”  $Obs_1$ , that is  $Obs_{2\pm}$ , disappears like all other “values” of  $Obs$ , except those for which  $Obs = Obs_1$ ;  $Obs$  will be replaced either in  $Obs_2$  “stable eigenvalue”, or in some other eigenvalue  $Obs_1$  “unstable eigenvalue”.

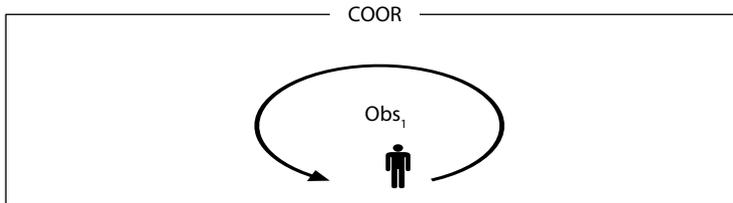
In other words, the eigenvalues represent equilibrium and according to the chosen domain of the primary argument, these equilibriums can be equilibrium values, “fixed points”, functional equilibrium, operational equilibrium, structural equilibrium.

2. Also note that the eigenvalues  $Obs_1$  and its operators COORD maintain with each other a complementarity relationship, since one implies the other and vice versa; here the  $Obs_1$  represent the external observable manifestations of the calculations “cognitive-accessible operations by COORD introspection”.



3. That the eigenvalues, due to their self-defining or self-generative nature imply a topological “closing” (circularity).

Figure 5  
Types of observer



Source: own elaboration

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This state of things authorizes a symbolic reformulation of the expression:

$$\text{Obs} \rightarrow \lim_{n \rightarrow \infty} \text{COORD}(n) (\text{Obs} \rightarrow)$$

That is, knowledge calculating its own knowledge.

To the extent that thoughts processes and new schemes are organized, behavior becomes more complex and adapts to the environment.

**The second is adaptation.** In addition to tending to organize their structures, people are also usually inherited to adapt to their environment. Adaptation involves two basic processes: assimilation and accommodation.

*Assimilation.* It takes place when people use the schemes they have to make sense of the world’s events: it includes trying to understand something new and adjusting it to what is already known, sometimes people can distort the new information in the attempt to adjust it to the one known, is the case of many children who see a skunk but call it kitten, in an attempt to adapt the new experience to the scheme they have for the identification of animals.

*Accommodation.* It happens when a person has to change the schematics, which he/she has to respond to a new situation. If it is not possible to run the data to any of the schemas, then it is necessary to establish more appropriate structures. Instead of adjusting the information to fit the thinking, thinking is adjusted to adapt to the new information. Children show accommodation when they add the scheme to recognize the

skunks to the systems they already have to identify the animals. From there, the coordination operations COORD, seem to coordinate the whole, that is, the composition of the parties.

$$Acom \rightarrow (Op_1 * Op_2) = Acom (Op_3) = Data (COORD (obs_1)).$$

A manifestation of the accommodation can take place at the same time of the assimilation of the new logical thinking structures to recognize the reality.

Considering the observer (obs) and the operator (Op) or linear transformations in the knowledge and its fusion with the experience (exp) and applying this recursively to  $X_0, X_1$  and its continuity  $x^\infty$ , whose domains are the real numbers, is chosen an initial  $X_0$  (4) as:

$$\begin{aligned} X_0 &= 4 \\ X_1 &= Op_1 (4) = 4/2+1 = 2+1 = 3; \\ X_2 &= Op_1 (3) = 2500 \\ X_3 &= Op_1 (2500) = 2250 \\ &\dots\dots\dots \\ X_{11} &= Op_1 (X_{10}) = 2001 \\ X_\infty &= Op_1 (X_\infty) = 2000 \end{aligned}$$

This form shows how knowledge is adapting and accommodating to the circumstances of each environment with its experiential form.

To adapt to environments of increasing complexity people use the schematics they have, as long as they work (assimilation) and modify and increase their schemes as in the previous equation, when something new is required (accommodation). In fact, both procedures are required, even the use of an established pattern, such as taking a covered or carve may require some accommodation if the shape or size of it differs from the known type. If been in a gala dinner and the forms of cutlery, cups or dishes are not at home, the person will need to add a new skill to the eating scheme. Each time new experiences are added to a scheme, it grows and modifies, so the simulation necessarily implies some accommodation.

There are other times when assimilation and accommodation are not used, people can ignore something if they find it too strange, the experience is filtered to fit the kind of thinking that the person presents at a given time.

