



## THE IMPORTANCE OF COGNITION IN EDUCATION



 Ceausu Felicia

The Institute of Economic and Social Research, Ghe Zane, Iasi, Romania.

Email: [ceausufelicia@yahoo.com](mailto:ceausufelicia@yahoo.com)



### ABSTRACT

#### Article History

Received: 18 July 2019

Revised: 23 August 2019

Accepted: 27 September 2019

Published: 11 November 2019

#### Keywords

Multi-environment

Irrigated ecosystem

Rice (*Oryza sativa* L.)

Cognitive or mental architectures are models made up of *input - output* type modules of the central nervous system activity, formed with the help of white, black or grey cybernetic “boxed” and of the determination connection. Despite the great existing differences between the biochemical and electronic processing of information, the mental architectures aid in comparing the human intelligence with the artificial one and even contribute to the creation of a common language between the human and the animal intelligence (taking into account static and dynamic representations). Based on that cultural and social representations share a „situational“semiotics, we use a common language with connection to referentiality or not, for physical or social representations. In this work I will create the formal model as a representation more or less simplified of a “material world”. We will, therefore, admit the presence of some *physical-mathematical*, *psychic* and *semiotic* models (depending on the language). The physical - mathematical models refer to the image of the world starting from the 4<sup>th</sup> dimensional continuum perceived by our senses. The models are referential rather than imaginary because physics inhibits the mathematical tendency of generating too many possible worlds. On the contrary, the psychological models can be also reported to imaginary luxurious worlds due to the outcome of our imagination which can be hardly quelled.

**Contribution/ Originality:** This study contributes in the existing literature by creating the formal model as a representation more or less simplified of a “material world”.

## 1. INTRODUCTION

In a proper motivational frame, sensorial stimulation transforms into conscious, psychic facts, communicated through the language. As an instrument of information transmission between people, the language appears to be a code, a system of linguistics signs (morphemes and words), orally transmitted or in written form. The word, as Ferdinand de Saussure said, is distinguished both by acoustic image (signifier) and by concept (signified) having a cognitive value only in a well-connected system. In contrast with the richness of meanings of natural languages, the formalized ones have high expression accuracy, thus they are sometimes preferred in science. The depth of the ideas expressed by language is the result of an evolved thinking, carried out by analysis and synthesis, comparison, abstraction, generalization, concretization, induction and deduction. The analysis (mental separation of features and parts of an object) and synthesis (mental integration of features or parts separated in a whole) are opposed psychic processes that are mutually integrated in the knowledge evolution. By comparison, the resemblances and differences of things are set based on some comparison criteria allowing the division on groups, classes or categories. Abstraction takes out from an assembly certain features and makes possible generalization which extends common

aspects of a distinct class of objects or phenomena, designated by notion. Thus, the notion, expressed by word, is characterized by the notion's sphere and the specific difference, aspects that should be taken into account in the correct formulation of definitions.

For the results of science should be applied in practice, it is necessary the passing, through the concretization operation, from the level of abstract features to the object expressed in its determination wholeness. In logical reasoning, often we call for deduction, through the passing from general assertions to particular cases. The syllogism is the typical form of deduction, but there is also the hypothetic or disjunctive form. Deduction is much more rigorous than induction, based on the passing from particular cases to general assertions. Ultimately, verification in practice is the fundamental criteria of setting up the truth. The thinking process is triggered, in all its complexity, by the resolution of life issues. The solution does not appear either as a sudden illumination (gestaltism) or as a succession of trials and errors (behaviorism), but involves adequate strategies and plans subordinated to a purpose. An important role is played by heuristic procedures which can direct the cognitive approach: analogy, modeling, analysis by synthesis, resorting to simpler problems, recreation of the reverse route, starting from results to initial data. The analogy suggests the possibility of existence of some deep relations between similar phenomena in an external plain. Many times in order to simplify the study of reality we go to the simplified reconstruction of objects and phenomena by removing the insignificant aspects, an action called modeling. The model can be carried out by materials (models, moulds) or can be expressed by mathematical representations (mathematic model). The analysis by synthesis resorts to placing an object in a new context, a case in which it reveals unknown valences. If the issue to be solved is complicated, we can reduce it to simpler issues, ultimately reconsidering the complex situation.

