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Transdisciplinarity and education: "The treasure within" Towards a transdisciplinary evolution of education

"*I believe we need to open ourselves up to exchange. Just as Asia opened itself up to Western technology…History tells us that we have to reckon with the improbable…*" (E Morin)

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ABSTRACT

Our paper is, primarily, the manifestation of a participative attitude of the Romanian educational agents in the field of transdisciplinarity. Our research sustains the option for a transdisciplinary approach as understood and proposed by the UNESCO studies on the future of education in the twenty first century and by the scientists of CIRET, Paris. We fully support the opinion of the CIRET president, the well-known scientist Basarab Nicolescu, that transdisciplinarity represents the answer to man's eternal desire for the unity of knowledge. The ideal framework for the manifestation of this unity of knowledge is the University. We believe that in order to materialize this "beautiful dream" that we call transdisciplinarity and to avoid converting it into a new post-modern Utopia, it is not necessary to create new universities, as the transdisciplinary spirit has been alive in the great universities of the world since their establishment. What we need to do now is to recover it as a natural manner of interaction with contemporary ideas and information.

The study also presents a part of the Romanian transdisciplinary perspective and experience in the field of education.

KEYWORDS: Globalisation, Change, Education, University, Transdisciplinarity.

1. Prolegomena to an epistemology of transdisciplinarity in education

"History tells us that we have to reckon with the improbable…" (E. Morin) Indeed, one of the post-modern challenges to reckon with is, no doubt, *transdisciplinarity*, a vast field covered by explicit and implicit meanings.[1]

In this section, we will raise some issues and overview the main current senses of transdisciplinarity on the basis of the specialist literature we have consulted.[2]

We will not insist on the definitions of the domain of transdisciplinarity for the following two reasons:

1.1. The definitions proposed by Nicolescu (1985, 1996) are extremely clear, bringing solid scientific arguments not only for researchers in exact sciences but also for researchers in humanities.

[1] "human knowledge *unity* and *understanding* of the present world " (Nicolescu, 1996, p. 53).
[2] We have noticed the scarcity of bibliographical references in most of the articles we have managed to study.

1.2. The quantic physicist's opinion fortunately concurs with the tendencies in pedagogical research that has reunited personalities like Jean Piaget, L. d'Hainaut, Federico Maior, Fernando Savater, Jacques Delors, etc. around UNESCO and OCDE since the1970s.

What other field of fundamental human activity could manifest such an acute need for transdisciplinarity as the sciences of education?

This interrogative statement may sound like a rhetorical question, but let us remember that the human knowledge that transdisciplinary research aims to unify as its utmost purpose, as well as understanding the present world, is determined by education. Science itself is the result of human evolution that education has greatly contributed to. We can all agree, paraphrazing the famous biblical dictum, that *If there is no education, there is nothing*. The question is if we can say the same about transdisciplinarity.

From a certain point of view, to sustain that might seem an exaggeration. We are all products of a certain education, culture, history, opportunities and constraints. Education plays a fundamental role because it is based on knowledge and, as compared to force and fortune, knowledge is the most democratic source of power.[3] By *knowledge* we understand information, abilities, skills, competences that produce a high level of understanding. As we hope to prove herein, *authentic knowledge is transdisciplinary*. We can identify a potential syllogism of the relation between transdisciplinarity and knowledge (by extension, education): *As much transdisciplinarity, as much authentic knowledge and understanding.*

Can we conclude that transdisciplinarity should be introduced in schools and universities as a magical solution for the future of mankind? Not at all. First, because, as we know[4], transdisciplinarity is not a new discipline or a super-discipline, and it is neither a miracle or a magic word that will open the door to a world where all ideals are attained. We must see transdisciplinarity as a superior manner of understanding the world from a scientific, systemic and holistic perspective, as one of the evident opportunities available to foster more harmonious forms of human development. Second, if we transform transdisciplinarity into a curriculum component at any level, we would deny its deepest meaning: openness, freedom and the power to overcome limits. As the prefix *trans-* indicates, transdisciplinarity concerns that which is at once *between*, *across* and *beyond* all disciplines.

In this "era of disciplinary big bang", there remains an obsessive potential question for most educators: *How can trasdisciplinarity enrich education if not as a discipline?* How can it enter the conscience of teachers and trainees without being taught in school or learned in other institutions? "It cannot, it is pure non-sense", the specialist in educational sciences could say, following the classical rules of causality, which are still valid.

Nevertheless, our times need a transdisciplinary education[5] based on a strong epistemological platform and methodology. The process of identifying and generating this new epistemology of transdisciplinarity in education is very complex and closely connected with the methodology of transdisciplinary research, determined by the three pillars of transdisciplinarity: *levels of Reality, the logic of the included middle* and *complexity*.[6] The meaning of the three pillars of transdisciplinarity is simultaneously epistemological, pragmatic and ontological. These pillars emerge (strong epistemological argument!) from the most advanced contemporary sciences, especially from quantum physics, mathematics, quantum cosmology and molecular biology. We will present them, making reference to Nicolescu's works.

"Reality" designates that which resists our experiences, our representations, descriptions, our images or mathematical formalizations. Reality is not only a social construction, a consensus

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[3] Bertea, 2004, pp. 16-18.
[4] *Charter of Transdisciplinarity*, Article7, in Nicolescu, 1996, pp. 173-174.
[5] It doesn't means that transdisciplinarity belongs to education.
[6] Nicolescu, 1985, pp. 101-105.

of a collectivity, or an intersubjective agreement. It also has a *trans-subjective* dimension, to the extent that one simple experimental fact can ruin the most beautiful scientific theory.[7]

"Level of Reality" designates an ensemble of systems that are invariable under the action of certain general laws. For example, quantum entities are subordinate to quantum laws, which depart radically from the laws of the macrophysical world. Two levels of Reality are different if, while passing from one to the other, there is a break in the laws and a break in fundamental concepts (e.g. causality). The discontinuity that is manifest in the quantum world is also manifest in the structure of the levels of Reality, which does not prevent the two worlds from co-existing. The levels of Reality are radically different from the levels of organization, as these have been defined in systemic approaches.[8] Levels of organization do not presuppose a break with fundamental concepts: several levels of organization appear at one and the same level of Reality.

The "logic of the included middle", which comprises knowledge of the coexistence of the quantum world, the macrophysical world and the development of quantum physics, has led to the upheaval of what were formerly considered to be pairs of mutually exclusive contradictories (*A* and *non-A*): wave and corpuscle, continuity and discon(-)tinuity, separability and nonseparability, local causality and global causality, etc. The dispute provoked by quantum mechanics consists in the fact that the pairs of contradictories it generates are actually mutually contradictory when they are analyzed using the classical logic and its axioms.[9] Quantum logic has modified the second axiom of classical logic – the axiom of *non-contradiction* – by introducing non-contradiction with several truth values in place of the binary pair (*A*, *non-A*). Stéphane Lupasco[10] has shown that the logic of the *included middle*[11] is the true logic, formalizable[12] and non-contradictory. The third dynamic, that of the *T*-state, is exercised at another level of Reality, where that which appears to be disunited (wave or corpuscle) is in fact united (quanton), and that which appears contradictory is perceived as non-contradictory.[13]

The *T*-term is the key (in) to understanding *indeterminacy*: being situated on a different level of Reality than *A* and *non-A*, it necessarily induces an influence of its own level of Reality upon its neighbouring and different levels of Reality. The laws of a given level are not self-sufficient to describe the phenomena occurring at the respective level.[14] The logic of the included middle is the *privileged logic of complexity*, in the sense that it allows us to cross the

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[7] Nicolescu, 1985, pp. 103.
[8] Nicolescu and Voss, 1998, pp. 94 –103.
[9] The axiom of *identity* (A is A), the axiom of *non-contradiction* (A is not non-A), the axiom of the *excluded middle* (There exists no third term *T* which is at the same time *A* and *non-A*). Under the assumption of the existence of a single level of Reality, the second and third axioms are obviously equivalent (Nicolescu, 2000).
[10] Lupasco, 1987, p. 49.
[11] Axiom of the included middle: there is a third term *T,* which is at the same time *A* and *non-A*.
In order to obtain a clear image of the meaning of the included middle, we can represent the three terms of the new logic as: *A*, *non-A*, and *T*, and the dynamics associated with them by a triangle in which one of the vertices is situated at one level of Reality and the other two vertices at another level of Reality. If one remains at a single level of Reality, all manifestation appears as a struggle between two contradictory elements (example: wave *A* and corpuscle *non-A*).
[12] With three values: *A*, *non-A* and *T*.
[13] Nicolescu, 1985, p. 103.
[14] The entire difference between a triad of the included middle and an Hegelian triad is clarified by considering the role of time. In a triad of the included middle, the three terms coexist at the same moment in time. On the contrary, each of the three terms of the Hegelian triad succeeds the former in time. This is why the Hegelian triad is incapable of accomplishing the reconciliation of opposites, whereas the triad of the included middle is capable of it. In the logic of the included middle, the opposites are rather contradictory: the tension between contradictories builds a unity which includes and goes beyond the sum of the two terms. The Hegelian triad would never explain the nature of indeterminacy.

different areas of knowledge in a coherent way, by enabling a new kind of simplicity. It does not abolish the logic of the excluded middle: it only constrains its sphere of validity.

The open structure of the unity of levels of Reality is in accord with one of the most important scientific results of the 20th century concerning arithmetic, namely the theorem of Kurt Gödel.[15] Nicolescu[16] emphasizes the Gödelian unity of the world in order to understand the complexity of Nature. His scientific and rigorous answers to essential questions[17] describe the coherence between the levels of Reality by an iterative process containing the following stages: 1. A pair of contradictories (*A*, *non-A*) situated at a certain level of reality is unified by a *T*-state situated at a contiguous level of Reality; 2. In turn, this *T*-state is linked to a couple of contradictories (*A'*, *non-A'*) situated at its own level; 3. The pair of contradictories (*A'*, *non-A'*) is, in its turn, unified by a *T*-state situated at a different level of Reality, immediately contiguous to that where the ternary (*A'*, *non-A'*, *T*) is found. The iterative process continues indefinitely until all the levels of Reality, known or conceivable, are exhausted[18]. That means that the action of the logic of the included middle on the different levels of Reality induces an open Gödelian structure of the unity of levels of Reality.