Today, many problems that could not be analyzed in mathematical terms, because uncertainty or chance was the variable, are being posed in term of the probability theory, from economists, psychologists, educators, sociologists, these are structured in the form of probability in the

study and analysis of the human situations. Apostel (1977) proposes that this is equal to the accommodation of the knowledge, because in it there is not the chance but the probability of accommodation of the knowledge to structure appropriate answers to the environment and to the problems that seem unchangeable.

The permutations help structuring the knowledge and accommodation to cope with any dispersion of agents involved in the problem, this is how accommodation is done:

A is the set of three integers  $\{0, 1, 2\}$  and B the set of two integers  $\{7, 8\}$  Can the number of different ordered pairs be found,  $(a, b)$ , in which the first component of the couple is an element of A and the second component is an element of B? For each of the three ways in which can be chosen the first accommodation or component in an orderly pair, there are two ways in which the second component or accommodation is chosen. Thus, the whole of all these ordered couples or mental accommodations is:  $\{(0,7), (0,8), (1,7), (1,8), (2, ), (2, )\}$

Containing  $3 \cdot 2 = 6$  elements. The set of such ordered pairs is called a *Cartesian product* of A and B and is represented as:  $A \times B$ . This example illustrates the fundamental way of ordering ideas and counting and transmitting:

If an A set contains r elements, and a finite B set contains s elements, then there are rs different sorted pairs  $(a, b)$ , where  $a \in A$  and  $b \in B$  (that is,  $A \times B$  contains rs elements).

This principle can be extended to any form of accommodation or component and applied to many knowledge situations or also rationality counting. The following is a mathematical example of knowledge adaptability:

How many pairs of natural numbers exist that have a three-digit numeral?

As a help to reason about this type of problem a diagram like this can be made: 6: \_\_\_\_ \_\_\_\_ \_\_\_\_ . The hundreds numbers are either one of the nine elements of,  $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ ; Therefore, 9 is written 9 the first space. The digits of the dozens is an element any of  $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ , so 10 is written in the second space. The digit of the unit is any of the five of  $\{0, 2, 4, 6, 8\}$ , then 5 is written in the third space.

The fundamental principle tells that there are  $(9 \times 10)$  ways to choose the figures of the hundreds and the dozen; therefore, there are  $(9 \times 10) \times 5$ , that is, 450 different natural pairs numbers that have three digits.

Since the union of  $\{0, 1, 2\}$  and  $\{7, 8\}$ , is the set  $\{0, 1, 2, 7, 8\}$ , can be observed that the number of elements is the union in the sum of

the numbers of elements in the given sets:  $5 = 2+3$ . On the other hand, the union of  $\{0, 1, 2, 7, 8\}$  and  $\{2,7\}$ , only has four elements  $\{0, 1, 2, 7\}$ , since number 2 is element of the two given sets, that is:  $\{2\}=\{0,1,2\}$

$$(1 + x)^n = 1 + \frac{nx}{1!} + \frac{n(n-1)x^2}{2!} + \dots \{2,7\}$$

$$\exists x (Persona(x) \wedge \forall y(Tiempo(y) \rightarrow Objeto(x, y)))$$

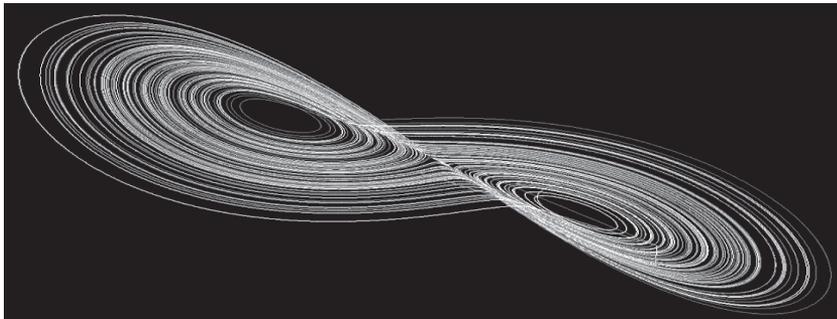
$$\int_{-\infty}^{\infty} e^{-opx^2} COORD = \left[ \int_{-\infty}^{\infty} e^{-opx^2} Coordinación \int_{-\infty}^{\infty} e^{-exy^2} Coordinación \right]^{1/2}$$

$$= \left[ \int_0^{2\pi} \int_0^{\infty} e^{-r^2} sujeto \, d\theta \right]^{1/2} = \left[ \pi \int_0^{\infty} e^{-u} sujeto + objeto \right]^{1/2} = \sqrt{\pi}$$