Due to the simultaneity and succession of real events, they intimately associate themselves in the memory by forming some nervous, temporal, more or less stable connections. We should proceed with a great spirit of understanding since not every associated fact reflects essential relations between phenomena. Based on the cognitive data stored in the memory, unprecedented situations can be elaborated through imagination and creative thinking, mostly if the process is stimulated by strong emotional experiences. The research of W. Okon offered the method of problematization as a valuable conquest of modern pedagogy, of learning through discovery. Starting from a "problem situation", the students remake step by step the way of scientific thinking, with real or apparent contradictions whose resolution generates an active attitude of searching some original solutions. The brainstorming method initiated by A. F. Osborn stimulates group creativity by spontaneous, uncensored issuance of idea necessary for solving some theoretical or practical problems. Each participant is encouraged to consider the suggestions of his/her colleagues, to modify them as he/she wishes in order to attain superior ideas. Critical remarks are forbidden and the assessment is delayed in order to avoid inhibition of thinking. Another method related to brainstorming is the engineering of ideas in which the experts direct the debates towards well defined objectives in order to avoid useless efforts. Synectics was initiated in 1944 by W. Gordon based on powering of psychic mechanisms of the subconscious in the creation act.

## **2. WHAT ARE THE MAPS OF THINKING?**

This concept developed by Dr. David Hyerle represents a set of visual techniques encouraging long term learning and memorizing. These techniques – maps of thinking – are used in kindergartens, schools, high schools, universities, companies, corporations from all over the world. In kindergartens for example, they are useful for grounding notions of grouping, classification and sorting. Later, in middle school, they can be used to categorization: main ideas, classifications, details of some concept such as: motivation, thinking for an easy following and understanding.

1) Circle type map which is used in description, brainstorming, defining ideas, things, concepts, objects. In the center of the circle we use a name, an idea, a concept, a symbol we want to define, to describe.

2) Bubble map- represents the second type of logical diagrams of mental representations and are used for describing, characterizing the qualities of objects, things, ideas, concepts etc.

3) In the central circle the object to describe is located, and around it, its features are connected with other connected circles.

4) Comparative-contrast maps are used when we are comparing in contrast two ideas, concepts, objects, each in one circle and their features revolve around them.

5) Tree type maps- these are used for classification and grouping. Ideas and objects are sorted in categories and groups and sometimes new categories and groups are created. On the top of the tree, there are written the name of the appurtenance classes, categories, general ideas. Under each category, there are written the group members. These types of logical diagrams are ideal for studying tests, social surveys etc.

6) Structure with brackets – helps us to easily learn the relation between whole and part that interferes in thinking, memorizing etc. There are used for analyzing the structure of an object, idea, concept etc. It has an important role in group organizational structure, plans of working agenda etc.

7) Flow map- this type of logical diagrams divides and ordinates a process in stages and phases. It is the type of mental representation of concepts, ideas characterizing as correctly as possible the concepts, ideas and processes described in the book of professor Golu since they are specific to cybernetic sciences structured on stages, phases.

### 3. THINKING

#### 3.1. Categorization

- Categorization represents the process of grouping on classes of the information avalanche we enter into contact every day. This information is grouped on classes, categories after certain criteria. The most important quality of these categories is that they contain maximum of information in a minimal format; Prototype.

#### 3.2. What is the Prototype?

The prototype is the concept reuniting at a given time all common, most obvious features of a category. For example: Category of birds – parrot; Domestic animals – cat.

#### 3.3. What is the Concept?

- By abstracting, the thinking creates mental models of reality.
- These are informational models condensing, preserving, systematizing common features, generally valid for the entire category of objects-phenomena.
- The concepts represent mentally constructed, cognitive entities referring to classes of experiences formed by various specimens.

#### 3.4. Empirical Concepts

They integrate concrete, particular features, local characteristics. They are formed since childhood and during schooling by storing and systematizing of a concrete intuitive experience in an ascending manner (down-up). These are unstable, they can be restructured in time, they are subjected to hazard and they are random.

#### 3.5. Scientific Concepts

These are usually acquired by learning, education, assimilation of systematized scientific knowledge in the human knowledge at a given time. They integrate and condensate universally valid essential features for a category of phenomena. They use specialized languages specific to various fields of knowledge such as the language of mathematics, informatics, physics etc.

#### 4. THINKING AS AN UNDERSTANDING PROCESS

Understanding expresses the best the processes of thinking that describes the way in which information is processed. In the ascending processing, understanding is a concentration, an integration of features in a general representation, an empiric concept. In the descending processing, understanding is the result of an imposing of some explicative models of reality through learning, training and education. In the ascending processing, understanding is a consequence. In the descending processing, understanding is a premise. The understanding leads us to an explanation, and the explanation allows us to elaborate a functional model of the reflected reality (Johnson-Laird, 2006).