This structure has considerable consequences for the theory of knowledge because it implies the impossibility of a complete theory, closed in upon itself: "In effect, in accordance with the axiom of non-contradiction, the *T*-state realizes the unification of a pair of contradictories (*A*, *non-A*), but it is also associated with another pair of contradictories (*A'*, *non-A'*). This signifies that, starting from a certain number of mutually exclusive pairs, one can construct a new theory which eliminates contradictions at a certain level of Reality. This theory is only temporary because it inevitably leads, under the joint pressure of theory and experience, to the discovery of new levels of contradictories situated at a new level of Reality, a process that will continue indefinitely without ever resulting in a completely unified theory. The axiom of non-contradiction is increasingly strengthened during this process. In this sense, we can speak of an evolution of knowledge that encompasses all the levels of Reality: *knowledge which is forever open*."[19]

Nicolescu demonstrated that the implications of Gödel's theorem have considerable importance for all modern theories of knowledge. The Gödelian structure of the unity of levels of Reality associated with the logic of the included middle implies that it is impossible to construct a complete theory to describe the passage from one level to the other and, *a fortiori*, the unity of the levels of Reality. If it does exist, the unity linking all the levels of Reality must necessarily be an *open unity*. The coherence of this unity is oriented as follows: there is an arrow associated with all transmission of information from one level to the other. Consequently, if coherence is limited only to the levels of Reality, it is stopped at the highest level and at the lowest level: "The highest level and the lowest level of the unity of levels of Reality are united across a zone of absolute transparency. But these two levels are different; from the point of view of our experiences, representations, descriptions, images, and

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[15] "Gödel's theorem tells us that a suffciently rich system of axioms inevitably leads to results which would be either undecidable or contradictory" (Nicolescu, 2000, p. 133).
[16] Nicolescu, 2000, pp. 127-158.
[17] What is the nature of the theory which can describe the passage from one level of Reality to another? Is there truly a coherence, a unity of the totality of levels of Reality? What is the role of the subject-observer of Reality in the dynamics of the possible unity of all the levels of Reality? Is there a level of Reality which is privileged in relation to all other levels? What is the role of reason in the dynamics of the possible unity of knowledge? What is the predictive power of the new model of Reality in the sphere of reflection and action? Finally, is understanding of the present world possible? (Nicolescu, 2000, p. 133).
[18] Nicolescu, 2000, p. 134.
[19] Nicolescu, 2000, p. 136.

mathematical formalizations, absolute transparency functions like a veil. In fact, the open unity of the world implies that what is *below* is the same as what *is above*. The isomorphism between *above* and *below* is established by the *zone of non-resistance*. Quite simply, the non-resistance of this zone of absolute transparency is due to the limitations of our body, especially of our sense organs, limitations that apply regardless of the instruments of measure used to extend these organs. The zone of non-resistance corresponds to the *sacred*, that is to say to that which does not submit to any rationalization."[20] (*Fig. 1*)

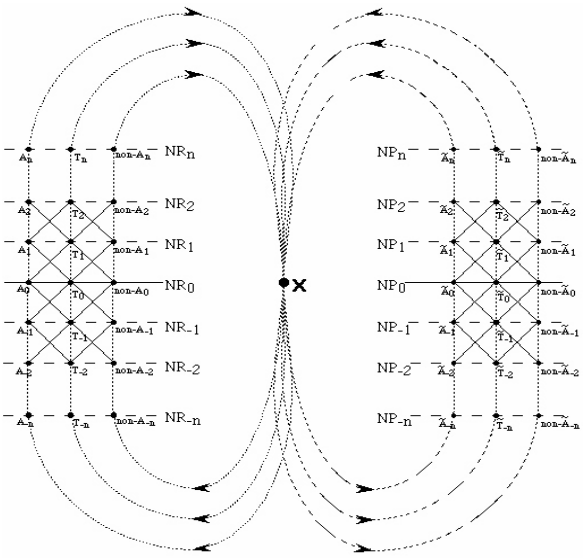

Fig. 1 : The transdisciplinary Object, the transdisciplinary Subject and the Interaction term.

The unity of levels of Reality and its complementary zone of non-resistance constitutes the *transdisciplinary Object*. A new Principle of Relativity emerges from the co-existence of complex plurality with open unity: no one level of Reality constitutes a privileged place from which one is able to understand all the other levels of Reality. A level of Reality is what it is because all the other levels exist at the same time. This Principle of Relativity generates a new perspective on religion, politics, art, education, and social life.

In the transdisciplinary vision, Reality is not only multi-dimensional but also multi-referential. The different levels of Reality are accessible to human knowledge thanks to the existence of different *levels of perception*, which are in bi-univocal correspondence with the levels of Reality.

As in the case of levels of Reality, the coherence of the levels of perception presupposes a zone of non-resistance to perception. The unity of the levels of perception and its complementary zone of non-resistance constitutes the *transdisciplinary Subject*. The two zones of non-resistance of transdisciplinary Object and Subject must be identical so that the transdisciplinary Subject can communicate with the transdisciplinary Object: k*nowledge is neither exterior nor interior*; *it is at the same time exterior and interior*.[21]

This demonstration is a great epistemological "spectacle" of transdisciplinarity by the "philosopher of physics" Basarab Nicolescu!

[20] Nicolescu, 2000, pp. 136-137.
[21] Nicolescu, 2000, p. 137.

2. The transdisciplinary model of learning

Nicolescu has also proposed[22] a transdisciplinary model of learning. This model is specific to the so-called exact sciences and offers a new basic scientific vocabulary for *disciplinarity*, *multidisciplinarity*, *interdisciplinarity*, *transdisciplinarity*, as well as guidelines for a *transdisciplinary evolution of education.* He points out[23] that the indispensable need for bridges between the different disciplines was confirmed by the emergence of pluridisciplinarity and interdisciplinarity around the middle of the 20th century.

Pluridisciplinarity concerns studying a research topic not in only one discipline but in several disciplines at the same time.

Interdisciplinarity has a different goal from multidisciplinarity. It concerns the transfer of methods from one discipline to another. Like pluridisciplinarity, interdisciplinarity overflows the disciplines but its goal still remains within the framework of disciplinary research.

As the prefix *trans-* indicates, *transdisciplinarity* concerns that which is at once *between* disciplines, *across* different disciplines, and *beyond* all disciplines. Its goal is understanding the present world and the unity of knowledge.

Transdisciplinarity entails both a new vision and a lived experience. It is a way of self-transformation oriented towards the knowledge of self, the unity of knowledge, and the creation of a new art of living. The emergence of a new culture capable of contributing to the elimination of the tensions that menace life on our planet will be impossible without a new type of learning that takes into account all the dimensions of the human being. A viable education can only be an integral education of the human being.

It an inspired moment when Nicolescu put together his new theory and the ideas from Delors' UNESCO Report[24], emphasizing and enlightening the four pillars of a new education: *learning to know, learning to do, learning to live together* and *learning to be* (See ADDENDUM I).

In this respect, The International Center for Transdisciplinary Research, CIRET (*Centre International de Recherches et d'Etudes Transdisciplinaires*, Paris), in collaboration with UNESCO, elaborated the project "The Transdisciplinary Evolution of the University".

The CIRET-UNESCO project was discussed at the International Congress "What University for Tomorrow?" (Monte Verità, Locarno, Switzerland, April 30 - May 2, 1997) and concluded by adopting the *Declaration of Locarno*, which is valid not just for universities but also for other educational institutions.

The *Declaration* includes the following main proposals:

a) **Creation of institutes for the research of meaning**

Because the most complex key-problem of the transdisciplinary evolution of learning is that of the teaching of teachers, Universities must fully contribute to the creation and operation of bona fides 'Institutes for the Research of Meaning.'

b) **Time for transdisciplinarity**

It is recommended to devote 10% of the teaching time for each discipline to transdisciplinarity.

c) **Creation of workshops on transdisciplinary research**

The different teaching locations that exist are encouraged to create workshops (ateliers) of transdisciplinary research (free from any ideological, political, or religious control), comprising researchers from all disciplines. It is a matter of gradually introducing researchers and creators

[22] Nicolescu, 1996, pp. 153-165 and Nicolescu, 2004, pp. 104-106.
[23] Nicolescu, 1996, pp. 48-57.
[24] Delors, 1996.

(e.g. musicians, poets, artists) from outside the traditional teaching locations to specific projects in order to establish a viable dialogue between different cultural approaches. It is recommended that co-direction of each atelier be ensured by a teacher of exact sciences and one of humanities or arts, each being selected by an open process of co-optation.

d) **Creation of centers of transdisciplinary orientation**

The purpose of the Centers of transdisciplinary orientation will be to foster vocations and enable the discovery of the potential in each person.

e) **Transdisciplinarity and cyberspace: Pilot centers**

Pilot centers are recommended to encourage and develop all technical means available in order to provide emergent transdisciplinary education with the requisite universal dimension and, more generally, to promote the public domain of information. In this respect, it is also highly recommended to develop pilot experiences based on the extension of networks, such as the Internet, and 'invent' the education of the future by ensuring planet-wide activity and continuous feedback, thereby establishing interactions at the universal level.

f) **Creation of an itinerant UNESCO Chair and of transdiciplinary doctoral theses**

It is recommended that UNESCO create an itinerant chair, if possible in collaboration with the University of the United Nations (Tokyo), which will organize lectures involving the entire community and enabling it to be informed about transdisciplinary ideas and methods. The creation of an Internet site, which would prepare the international and university community for a theoretical and practical discovery of transdisciplinarity, could support this chair. The aim is to put everything in place so that the seed of complex thought and transdisciplinarity can be applied to the future structures and programs of learning.