This shows that knowledge is circular or coiled and experimental in the different stages of adaptation and organization, as in the evolution process (see Figure 5)

$$e^x = 1 + \frac{opx}{obs1!} + \frac{opx^2}{obs2!} + \frac{opx^3}{obs3!} + \dots, -\infty < x < \infty$$

Accommodation ways of knowledge



$$f(observador) = \sum_{n=0}^{\infty} \frac{f^{(observador)}(a)}{n!} (cd(\gamma)-a)^n$$

It is seen how the already remembered constants and previously learned are equal to the sum of COORD in both the frequencies of (a) and (OBS). This can be called knowledge growth and adaptability.

It is a modified logistical equation to reach the understanding, to capture the object, although this is abstract or metaempirical, but it is a phenomenon that the subject abstracts to be able to decode it and to refer to the reality of the object in a process to be known.<sup>1</sup>

**The third is the balance of knowledge.** Organizations of assimilation and accommodation can be seen as a kind of complex act of weighting; the changes in the thought are given through the equilibrium process which is the search of the balance, supposing that to obtain it, people test the properness of their thinking processes.

In a short way, it can be said that the equilibrium process works like this: there is equilibrium if applying a particular scheme to an event or a schema situation, it works; but if the scheme does not produce a satisfactory result, then there is equilibrium and the person feels uncomfortable; the discomfort motivates people to seek for a solution through assimilation and accommodation, to which the thinking changes and advances. To balance the understanding of the world and the data it provides, people continually assimilate new information through schemes and accommodate thought as long as the unfortunate attempts of analysis produce equilibrium.

As seen in reality, there are equilibrium phenomena, the imbalance and the rebalancing or in other words, the relationship between continuous changes and the discontinuous changes that operate by jumps and that correspond to the transit of a structure to another. It is a general problem of all evolution, as has been repeatedly pointed out by Hegel towards Marx, and to treat it in all its extend should be taken into consideration the propositions and use the concepts of dynamic topology.

The cognitive systems provide an equilibrium typology that can be classified:

*Incremental equilibrium:* The one that corresponds to the mastery of the compensatory regulations, and therefore, regular and continuous, which corresponds to the mastery of the compensatory regulations and the one that raises the creation by reflective abstraction of the regulation mechanism with transit to a higher or composed level. The discussion has shown that the mechanisms described imply, even in a special way, a mechanism of discontinuous jumps, especially by a decrease in the range behavior, with the aim of describing a discrete “gait” (Halbwachs, 1964, p. 87).

The structures that reach the dominion frontier, in which the disturbances  $(cond(\gamma)-a)^n$ , can still be integrated or absorbed, are immersed in a zone of disorder and chaos, from which arises a new zone of equilibrium through a determination process, but not predictable. This radical type of imbalance and rebalancing causes bigger problems in each specific domain, by showing only the analogy, in a domain fairly close to the one discovered by Piaget, the mastery of the history of science, which

is also a cognitive domain. The most important moments in the history of a science are those developmental crises called scientific revolutions.

It can be said that Piaget's typology can be applied quite well to these revolutions, which in the background are jumps from one theoretical structure to another. If wanted to understand the dynamics of these jumps, must be understood how thinking structures its cognitive development according to adaptability and balance.

A good example is provided by the origin of relativity ( $E=m \cdot C^2$ ). As known, it is about determining the velocity of the earth in relation to the space, seat of luminous undulations. The experiences offered a speed value of light (300000Kn/s), which was paradoxically the same for different references in motion; these results constituted a disturbance in relation to the dominant theory. It started ignoring this result or at least simply to mention it without regard. According to Lord Kelvin, the basic system of the fundamental notions of physics was already definitively established in the fact of the rotation.

$$\begin{pmatrix} U(t) \\ V(t) \\ W(t) \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \text{Objeto Rt} & -\text{Sujeto Rt} \\ 0 & \text{Sujeto Rt} & \text{Objeto Rt} \end{pmatrix} \begin{pmatrix} U(0) \\ V(0) \\ W(0) \end{pmatrix}$$

And it was totally satisfying except for the different black dots, which is now known as dark matter or irradiation law of dark particles and the negative result of that experience.

Thus, considering this analogy can be stated that in the mathematical logical knowledge, is given equally the exceptions to produce a true balancing and revival of the interpretation.