Mechanisms of understanding – informational coupling:

- The mechanism of understanding is mainly based on an informational coupling.
- The situations that need to be understood – usually – problematic situations, e.g. those situations for which our collection of answers is not enough in order to solve them.
- The second mechanism is represented by associative systems
- The third mechanism of understanding is analogy.

When people understand something by analogy, they understand one thing in relation to another thing. Here are some suggestive examples of analogy:

- Atom structure – solar system.
- Gas molecules – pool balls.
- Human memory – library.

By analogy we can understand something unfamiliar in the terms of another already understood thing. Another well-known example for understanding problems, discussed by Wertheimer (1959) is finding the area of a parallelogram. The students are taught that the area of a parallelogram is calculated after the formula  $A=b \cdot h$ , where  $b$  is its base and  $h$  its height. Wertheimer described two ways in which the formula can be understood. In a representation,  $b$  is the length of the horizontal side of the parallelogram and  $h$  is the length of the vertical line from a corner to the top of the figure until the base. Many students, apparently using this representation become confused if they are asked to find the area of a parallelogram oriented in a different direction. A second way of understanding the formula consists of a relation between parallelograms and rectangles. A parallelogram can be transformed in a rectangle by removing a triangular part from an end and attaching it to the other end. Thus, the base and height are equal with the length, respectively the width of the rectangular in which the parallelogram was transformed. The students understand the parallelogram issue as they do not encounter any difficulty in solving the problems in which the figure is directed in a different way and can frequently transfer their knowledge in order to solve more complex problems such as finding the area of a trapeze.

The two representations have different features compared to specific problems, one is that the base and height identified with specific locations in the figure and the other with the base and height defined in more general terms.

#### 5. ASSOCIATION AND ANALOGY AS MECHANISMS OF UNDERSTANDING

- Association – puts in relation the knowledge, experiences stored in the memory with present situations and advances explanations.
- There are three basic forms of association: after resemblance; after contrast, after spatial co-existence and temporal succession.
- Analogy – represents that mechanism of understanding through which people understand one thing in relation to another.

### 5.1. Problem Solving

It is the performance field of thinking. The problems represents a cognitive obstacle compared to which the collection of answers of the subject is not enough for understanding it. Various explicative models were created out of which the most important are as follows:

1. Trial-error model (Thorndike).
2. Spontaneous intuition model (Kohler).

### 5.2. Resolution Strategies

1. *Algorithmic strategy* – expresses a full convergence between the problem, solving means and problems solution. The problem is well structured, well defined, the requirements are clearly formulated and in relation with them, there is set of means, standardized working formulas that lead to a unique result if they are correctly applied.

2. The heuristic strategies express a divergence, a discordance between the problems, means and solution; The problems is not very well defined. It is the solving way of very complex problems by exploration, discovery. The stages of resolution process:

1. Problems definition.
2. Problem resolution.

Notions:

1. The problem (cognitive obstacle, as a breach in knowledge, as a situation for which the collection of answers of the subject is not enough for understanding it).
2. Problematic situation (what is atypical and generates conflicts).
3. Problematic space (problem representation; consists of 3 states: initial, final and intermediary).
4. Resolution conduct (the passing from one state to another through some logical operators).

Model of problems solving (Newell *et al.*, 1958):

Problem definition.

Internal representation of the problem in the working memory.

Identification of means and strategies.

Application of strategies.

Verification.

Solution.

### 5.3. Thinking a Superior Cognitive Process

- Thinking is the superior cognitive process of extracting the essential, logical and necessary features with the help of some abstract-formal operations for understanding, explaining and predicting some causal relations of reality and creating some concepts, notions, theories, cognitive systems as mental models of reality.
- Cognitive processing has a deep character, has a high degree of mental autonomy, a maximum level of selectivity in relation with the features of the world and life.