Doctoral theses in subjects with a clear transdisciplinary orientation have to be allowed. This transdisciplinary Ph.D. could have both the labels of the respective University and of UNESCO.

g) **Development of responsibility**

It is recommended that universities resort to the framework of a transdisciplinary approach, notably to the philosophy of nature, philosophy of history and epistemology, with the goal of developing creativity and a sense of responsibility in the leaders of the future. It must introduce courses at all levels in order to sensitize students and awaken them to the harmony between beings and things. These courses should be founded on the history of science and technology, as well as on the multidisciplinary themes of today, especially cosmology and general biology. This will accustom students to reflecting upon things within context and with clarity, with a view to industrial development and technological innovation and in order to ensure that applications will not contradict the ethics of responsibility relating to other human beings and the environment.

h) **Transdisciplinary forums**

In order to reconcile two artificially antagonistic cultures – scientific culture and literary or artistic culture – and to make mentalities evolve, it is recommended that learning places organize transdisciplinary forums including history, philosophy and sociology of science, and history of contemporary art.

i) **Pedagogical innovation and transdisciplinarity**

It is essential to perform the follow-up of the results of experiences representative for pedagogical innovation linked to the transdisciplinary approach in teaching. The learning places must encourage and stimulate publications that record and analyze the major examples of innovative experiences.

j) **Regional ateliers and transcultural Internet forums**

It is recommended to organize regional ateliers for transdisci-plinary research, including the application of a transcultural, transreligious, transpolitical and transnational view. Special

effort must be made to organize these ateliers in, or in close collaboration with, developing countries. Of particular interest is the organization of Internet-based forums with teachers and students from countries involved in religious, cultural, political or national conflicts, as the transdisciplinary approach also constitutes a science and an art of dialogue.

Some conclusions contained in the *Declaration of Locarno*:

If learning places intend to be valid actors in sustainable development, they must first recognize the emergence of a new type of knowledge: *transdisciplinary knowledge* (our emphasis). The production of this new type of knowledge implies a necessary multidimensional opening towards:

- civil society;
- other places of production of *new knowledge* (e.g. private institutions and laboratories, industrial companies, non-profit organizations, etc.);
- cyber-space/time;
- universality;
- a redefinition of values governing the existence of learning itself.

The 2nd World Congress on Transdisciplinarity, Brazil, September 2005, will be a good opportunity to make a concrete and useful evaluation of these recommendations and transdisciplinary goals.

3. Towards a transdisciplinary model of Education

From our point of view, Nicolescu's transdisciplinary model of Reality could have important consequences for the evolution (*revolution*[25]) of Education as epistemological support in the re-construction of a *new type of knowledge, learning* and *understanding* despite the fact that this reform of our way of thinking, which itself requires a reforming of education, is not happening anywhere even though it is needed everywhere.[26]

3.1. **Some important questions to ask and answer**

a) Has transdisciplinary Education a ternary structure? Can we distinguish these three major aspects of Education in accordance with the transdisciplinary model of Reality?

(a.1.) *Objective Education*, connected with the natural properties of the transdisciplinary Object of Education
(a.2.) *Subjective Education*, connected with the natural properties of the transdisciplinary Subject of Education
(a.3.) *Trans-Education*, connected with a similarity to Nature that exists between the transdisciplinary Object and the transdisciplinary Subject.

b) Does *Trans-Education* concern the domain of the sacred too?

c) Is *Objective Education* subject to subjective objectivity (subjective to the extent that the levels of Reality are connected with the levels of perception)?

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[25] *Educational revolution* was heralded as imminent as early as the 1970s (See Cornish, *The Coming Revolution in Education*, 1977), while the most frequently used syntagm in Delors' UNESCO *Report* (1996) is *learning society*.
[26] Morin, 1997.

d) Is *Subjective Education* subject to objective subjectivity (objective to the extent that the levels of perception are connected with the levels of Reality)?

e) Can we contend (and prove) that this ternary structure (objective Education, subjective Education, trans-Education) of transdisciplinary Education defines *living Education*[27]?

f) Does *living Education* require a new transdisciplinary methodology?

We strongly believe that if an "attempt to elaborate a new Philosophy of Nature, a privileged mediator of a dialogue between all the areas of knowledge, is one of the highest priorities of transdisciplinarity"[28], then an attempt to elaborate an epistemology and an axiology of transdisciplinary Education is also a high-level priority. Transdisciplinary education is founded on the inexhaustible richness of the scientific spirit, which is based on questioning and the refusal of *a priori* answers and contrary-to-fact certainty. It also reevaluates the role that intuition, the imaginary, sensitivity and the body have in the transmission of knowledge.

If the University intends to be a valid actor in sustainable development, it has first to recognize the emergence of a new type of education, i.e. *transdisciplinary education*.

g) Is this the very moment to be concerned with transdisciplinarity? „Indeed, because globalisation is out of control, it is accompanied by many instances of regression. But it is a possibility that could be desirable. Obviously, globalisation has a very destructive aspect: it generates anonymity, reduces individual cultures to a common denominator and standardises identities. However, it is also a unique opportunity to promote communication and understanding between the peoples of the planet's various cultures and encourages their blending."[29]

h) How can we overcome the great distance between traditional education and the new transdisciplinary approach?

Following Edgar Morin's framework of contemporary world complexity, it is essential to consider the unity of diversity and the multiplicity of the unit: "We tend too much to overlook the unity of mankind, when we see the diversity of cultures and customs and to dismiss the diversity when we see the unity. The real problem is being able to see one in the other; after all, the nature of mankind lies precisely in this potential for diversity, which cannot call into question the unity of mankind from an anatomical, genetic, cerebral, intellectual and affective point of view. It is easy to see, then, that the general and the particular are not conflicting since the general itself is singular. The human race is singular compared with other species, yet it produces multiple singularities. Our universe itself is singular, yet it produces diversity. One must always be able to think of the unit and the multiple; if not, minds incapable of considering the unity of the many and the multiplicity of the unit will inevitably promote a unity that standardises and multiplicities that withdraw into themselves."[30]

i) *The unity of the many and the multiplicity of the unit*? As it is known, Nicolescu[31] recommends to establish in every educational institution, especially in universities, transdis-

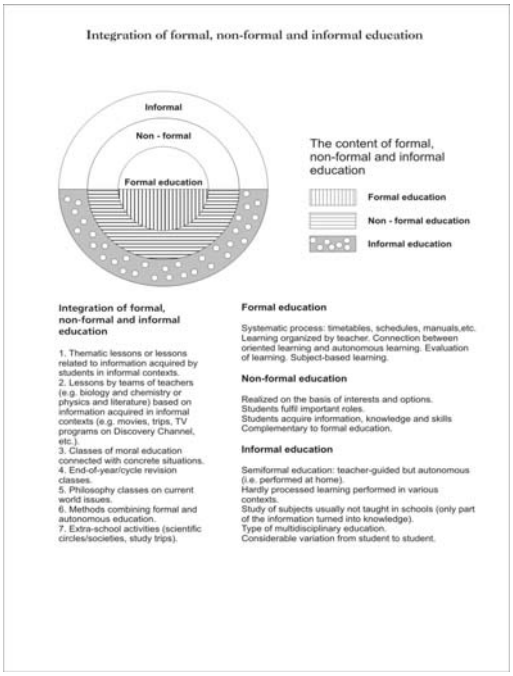
[27] This Education is *living* because it is there that life is present in all its forms and because its study demands the integration of lived experience. Transdisciplinarity entails and requires both a new vision and a lived experience. The three aspects of Education must be considered simultaneously in terms of their inter-relation and their conjunction within all the phenomena of living Nature (Nicolescu, 2000, p. 157).
[28] Nicolescu, 2000, p. 158.
[29] Morin, 1997.
[30] Morin, 1997.
[31] Nicolescu, 1999, pp. 162-163.

ciplinary research workshops that will reunite students, teachers and specialists from several domains. What is interesting is that the formula itself, both complementary and potentially antagonistic, is a complex one, as it poses the question of how we should examine the way in which the participants in these workshops relate to each other.

We will try to explain using an amazingly genuine association[32] inspired by Morin[33], which refers to the formula and values of the Republican trinity, namely *Liberty, Equality, Fraternity*. The three terms are also complementary and antagonistic: "Liberty on its own quashes equality and even fraternity. Once imposed, equality destroys liberty without achieving fraternity. As for fraternity, which cannot be decreed, it must regulate liberty and reduce inequality. It is a value which, in fact, is based on one's own relationship with the general interest, in other words, citizenship in its deepest sense. As soon as the spirit of citizenship crumbles, as soon as we cease to feel responsible for - and united with - those around us, fraternity is done for. These three notions are therefore very important." *Contraria sunt complementa…*

From a pragmatic perspective, these transdisciplinary research workshops can become a reality more easily and efficiently if we framed them into a *permanent education* structure, as transdisciplinary education brings a new perspective on the more and more acute need for education throughout our life and everywhere outside our professional life.[34]

Figure 2



[32] Amazement and complexity are transdisciplinary.
[33] Interview conducted by Anne Rapin.
[34] "A specific issue is raised by transdisciplinary education outside professional life. In a balanced society, the frontier between spare time and learning time will gradually fade away. The revolution of the computer science can play a significant role in our lives, transforming learning into entertainment and entertainment into learning. The unemployment issues, especially regarding the young, will definitley find unexpected solutions. In this context, the associative activity will play an important role in transdisciplinary education throughout our entire life." (Nicolescu, 1999, p. 163).

3.5. **Principles and main directions**[35]

a) Emergence of designing and building our common future
b) Looking ahead: new times, fresh fields
c) "Dematerialization" of work
d) Global interdependence and international cooperation
e) Education for a multicultural world
f) Seeking out educational synergies
g) Learning to know, learning to do, learning to live together and learning to be
h) Active self-reliance
i) Lifelong learning
j) Universal communication
k) Promotion of information and learning societies[36]
l) Teachers as main agents of change
m) Bringing the joy of discovery
n) Understanding the world
o) Understanding ourselves

3.6. **Tensions to be overcome**[37]

(1) Object *vs.* Subject
(2) global *vs.* local
(3) universal *vs.* individual
(4) tradition *vs.* modernity
(5) long-term *vs.* short-term considerations
(6) need for competition *vs.* concern for equality of opportunities
(7) expansion of knowledge *vs.* human capacity to assimilate it
(8) knowing *vs.* understanding
(9) pragmatic *vs.* value
(10) mind/reason *vs.* feeling; imagination and intuition
(11) spiritual *vs.* material.