It should also be said that the first experiences were at the limit of the precision of measures, although this precision was increasing from year to year, which amounted to an insistent disturbance increasingly strong, it was an alpha-type behavior.

Subsequently the contraction of the intangible rules, which automatically compensated the disturbance: beta-type behavior, which comes to introduce the emission model. Not only did the source not deposit the luminous undulation in space once and for all, but it remained in relation to the source, which remained the center of the expanding spherical wave.

It is the behavior of a set of knowledge, like projectiles launched, at the same time by an object, and that throughout the movement remain located in a sphere whose center is joined to the emitter object, this conception is united fundamentally to the theory that knowledge and

adaptability in the human brain is generated at the speed of light, which characterizes a range-type theory.

Einstein proposes in his studies, that the comparison in moving lengths and the similarity in two different places does not have an absolute sense but relative, in dependence of the reference to which the observer is attached. It is the same situation that makes the reference of a point in its system of spatial axes, to change when the system of axes is changed, as it requires the three-dimensional character of the system of the physical space. Additionally, Einstein extends this spatial relativity to the time, which is equivalent to considering a dimensional space time, in which a change of axes, corresponding to a change of movement of the referential produces a correlative change of the references space and time, preserving at all times the speed of light as a fundamental invariant. This process, which rests on reflective abstraction and which leads to a qualitatively new balanced system, seems to correspond to the second type of incremental balancing or rebalancing.

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## The support of intellectual language in the structuring of knowledge

The spectacular development of the technique has shifted from the point of view of the humanistic development forged from the Renaissance to the modernity.

Science and humanism, deep down, have a unique support for progress: the intellectual. The development of the ideas, either from the speculation or the analysis of the nature, is produced by the reflection of the intellect on the mind. This reflection of knowledge on knowing is the inexhaustible source that generates the accumulation of knowing, whether it is called science or culture.

It may seem that intellectual action is simple or almost spontaneous in humans, but it is not. The real intellectual act that generates progress is only the one that is creative, that is, the one that does not remain in the contemplation of the knowledge but generates a new idea that increases the whole of the related ideas. To contemplate and to reflect on the knowledge is to learn, and although this implies a progress of the personal *acquis*, it does not increase the cultural heritage of humanity.

The contribution of creative intellectual acts in turn does not imply real progress if they do not correspond to the contribution of a truth. Only true knowledge is enriching for science; although it is not easy for

the intellect to distinguish the characteristics of the error. The intellectual progress, therefore, is continually debated in the contrast of the conditions of truth of each new discovery.

There are many external supports for intellectual development, the fundamental is cultural heritage; possibly followed by the system, that is, of the structure of work, where is emphasized the work of group and the teamwork.

Perhaps the most important supports for intellectual progress are the personal ones, those who support the professional work of each intellect. Although teamwork is fundamental, it corresponds to a set of intellects whose creative work, ultimately, is a personal affirmation. Only the individual mind generates the idea that is enriched or perfected in the contrast of collective work.

Being so important the personal intellectual work, its supports will be fundamental for all progress. At this level, perhaps, the essential supports are two: self-criticism and analytical capacity.

The analytical capacity consists of the mind disposition by system to analyze the different elements that constitute an intellectual proposition. To the extent that the elements that make up a reality are analyzed, the reality itself can be evaluated according to the criteria of truth that each element contributes. What is evident in science, with the detailing up to the atom, the cell, the genes, etc., in the analysis of the humanistic reality is not given in such a general way, so that many intellectuals assert without the previous rigor of the analysis and detailed contrast of the constituent elements. This analysis capacity that some minds have by nature is their best weapon or support for the real contribution to the common intellectual heritage.

A second support is the capacity of self-criticism. Those who formalize in the personal security the fundamental element of the disposition of progress, usually soon realize the wrong course of the performance. The capacity of self-criticism, which has its origin in the experience of the error itself, constitutes one of the most valid supports for the recognition of the conditions of truth of the developed work. To the extent that one is its maximum critic, it accepts and computes the foreign criticisms as constructive elements correctors of the thought itself, facilitating the verification processing, which constitutes the best ways of security for the progress.

The difficulties of the knowledge study throughout history are due to the possible and different perspective that is acquired from the theory of knowledge according to which is considered priority in a subjective way, of the person who knows, or in an objective way, what is known.