### 5.4. Operations of Thinking

The operations of thinking ARE psychic instruments gained and improved by intellectual developed, by learning and exercises. The operations of thinking act in operative couples that are mutually completed: analysis and synthesis, abstracting and generalization, induction and deduction. The cognitive analysis and synthesis have their origin and are preceded by perceptive analysis and synthesis that are carried out in a concrete-intuitive plane on some concrete objects and situations. Instead, cognitive analysis and synthesis are carried out in a mental plane after a model and are mediated by word and other systems of signs and symbols. By analysis, the features of an

object or of a class of objects are separated, ordinate – in the mind – after certain criteria, after a certain model and are synthesized, remade same or in different way depending on requirements of intellectual activity. Synthesis is defined as the mental re-composition of the object from its initial features. The comparison is the assessment operation by relating to one or more criteria. Also, this operation has its origin in comparison after perceptive criteria of color, shape, size, contrast etc. Comparison involves evidencing essential resemblances and differences of minimum two objects, persons, events, situations, phenomena, after one minimum common criterion. Abstracting and generalization comprises of the most complex operations of thinking and have a formal character, are exclusively carried out in the mental plane, are typical for the descending type processing. Abstracting is the extraction operation of some essential features, of some cognitive invariants, common features for an entire class, category. The operation of abstracting simultaneously expresses two meaning: on one hand something essential is extracted and on the other hand all that is irrelevant is dropped, accidental, contextual or conjunctural (Richard *et al.*, 1990). The abstracting advances in depth, as the diamond seeker digs and removes earth in order to reach the diamond (essence). Generalization is the operation through which the features extracted with the help of abstracting are extended to an entire class of objects-phenomena. Abstracting and generalization operate simultaneously so that, as the essential features are revealed, they are extended to more and more broad categories. Abstracting and generalization have varied degrees of depth and expansion depending on the evolution of human knowledge. Opposed to abstracting and generalization are the operation of concretization and particularization. The route from concrete to abstract is complementary to the one from abstract to concrete, but extremely different regarding quality. Concretization following abstracting defines by essential features an ideal, abstract object meeting the features. Induction and deduction are the operations best describing the evolution of thinking on the knowledge's vertical. J. Piaget shows that induction organizes the observation or experience data and classifies them as concepts. Induction is the logical support of ascending processing starting from the database, concrete-intuitive experiences and mental images. Induction has a deeply intuitive character, simple relations are extracted grouping a class of objects after empirically observable criteria.

### 5.5. Reasoning (Inference)

When we think in propositional terms, the succession of our thoughts is organized.

The organization type is manifested when we are trying to create Reasoning.

Reasoning is a procedure through which new information is obtained by combining existing information (Rogers *et al.*, 1992):

- Deductive reasoning.
- Inductive reasoning.
- Heuristics.
- Inductive reasoning intercepts regularity and facilitates the extraction and formulation of a general conclusion from a multitude of particular cases. The limit of this type of reasoning consists in the fact that there are not used more varied specific cases and as many as possible. Thus, the conclusion is valid until an exception is met, since in inductive reasoning, the hazard intervenes as it has a probabilistic character.
- Deduction describes the descending approach of thinking on the knowledge's vertical. Deductive reasoning starts from general, by inferences and implications and reaches particular cases. Deduction starts by hypotheses or premises transformed to be valid and then derives the implications of these hypotheses.

### 5.6. Deductive Reasoning

- Rules of logics: According to logicians, the most powerful inferences are those having deductive validity – *it is impossible for a conclusion of inference to be false the its premises are true.*

*Example:*

a) *If outside is raining, I will take my umbrella.*

b) *Rains.*

c) *Thus, I will take my umbrella.*

*If p then q.*

*Logical connectors: p or non p; pVq;*

*p and q with true and false values.*

### 5.7. Inductive Reasoning

- “It is improbable for a conclusion to be false if its premises are true”.
- RI= induction reasoning of a propriety consists in the induction or generalization of a constant characteristic of some members belonging to a category – for all the category members.

Example of inductive inference:

- a) George studied accountancy as fundamental specialization in faculty.
- b) George works for an accountancy firm.
- c) Thus, George is an accountant.