3.7. **Current issues**

(1) Clarification of transdisciplinary terminology
(2) Epistemological rigor
(3) Sustainability of transdiciplinary research and education.

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[35] Delors, 1998.
[36] This technological revolution is vital for an undertanding of our modern world, as it is creating new forms of socialization and new types of individual and collective identity. The expansion of information technologies and networks tends to encourage communication with other people and reinforce trends against isolation.
[37] Delors, 1998, pp. 16-18.

4. The Romanian perspective and transdisciplinary experience[38]

4.1. The transfer of transdisciplinarity from the context of research to the context of education

4.1.1. *The meanings of intra-, inter-* and *transdisciplinarity*

Transferred from the field of research to the field of educational practices, the two perspectives have led to several types of *inter-* and/or *transdisciplinary* education:

a) *The intradisciplinary perspective* focused on rigorously separated disciplines, adapted to the specificity of the didactic logic.

b) *The pluridisciplinary* or *thematic* perspective, where the themes or work assignments are approached through several disciplines, each operating from different but compatible angles, internal logic and methodology.

c) *The interdisciplinary perspective*, the most adequate in Romania[39], approaches complex phenomena and processes, contributes to the creation and assimilation of a unitary methodology of the learning process and to the development of integrative thought, which is instrumental in the achievement of the unity of knowledge. This perspective has manifested itself in the following directions and with the following meanings:

- *intradisciplinary correlations* was understood as a kind of "first-level", elementary interdisciplinarity;
- *conceptual interdisciplinarity*, an approach initiated in the early 1970s in integrated sciences, is a common concept that defines the so-called cohesion knots;
- *methodological interdisciplinarity* makes use of the formative virtues of transferring methods between different disciplines and the common methodologies of science;
- *axiological interdisciplinarity* (the highest possible level of interdisciplinarity in education) refers to the transfer of values from one discipline to another and the complicated process of converting values into behavioral patterns; it can contribute to structuring patterns of attitudes and behavior in a genuine and multidimensional manner;
- *limitrophic interdisciplinarity* (or *hybridization*) is specific to scientific research, creating the boundary disciplines; it can be useful especially in academic education;
- *integrative interdisciplinarity*[40] has transformed the research processes and consequen-tly marked new territories of knowledge and culture, including the sciences of education.

d) *The transdisciplinary perspective* referred, until the mid 90s, to the manner of applying reality search processes, especially complex phenomena and processes, from the epistemological perspective. From the didactical perspective, transdisciplinarity has become the key to supporting and promoting the new types of education, especially the *education for change*. Its main advantage is that it determined great changes in the trainee's personality.

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[38] We are convinced that different universities and institutions can give different answers to these questions, not necessarily as a result of mentality or culture differences. This is also the reason why we will not generalize. On the contrary, we will present some instances of our experience, a brief of what a Romanian transdiciplinary team has achieved in the field of transdisciplinarity.

[39] Antonesei, 2002.

[40] It generated, in the decades following World War II, disciplines and theories such as the cybernetic science (Wiener), the theory of information (Shannon), the theory of general systems (Van Bertanlaffy), structuralism and semiotics.

We should mention that the Romanian education system currently lacks educators of inter/transdisciplinary formation, due to the structure of academic education based mainly on mono/double (conditioned) specialization.

In order to succeed in developing experts for inter/transdisciplinary activities, specific pedagogical objectives and assessment tools have been established for interdisciplinary modules and learning methodologies.

4.1.2. *The New Romanian National Curricula*, which have introduced the concept of transdisciplinarity (with its various meanings) even at the pre-academic level, aims at endowing the student with a structured assembly of functional knowledge. They mark the shift from an encyclopedic type of knowledge *to a culture of contextualized action*. This has led to the organization of the school programs in a structure that allows teachers to focus on the development of students' competences and ensure the correlation of the learning content with these competences (See ADDENDUM 2, *Outcomes of pre-academic education in Romania*).

By defining these outcomes we have also structured the general mission of secondary education in Romania, which is presented below:

- Giving priority to *the learning process and students' interests*;
- Focusing the teaching efforts on *generating and developing basic functional competences* requiered to continue the education process and enter the labor market;
- Ensuring gradual diversification of the curriculum offer according to branches, profiles, and specializations and *multiplying students' opportunities for choice*;
- Defining secondary education as a *provider of educational services*, where students are permanently and directly involved in building their own study itinerary;
- Focusing the teacher on the roles of *organizer* and *mediator* of the learning process;
- Increasing the responsibility of secondary education to its beneficiaries and the civil society; diversifying its involvement in the local community;
- Switching from universalistic knowledge to *functional knowledge* adapted to the outcomes of each specialization.

The current *school curricula* highlight the importance of increasing the students' role in their own development. This demonstrates that focus on *objectives* and *competences is the only way to make the slogan focus on the student* meaningful.

The design of the competence-based curricula welcomes the transdisciplinary orientation, which states that the transfer and use of knowledge and skills are achieved in new and dynamic contexts. The education plan has been conceived in order to produce the programs required for the integration of disciplines and the correlation of the learning content in the following manner:

- Mother tongue – foreign languages – history of culture
- Physics – chemistry – biology
- Mathematics – computer science
- History – geography – civic culture
- Psychology – pedagogy – philosophy – sociology – economics – logic
- Esthetic education – music – painting
- Sports – anatomy – psychology/sociology – pedagogy (applied to sports).

4.1.3. *New didactics*

The existence of curricula focused on students' achievements has determined major changes in the didactics of every discipline. The table below contrasts the general characteristics of the teaching-learning process in the traditional and the current didactics.

Criteria	*Strategies focused on teaching*	*Strategies focused on learning*
Student's role	Follows the teacher's lecture, presentation, explanation	Expresses personal points of view
	Tries to memorize and replicate information	Exchanges ideas with the others
	Accepts ideas and information passively	Gives arguments; asks himself and others questions in order to understand
	Works in isolation	Cooperates in solving problems and completing assignments
Teacher's role	Presents, lectures	Facilitates and monitors learning
	Imposes information and points of view	Helps students understand and explain their personal points of view
	Considers himself an authority/an "official" and manifests himself as such	Is a partner in learning
How study is achieved	Through memorizing and replicating information, using "classical" examples	Through developing intelectual and practical skills and competences
	By competition between students, aimed at establishing a hierarchy	Through cooperation
Assessment	Measures and evaluates knowledge	Measures and evaluates competences (what the student can do with what he knows)
	Emphasizes aspects related to quantity (how much information the student possesses)	Emphasizes aspects related to quality (values, attitudes)
	Classifies students	Ensures that each student achieves progress

4.1.4. *The alternative manuals (textbooks)*: oportunitiess for diversifying the didactic approach

The alternative manuals is indicative of school *normalization* (alternative manuals also existed between the two world wars in Romania). They are necessary and recommended given that students are not identical, and neither are teachers. Having the possibility of choice, the students and teachers themselves can choose the most adequate textbooks and teaching materials.

The essential differences between the traditional and the modern manuals are shown in the table below:

Traditional manual	*Modern manual*
Operates a rigid selection of contents that result in a fixed amount of information and leads to a mechanical learning process	Operates a permissive selection of contents that results in a variable amount of information and gives the student and the possibility to create
Presents standard and universally valid information as a closed system and as a purpose in itself	Presents information in order to stimulate open interpretation and form competences, values and attitudes
Encourages a teaching style based on memorizing and replicating information	Encourages a teaching style based on understanding and explaining processes
Represents a mechanism aimed at creating stereotypes.	Represents a mechanism aimed at stimulating critical thinking.

5. *Romanian educational transdisciplinary experiments*

5.1. *The School of Reform*

A generous program meant to sustain the education reform in Romania, coordinated and financed by the Center *Education 2000+* in Bucharest[41] gave us the opportunity to participate in offers and auctions of educational programs and then in experiments and applications where, as an institution of pre-service and in-service teacher training, we discussed key-concepts, such as the *new national curriculum, school development, strengthening school-community relationships* and *developing cooperation* between the main institutions in education.

The outcome was a number of team-projects, promoted by the representatives of the Training Departments of universities, the Pedagogical College, the School Inspectorate and the Teaching Staff Center. This was intended to be a *School of Reform* for a college of cutting-edge didactics, active learning and transdisciplinarity that prepares future innovative school-masters and teachers. The studies and projects already developed under the coordination of the Regional Resource Center *Education 2000+*[42] are an eloquent proof that it is second nature to school masters and teachers in the Cluj district to apply transdisciplinary methodology.

We have thus experienced a new kind of education that responds to the imperative of *consciousness raising* and the need for the development of a sense of participation in shaping one's future. We continuously encourage the elaboration and affirmation of original opinions, the selection of rational solutions to problems and responsible debates of ideas. To this we may add the social dimension, the value of team work, the ability to appreciate different points of view and the recognition of the way in which experience can influence our attitudes and perceptions. In a society where the dimension of change remains unprecedented during the history, we have chosen the transdisciplinary perspective on education.

This is not a new *classroom subject matter*, but a natural manner of interaction between fundamental ideas and information in the field of transdisciplinarity and a certain option for a new kind of education, as understood by UNESCO studies on the future of education in the first century of the 3rd millennium[43], as well as by the International Center for Transdisciplinary Research in Paris[44], whose President is Basarab Nicolescu.

5.2. *"Education 2000+" summer schools*

In the context of the above mentioned objectives and actions, the *Summer Schools* 2000-2002, which took place at Holiday Inn Hotel, Sinaia, benefiting from excellent facilities and logistics, have played an important role. They have put to effect the program area *Pre-service and in-service training* and focused on student-centered learning, improving classroom

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[41] *The Center Education 2000+* is a non-governmental organization, founded by the Open Society Foundation. The main objective of the programs initiated by the Center *Education 2000+* was to develop models of implementing reform in Education at local level, models that can be then multiplied at national level, thus making easier the visible impact at the level of the whole educational system in Romania. This was the specific objective carried out with the support of the Ministry of National Education within the framework of a cooperation protocol between Education 2000+ Center and the ministry. The process of implementation started in 1999, at first in 8 centres selected by open contest out of a number of projects drafted by local School Inspectorates, Teaching Staff Centres (CCDs), Training Departments in local Universities and Pedagogical Colleges. These institutions became partners in the framework of the Program *Education 2000+*. The program is being implemented in the districts of Cluj, Galati, Iasi, Timis, Constanta and Hunedoara as well as in Bucharest.