Both perspectives are necessary for knowledge, subject and object, since nothing could be known if there was not a being with the capacity to know, and nothing could be known if there was no reality with possible objects of communicating as cognoscente beings.

The metaphysics of being and idealistic philosophies have prioritized one or another perspective of the knowledge entity without giving a formally coherent response of the multiple implication of the subject and the object to enable knowledge, especially when they have to deal with intellectual knowledge, because sensitive knowledge responds to a simpler process and, therefore, more accessible to define. Intellectual knowledge offers the peculiarity of knowing that knows, and therefore the act of knowledge manifests itself as subject and object.

A turning point in the development of philosophy on human knowledge can be admitted in the rationalism of Descartes, when categorizing the existence according to the thinking subject who perceives it. From this intellectual moment the subject of knowledge, who thinks, transcends his/her subjectivity to be configured, at the same time, as the object of knowledge, the one that exists.

If the cognitive process is considered as a linear transfer of information from the object to the subject, the relationship between the two ends of the process is marked by the suitability of elements to be compatible in the encryption process, transmission, decoding and retention. Each party presents its own process, the object through the accidents of its matter that make it knowable, and the subject through the processes that allow him/her to know.

When considering the nature of the intellectual knowledge, the problem is complicated because it is identified with a reflection act by which the information of the object does not come from a group of imputable external signals but from a mental immaterial content, whose entity lies in the same subject who thinks. This procedure composed of intellectual knowledge presents a double articulation by which the object has to be psychéd in the subject so that it can be the subject of the new act of knowledge of the same subject that makes the reflection possible.

This double articulation of the intellectual knowledge establishes a new form of relation between the object and the subject, since the object of the knowledge is no other than the same subject and its sensitive capacity to know that relates to the external reality. When the object of knowledge is the subject who knows, is when he/she knows himself/herself, and therefore establishes an intimate convergence relationship between the subject and the object, from which the act of intellectual knowledge follows the intuitive perception of the own existence.



As Ruben Bravo says, the crisis disarticulates the very existence of human beings:

This disarticulation is also caused by the heterogeneity of the movement, especially in the process of changing the period. Not only is the movement unequal, in the interior of the world, the logics that govern these movements are also diverse, the movement in the spaces of accumulation is more accelerated, its time is the time of the progress and the richness; on the other hand, the time of the education, which is the space of knowledge and culture is slower (Bravo, 2008, pp. 72-73).

When the double articulation of intellectual knowledge is ignored as a form of human knowledge, and the process of sensitive and intellectual knowledge is postulated as simple and unique, the interpretation of existence is carried out from the consideration of object or subject, and as considered one and another perspective will be concluded in a materialistic or idealistic philosophy. If it is accepted that all the knowledge is followed by a totally objective process of the external perception, there will be no way to justify the self-consciousness by which each person knows himself/herself, reaching an accidental knowledge of the characteristics of the matter itself and of the acts, which are followed by its way of being: one knows how it is, but one cannot obtain a knowledge of what one is. When knowledge is considered an activity without taking into consideration the double articulation of the knowledge of the relation between object and subject, one cannot preach the reality of the external to the own subject that it knows, which more or less radically affects to constitute an idealistic philosophy, conceived from the reality of the act of knowing without being able to assure the reality of the known object.



## Conclusions

In the knowledge and mathematics there is a superior level of thought to the one of the concrete operations, but is still debated the question about how universal is the thought of the formal operations, though these are linked to the physical environment, they can be the product of experience and practice in solving hypothetical problems and using formal scientific reasoning. These capacities tend to be valued and taught in different cultures.

All adults use thoughts, formal operations in some areas where they have more experience or interest, sometimes humans find alternative routes to manage problems.

An important implication is the problem of adequacy, which must keep the imbalance at the right point, to create situations that lead to error and finally be guided in the conflict between what think will happen and what actually happens, they are obliged to reconsider their understanding, which allows the development of new knowledge.

The active experience of building knowledge should not only remain in the manipulation of sensitive objects, but must also include the mental reasoning of ideas and numbers that help forming thought, so it is an interaction with the social structure as the basis of meaningful learning, putting the education actors as ends of the teaching-learning process, but in a guided form, to form stimulating educational contexts to enhance the aptitudes and attitudes of each one of the students in the learning process.

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## Note

- 1 In this equation can be observed that both the accommodation or organization of thoughts with reality, allow finding more appropriate ways to reach a management of brain functions; Based on the experience of both the sensitive and the cognitive, which leads to look at the knowledge phenomenon in evolutionary processes.

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