### 5.8. Heuristics

- Heuristics: is a mental procedure that is easily to be applied and can often lead to the correct but not inevitable answers. Heuristics related to causality: People estimate the probability of a situation according to the power of causal connections between the events of the situation. Assessment of probabilities. A large number of experimental studies examined how and how well people estimate probabilities for tasks involving simple or multiple events, doubtful quantities and composed and conditional probabilities.
- Probability as trust: Some events seem to be unique or close to uniqueness so that it is difficult to conceptualize them as coming out from sets of events with relative frequencies. The probabilities for these events can be interpreted as degrees of faith or degrees of trust. For such probabilities, there is no correct answer; different persons can have in a justified way different degrees of trust in the same proportions. However, a kind of validity, called calibration can be examined in a large collection of assessments of probability. A set of assessments of probability is well calibrated if, for all events for which a probability of O.XX type was attributed, O.XX% of events can happen.
- Judging probability after representativeness: When a uncertain event or sample is generated from an origin population by a process (such as the random extraction of a sample from a population), the surveys indicated that people judge its probability “after the degree in which: (i) it is similar in essential properties with the origin population; and “reflects fundamental features of the process through which it is generated”(Kahneman and Tversky, 1972). Kahneman and Tversky named this strategy of estimating probabilities heuristics of representativeness. People using heuristics of representativeness can be diverted either following characteristics that are normatively irrelevant or by not taking in consideration characteristics that are normatively important. As an example for the first type of error, people judging the possible results of a coin toss with an unaltered coin, consider HTTHTH more probable than HHHTTT, since the lack of an apparent order in the first case seems to be more representative for a random process. They also consider HTTHTH more probable than HHHHTH since the last does not represent the unaltered coin (Kahneman and Tversky, 1972). A second type of error is exemplified by not taking into account the sample size, a sample feature that has no parallel in a population. Thus, people believe that in a large hospital (where about 45 of children are born on the same day) it would be as probable as in a small hospital (where about 15 children each day are born) to have a day in which more than 60% of children to be boys.



- Combined probabilities: In the 60s, a thorough researched theme was the question: how well the people use data information in order to update the probability for a hypothesis to be true. This research [Lichtenstein and Slovic \(1971\)](#) was based on a strong normative model, the theorem of Bayes. Being given many hypothesis mutually exclusive and exhaustive, H, and data, D, the theorem of Bayes.

## 6. CONCLUSIONS

In modeling the reality, we rely on the knowledge we have, irrespective if this knowledge is real or imaginative, simple or sophisticated; our mental models are constructed in many cases of fragmentary information based on a partial understanding of what is happening and on a simple psychology postulating causes, mechanisms and relationships where, actually, none of these exist.

The mental model is constructed with the aim of understanding an aspect of the outside world, of the reality. In the process of mental modeling, the individual will necessarily use his acquired knowledge and depends on the speed he sets up an adequate relationship between previous knowledge and the new information provided by the outside reality. When the individual develops a certain mental scheme, he can acknowledge that this scheme is inadequate for his purposes. Now it is the moment in which he starts developing a new mental model in order to understand what is happening on the outside. While the schemes are structures of pre-compiled generic knowledge, the mental models are structures of specific knowledge that are constructed with the aim of representing a new situation using this generic knowledge.

Thus, the role of the scheme will be to provide to the individual the pre-requested knowledge in order to understand the process of interaction, but also the knowledge allowing him to understand the clues provided from the outside, at the same time, in what way his scheme is different from an adequate model of reality. The quantity of information kept in his memory represents a performance index and it is based on the hypothesis that, theoretically, the information which was integrated in a coherent, unique mental model can be recalled with easiness.

**Funding:** This study received no specific financial support.

**Competing Interests:** The author declares that there are no conflicts of interests regarding the publication of this paper.

## REFERENCES

- Johnson-Laird, P.N., 2006. How we reason. Oxford: Oxford University Press.
- Kahneman, D. and A. Tversky, 1972. Subjective probability: A judgment of representativeness. *Cognitive Psychology*, 3(3): 430-454. Available at: [https://doi.org/10.1016/0010-0285\(72\)90016-3](https://doi.org/10.1016/0010-0285(72)90016-3).
- Lichtenstein, S. and P. Slovic, 1971. Reversals of preference between bids and choices in gambling decisions. *Journal of Experimental Psychology*, 89(1): 46-55. Available at: <https://doi.org/10.1037/h0031207>.
- Newell, A., J.C. Shaw and H.A. Simon, 1958. Elements of a theory of human problem solving. *Psychological Review*, 65(3): 151-166. Available at: <https://doi.org/10.1037/h0048495>.
- Richard, J.F., C. Bonnet and R. Ghiglione, 1990. *Treatise of psychologicognitive: The treatment of symbolic informatio*. Paris: Dunod. pp: 121-123.
- Rogers, Y., A. Rutherford and P.A. Bibby, 1992. *Models in the mind*. New York: Academic Press. pp: 189.
- Wertheimer, M., 1959. *Productive thinking*. Oxford, England: Harper. pp: 345-346.

*Views and opinions expressed in this article are the views and opinions of the author(s), International Journal of Publication and Social Studies shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.*