[42] Bertea, 2003, pp. 14 -107.

[43] Delors, 1996.

[44] http://perso.club-internet.fr/nicol/ciret

atmosphere, using new methods and developing support materials as resources for students and teachers.

The themes approached were related to what is new in the teaching of the Romanian language and literature, History, Mathematics, Sciences and in the *teaching process from a transdisciplinary approach* in primary and secondary schools. The overall objective of the workshops was to strengthen teachers' competencies and skills, while the main specific objective was to train a professional corpus of "resource teachers" in new teaching methods and techniques, implementation of the curricular reform and subject didactics. The workshops highlighted those methods and techniques that enhance the chances to meet international standards in education.

The presentations and training sessions tackled topics such as international trends in teaching various subject matters, interactive teaching and cooperative learning, evaluation of students' skills of effective learning, developing teachers' capacity to anticipate methods of experience acknowledgement.

The program of the Summer Schools included various types of activities: presentations, debates, round table talks, projects on new trends in the assessment of the teaching-learning activity. Each session of the Summer school spanned over 48 hours distributed over a week.

The universities were made up of trainers from our country and from abroad. Their contribution was instrumental not only in the design of the workshop plans, but also through the opportunity they offered to analyze the Romanian educational environment and the ways and means of improving it. The evaluation was to be carried out over the first semester of the school year 2001-2002, by experimenting in class the practices acquired during the Summer School and through the follow-up session held at the Winter Transdisciplinary School between 31 January and 4 February.

The trainees received a Certificate of attendance, issued by the Center *Education 2000+* and approved by the Ministry of National Education.

5.3. *The transdisciplinary classes*

Starting from the requirements of the educational reform and from the priorities of the project "Education 2000+", the "Trans" Summer School aimed to increase the level of knowledge and information in the transdisciplinary field, practice specific skills and abilities, build on the trainees' professional experience, foster awareness of transdisciplinary issues, heighten motivation in order to apply new knowledge and skills, improve communication and interpersonal relations at the group level, and orient the group to the coordinates of a team that can approach transdisciplinary issues coherently.

In this context, the *themes* dealt with were relevant for the transdisciplinary area: class management, theory of multiple intelligence, communication, evaluation, teaching styles, teaching/learning methods, self-awareness, group dynamics, planning and taxonomy of values.

The training course was an opportunity for self-development and professional development, quick and better learning, for enriching feelings, developing personal and professional relations. It also represents the challenge of a new perspective, a starting point for new projects in schools, and a chance for long-term collaboration. All in all, it was an interesting, agreeable and useful experience and also a contribution to accomplishing teachers' cohesion.

As a consequence of the Summer School experience, the trainees decided to make significant changes in their own in-class activity: to introduce new interactive methods and new evaluation methods, to use the information about class management and change the learning environment, to use and build on activities that make students work in teams, to make a wider use of reflection, awareness, self-awareness, and self-assessment, to implement new methods of improving interpersonal communication and student-teacher relationships.

They have all agreed that transdisciplinarity requires responsible, enthusiastic, dynamic and creative teachers. They decided also to reduplicate their experience, to keep up the dynamism and innovative spirit, to send positive messages and to build a real team able to act as a catalyst for social and educational change.

The transdisciplinary perspective presupposes flexible and humane methods, creative and critical thinking skills and a reflexive and inquiring spirit required in the assessment of the real training and learning needs that will help teachers and trainers customize and contextualize their activity and create solutions to problems.

The Summer courses of the *Education 2000+* Center have brought clarifications and agreement of all participants on the concept of *a transdisciplinary perspective*, being an invitation to reflect on what they are heading for:

Learning as a destination in a subject-centered classroom based on: provision of pre-set and authority-approved knowledge, considering a unique intelligence with a measurable IQ, information-centered learning in a decontextualized approach, a rigid, hierarchical, authoritarian structure of class interactions, sequencing of teaching materials based on students' age, subject taught in complete isolation, discouragement of free expression of opinions, strong preoccupation with standards, education seen as a social necessity for a determined period of time in order to use a minimum set of acquired knowledge for a specific role, teacher-delivered knowledge, resulting in *a one-way street*.

or

Learning as a journey in a learner-centered classroom where every individual is considered to have a mind that works in a specific way, as there are many types of intelligence (H. Gardner); the role of education is to develop the potential of every student differently; competencies necessary for the 21st century are developed; stress is laid on how to learn, how to ask questions, be open, evaluate new concepts, get access to information, what we know and how we create a flexible structure, the conviction that there are more than one way to learn something; different opinions are part of the creative process; abstract theoretical knowledge is coupled with experimentation and experiments performed outside the classroom; preoccupation is shown for the learning environment; lifelong learning is encouraged as a prerequisite of the process of contextualized change; community absorption and control are encouraged; education is seen as a lifelong process, as knowledge changes and accumulates in time; teachers and students no longer assume roles dissociated from themselves as human beings.

They have discussed new topic, such as *transdisciplinarity as a new vision of the world*. This topic, as well as the study of the *Transdisciplinary Chart* adopted at the First World Congress of Transdisciplinarity (Portugal, 1994), have made them reflect on the future of the educator and on the new ways of approaching education for the young generation of the 21st century.

5.4. *The Regional Resource Center "Education 2000+"*

We will present only *New didactics in a transdisciplinary perspective*, one of the six school departments that we have implemented at the Regional Resource Center *Education 2000+* in Cluj.

What was our starting point? At first, there was one opportunity, namely the programs proposed by the Center *Education 2000+* from Bucharest. Then, a challenge and a great promise: the Reform of Education in Romania.

Who were the participants and what were the admission criteria? Any teacher in the country had the chance to participate. The admission to this course presupposed a selection of projects on personal development in the field of applied didactics. Since the number of places

in each class was limited (24), the competition was tight and the selection of the candidates rigorous, as they had to prove themselves not only well prepared, but also highly motivated.

The *curriculum* included the initiation in the theory and practice of active didactics and inter/multi and transdisciplinary methods, correlated with the New National Curriculum of Romania and based on innovative methods of organizing teaching/learning, stimulation of personal creativity, group/class/school management, as well as conflict prevention and conflict resolution. We also insisted on active collaboration and communication between teaching actors and institutions (students, teachers, parents, local community, informal educational factors, the media, etc.) These transdisciplinary schools benefited from the contribution and experience of education experts from The United States and Europe and from interactive methods of critical thinking, multiple intelligence and educational alternatives.

The fundamental attribute of these activities resided in their applicable nature, for most of the activities were organized and carried-out as workshops, which presupposed exercises of project conception, debates, negotiations, communication – areas where the Romanian teachers in general still lack experience, due to their initial formation and their activity during the communist regime – team work (another deficient area), evaluation and self-evaluation.

Since at present the Romanian school considers students as partners and co-organizers of their own formation pattern, the teachers attending these courses had to play and assume the role of co-partners (of students) and to evaluate the activities from this perspective as well. The result was dynamic, persuasive activities, with great impact on the projection, organization and evaluation of the didactic activities carried out by the participants within the modular workshops. Each participant had to apply the knowledge acquired at the transdisciplinary workshops of their schools in their daily school activity, being supervised and requested to present their experiments at the beginning of the following session of the summer or winter schools.

The evaluation questionnaire of these workshops indicates that most of the participants not only learned and experienced many new concrete things but, above all, they had the chance to be inventive, despite the rigorously determined tasks. They also discovered the advantage of giving deeper signification to their activities, the pleasure of exercise and shared work in groups or teams, and regained and recovered their enthusiasm for work.

5.4. *Tansdisciplinary workshops at the Faculty of Pshycology and Sciences of Education, "Babes-Bolyai" University of Cluj*

Transdisciplinary workshops were introduced in the curriculum of the Faculty of Pshycology and Sciences of Education, "Babes-Bolyai" University of Cluj, one of the most faimos Romanian universities. International conference organized during a week (December 2004) by the dean of the faculty, professor dr. Vasile Chis, and having as guest academician Basarab Nicolescu stirred the students', professors' and scientists' interest in this very modern topic. It was the beginning…

The two-year curriculum presented below is structured from a transdisciplinary perspective and can serve as a possible structure for *maste*r studies:

First year of study:

- Communication
- Negotiation and communication
- Group and class management
- Prevention and resolution of conflicts in the educational environment
- Interactive methods
- Methodology of the projection, organization and evaluation of interactive didactic activities.
- Presentation and self-evaluation of the interactive didactic project.

Second year of study:

- Introduction to transdisciplinarity
- Preliminaries: concepts, meanings, determinations
- Institutions and representatives
- Personalities and fundamental texts
- Transdisciplinary applications: *Hands on, La main à la pâte, La salle de découverte, L'aprentissage par l'action, Les itinéraires de découverte au croisement des disciplines*
- Methodology of the projection, organization and evaluation of educational activities from the transdisciplinary perspective.

We are also proposing a curriculum for a three-year *doctoral program* on transdisciplinarity:

- TD epistemology
- Workshops on the projection, organization and evaluation of educational activities from the transdisciplinary perspective
- Elaboration of a transdisciplinary project
- Evaluation of doctoral project.

In Romania, the principal advantage of transdisciplinary action was the fact that it made the participants aware of the need for communication and change (awareness and need for communication and change are transdisciplinary attitudes).

Obviously, the transdisciplinary school doesn't claim to prepare transdisciplinary experts, as the development of the transdisciplinary study requires time and hard work.

We strongly believe that there are no real standards in developing transdisciplinary study but only means, concepts and a transdisciplinary vision.

6. **Instead of conclusions**

✓ To speak about transdisciplinarity and try to apply it in education involves a *great responsibility*, namely the assumption of a new epistemology, of new principles, laws and values, and a new methodology – all this supported by a rigorous scientific spirit and an open worldview.

✓ The mission of transdisciplinarity, i.e. the unity of knowledge and understanding the world in its discontinuous harmony, still appears to be an almost impossible beautiful dream, a new utopia vs. a new "faith", or a new apostolate based on the isomorphic updating of modern science taken from under the influence of technocrats and economists and engaged in the service of a new planetary and cosmic humanism.

✓ In spite of possible appearances, transdisciplinarity is not a domain that lends itself to cheap digressions by amateurs and neither it is a restricted domain. The scientific rigor that grounds its epistemology, vision and practice requires a very thorough documentation.

Therefore, to be recognized as belonging to this domain one has to be a researcher, theoretician or practitioner whose work is based on considerable integrated references.

✓ Transdisciplinary research, vision and practice are complex processes that can provide solutions to problems of global and long-term impact.

✓ Nevertheless, transdisciplinarity is far from being understood and applied in its "illuminating" essence, as there are quite many countries, universities and scientific institutions that know next to nothing about this revolutionary field of inquiry into the future of mankind.

✓ The "battle" for transdisciplinarity is at its incipient stage. In order to win, this battle will have to be transformed into a revolution and transdisciplinarity could thus become a viable solution to revolutionizing knowledge and human life.

✓ Transdisciplinary revolution should begin from inside, in the sense that if in the case of exact sciences we can speak of a solid transdisciplinary epistemology, its applicability as a methodology in the social sciences still suffers from deficiencies: " Specifically, we need to attain more clarity with respect to levels of reality in the social world. Do *knowledge* and *understanding* really belong to different levels of reality? What about *being* and *having* or *reason* and *intuition*? Do the *anthropocentric* and *biocentric* visions and attitudes towards the world belong to different levels of reality?"[45]

✓ As we have presented and illustrated herein, two transdisciplinary models have already been conceived: one of learning and the other of knowledge as epistemological bases for transdisciplinary research and practice.

✓ Being fascinated by Nicolescu's theory and the ideas from Delors' UNESCO Report, we are concerned to create a possible transdisciplinary model in education that will be able to provide epistemological support for a new type of learning, knowledge and understanding. *Some important questions to ask and answer* (See paragraph 3.1.) constitute the starting point in the construction of this framework that will substantiate the ternary structure and the methodology of a Living Education.

As a complex and genuine association, we have framed this process into a lifelong education structure (See *Fig.2*).

✓ We have also mentioned the main current issues in the field of transdisciplinarity, such as clarification of TD terminology, epistemological rigor and sustainability of TD research and education.

✓ We have explained the meanings of *intra-*, *inter-* and transdisciplinarity from the point of view of Romanian pedagogues and researchers in education. We should specify that these meanings only partially coincide with what we understand by transdisciplinarity herein, the terms being principally used as names and senses of some didactic methods or principles of organization of the content of each discipline that follows the direction opened by the UNESCO research group, coordinated by Louis D'Hainaut[46] and summa-

[45] Max-Neef, 2005, p.11.
[46] D'Hainaut, 1979, p. 210.

rized in the figures you can compare accessing the following on-line address: http://nicol.club.fr/ciret/bulletin/b18/b18c12.htm.

✓ In addition, we have discussed the main tendencies and achievements related to a transdisciplinary vision in the Romanian education after the December 1989 Revolution.

One can easily observe that there existed and still exists interest in interactivity and integration of disciplines and that these steps are made from a disciplinary approach. As a result, we could speak of a fragmented interactivity in the current education in Romania, as each educational factor tries individually to do their best in their well-delimited discipline.

The problem is that the learning content should also be conceived in this manner, which is not the case although one cannot deny the significant changes in the curriculum and in the Romanian didactics.

✓ Therefore, we can only speak of a *pedagogically based transdisciplinarity* rather than an epistemologically based transdisciplinarity. On this view, the meanings we assign to the concepts are close to those summarized by Max Neef in the sense that what the Romanian pedagogues and researchers call "intra-/multi-/pluri-/interdisciplinarity" could be categorized as *weak transdisciplinarity.* In reality, we can approve of the idea that everything that is practical transdisciplinarity in the general system that is divided into disciplines can only be characterized as *weak transdisciplinarity*.

✓ *Strong transdisciplinarity* occurs only in fundamental research and as epistemological basis. Moreover, we believe that genuine transdisciplinarity is an ideal, a challenge, or what Goethe named "the feeling of wonder through contemplative looking, in which the scientist would come to see God in nature and nature in God"[47].

✓ In essence, any finality as a closed system takes the form of a "mono", even if that "mono" contains more than one entity. This is primarily about our human limitations. For this reason, in the workshops on transdisciplinarity that we organized at the Faculty of Sciences of Education at "Babes-Bolyai" University in Cluj, we have defined five levels of transdisciplinarity on the basis of pedagogical criteria:

- *Zero-degree TD* - deep, basic, epistemological TD
- *First-degree TD* - transdisciplinary model, the pragmatic equivalent of what Max Neef[48] calls *Value level*
- *Second-degree TD* - theories, systems, projects; equivalent of Max Neef's *Normative level*
- *Third-degree TD*- strong interdisciplinarity; Max Neef's *Pragmatic level* (purposive interdisciplinarity)
- *Fourth-degree TD* – pluridisciplinarity; Max Neef's cooperation without coordination
- *Fifth-degree TD* - multidisciplinarity; Max Neef's level of no cooperation

[47] Max-Neef, 2005, p. 6.
[48] Max-Neef, 2005, pp. 2-3.

It follows that unlike Max Neef (Schulz), we integrate these degrees of transdisciplinarity, i. e. forms of objective transdisciplinarity, in a pedagogical vision without defining them "at the next higher hierarchical level."[49]

Instead, we have considered them simultaneously linked and determined horizontally and vertically in their discontinuity, as a result of the separation of the specialized disciplines involved, in accordance with the epistemological view.

This process is represented by the figures below.

Figure 3

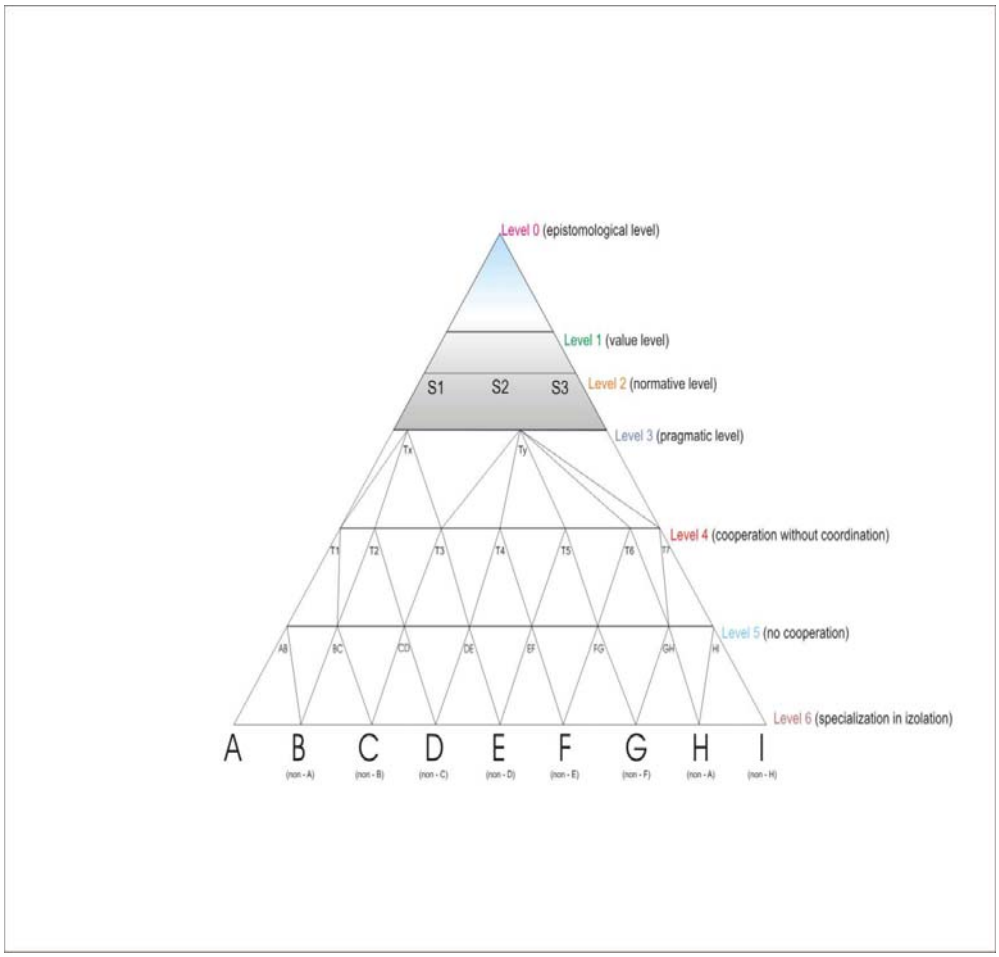

Figure 3. Sequencial view:

- **A**, **B**, **C**, **D**, **E**, **F**, **G**, **H**, **I** – school disciplines (subjects)
- **T1**, **T2**, **T3**, **T4**, **T5**, **T6**, **T7** – biology, phisics, chemistry, mathematics, geography, IT, astronomy.
- **Tx** - eg.: medicine
- **Ty** – eg.: cartography

[49] Max-Neef, 2005, p. 3.

Figure 4

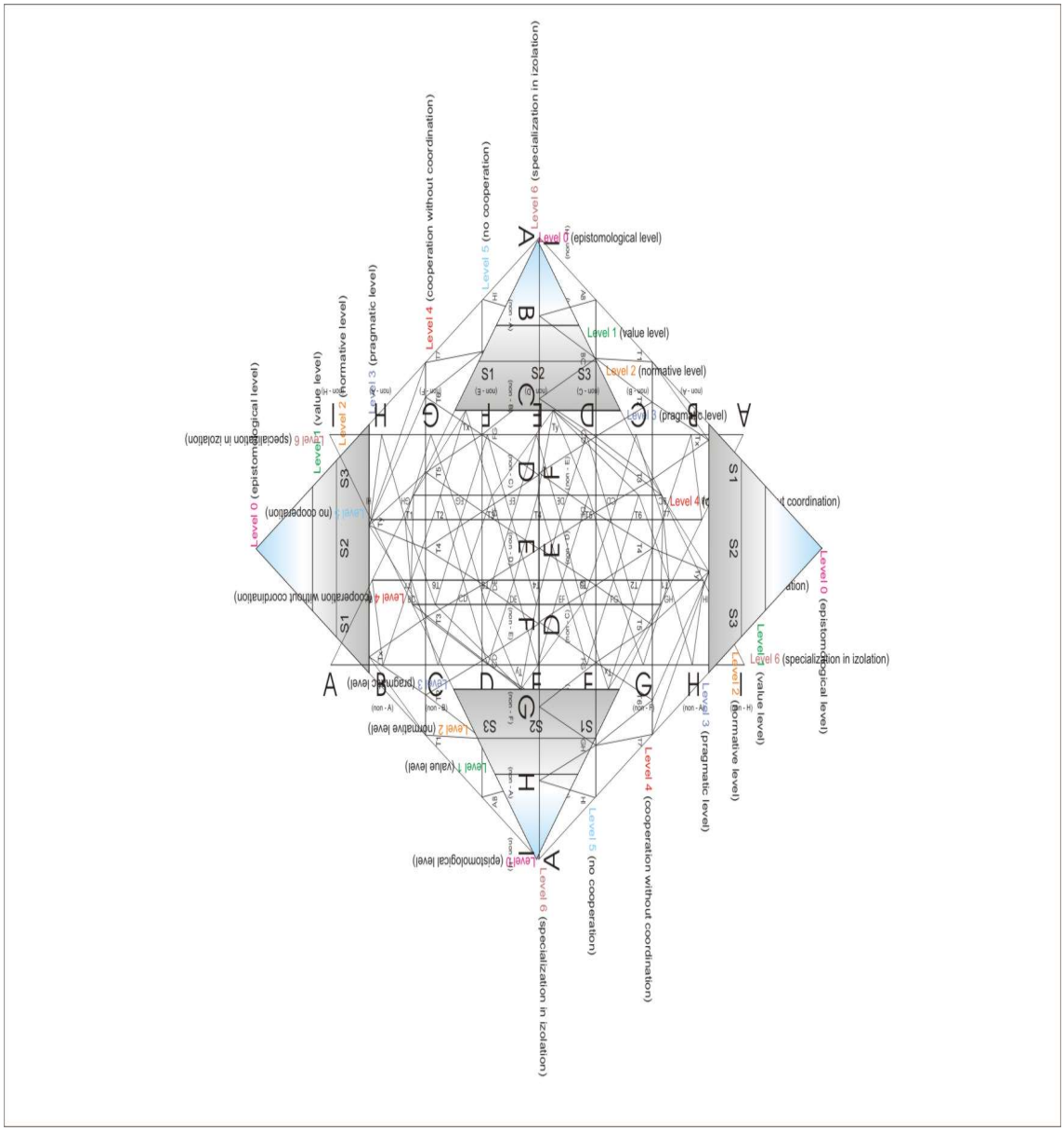

Figure 4. View in *complexity of the process*: simultaneously linked and determined horizontally and vertically in their discontinuity, as a result of the separation of the specialized disciplines involved, in accordance with the epistemological view.

The following three diagrams illustrate our TD perspective on the educational process.

Figure 5

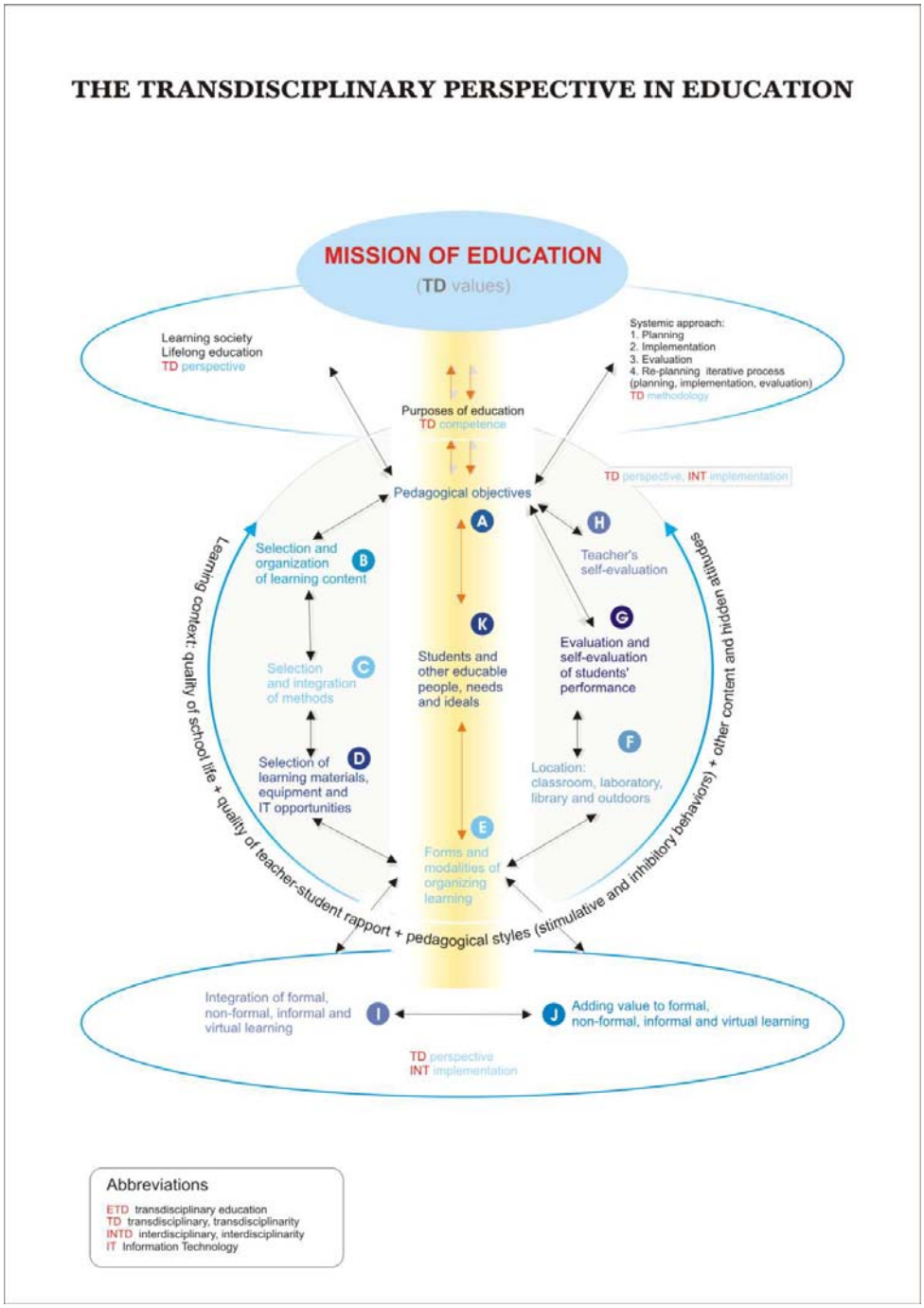

Figure 5. Horizontal view: sequencial interaction

Figure 6

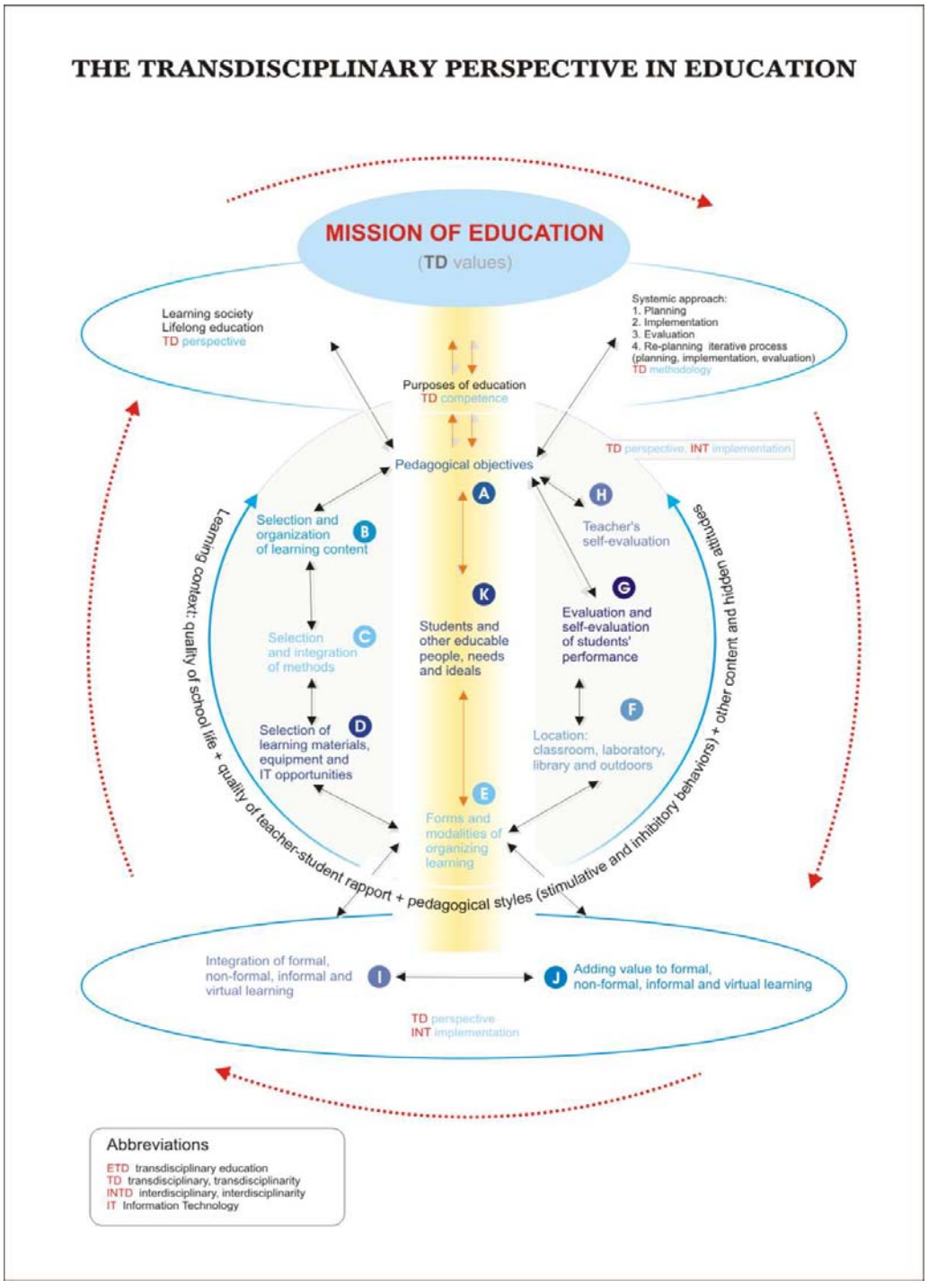

Figure 6. Top-down, left-right communication: closing circle

Figure 7

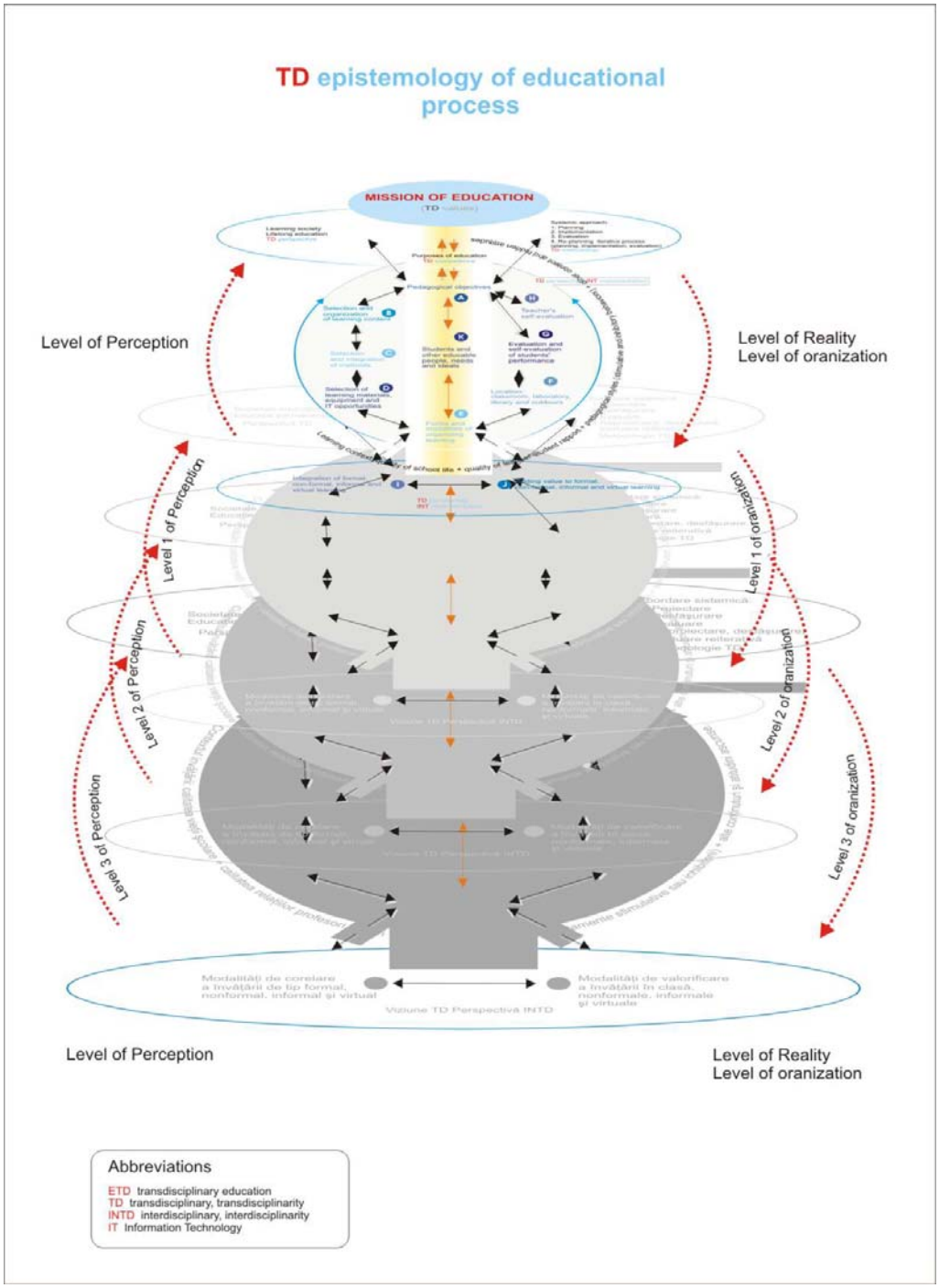

Figure7. Complex epistemological view

All the stages of the process occur simultaneously and at all levels through discontinuous and complementary transition from the given level of reality to the different levels of organization and perception. The transit from one to another generates fluxes that are in a relation of isomorphism. Information/knowledge is neither interior nor exterior. It is at the same time interior and exterior. The study of the different levels of organization and of the different levels of perception sustain each other in a multipolar relation capable of establishing feedback loops such as order/disorder, whole/part, system/ecosystem in such a way that they

remain simultaneously complementary and antagonic in a recursive process. In addition, they constitute simultaneous modes of reasoning the rational and the relational.

To conclude, we resort to the French historian Jules Michelet's insightful vision: "The wisdom of ancient times has taught us that the Muses are sisters… Knowledge is a single whole: languages, literature, history, physics, mathematics, philosophy – branches of learning that seem unconnected to one another – are in reality related or rather combine to make up a system that, given our limitations, we perceive in the form of successive discrete parts. Nevertheless, there will come a day when we will try to perceive the impressive harmony of sciences. This is the actual meaning of the evolution of human knowledge: first science, then sciences, and science again".

Apparently, thanks to the TD epistemology, the day wished for by J. Michelet is announcing its dawn.

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ADDENDUM I

THE TRANSDISCIPLINARY EVOLUTION OF EDUCATION

"The emergence of a new culture, capable of contributing to the elimination of the tensions menacing life on our planet, will be impossible without a new type of education, which takes into account all the dimensions of the human being. All the various tensions - economic, cultural, spiritual - are inevitably perpetuated and deepened by a system of education founded on the values of another century, and by a rapidly accelerating imbalance between contemporary social structures and the changes that are taking place in the contemporary world. In spite of the enormous diversity of the systems of education from one country to another, the globalization of the challenges of our era involves the globalization of the problems of education. The different upheavals continually traversing the area of education in one or another country are only indicators of one and the same flaw: the disharmony that exists between the values and the realities of a planetary life in the process of change. Most certainly, while there is not some miraculous recipe, there is nevertheless a common center of questioning, which it would behoove us not to hide if we truly want to live in a more harmonious world.

The report to UNESCO of the International Commission on Education for the Twenty first Century, chaired by Jacques Delors, strongly emphasizes four pillars of a new kind of education: *learning to know, learning to do, learning to live together with*, and *learning to be*. In this context, the transdisciplinary approach can make an important contribution to the advent of this new type of education.

Learning to know means, first of all, training in the methods that help us distinguish what is real from what is illusory and to have intelligent access to the fabulous knowledge of our age. In this context the scientific spirit, one of the highest ever attained in the human adventure, is indispensable. It is not the assimilation of an enormous mass of scientific knowledge that gives access to the scientific spirit, but the quality of that which is taught. And here quality means to lead the student into the very heart of the scientific approach, i.e. the permanent questioning in relation with the resistance to facts, images, representations, and formalizations.

Learning to know also means being capable of establishing bridges – between the different disciplines, and between these disciplines and meanings and our interior capacities. This transdisciplinary approach will be an indispensable complement to the disciplinary approach, because it will mean the emergence of continually connected beings, who are able to adapt themselves to the changing exigencies of professional life, and who are endowed with a permanent flexibility, which is always oriented towards the actualization of their interior potentialities.

Learning to do certainly means acquiring a profession. The acquisition of a profession necessarily passes through a phase of specialization. However, in our tumultuous world, in which the tremendous changes induced by the computer revolution are but the portent of other still more tremendous changes to come, any life which is frozen into one and the same occupation can be dangerous, because it risks leading to unemployment, to exclusion, to a debilitating alienation. Excessive specialization should be outlawed in a world that is in rapid change. If one truly wants to reconcile the exigency of competition and the concern for the equal opportunity for all human beings, in the future, every profession should be an authentically woven occupation, an occupation which would bind together in the interior of human beings threads linking them to other occupations. Of course, it is not simply a question of acquiring several competencies at the same time but of creating a flexible, interior core that could quickly provide access to another occupation should it become necessary or desirable.
In this context, the transdisicplinary approach can be invaluable. In the last analysis, 'learning to do' is an apprenticeship in creativity. 'To make' also means discovering novelty, creating, bringing to light our creative potentialities. Creating the conditions for the emergence of authentic persons involves insuring the conditions for the maximal realization of their creative potentialities. The social hierarchy, so frequently arbitrary and artificial, could thus be replaced by the cooperation of structural levels in the service of personal creativity. Rather than being levels imposed by a competition that does not take the interior being into account at all, these levels would in fact be levels of being. The transdisciplinary approach is based on the equilibrium between the exterior person and the interior person. Without this equilibrium, 'to make' means nothing other than 'to submit.' 'To live together with' does not mean simply tolerating the other person's different opinions, skin color, and beliefs; submission to the exigencies of power; negotiating between the in's and out's of innumerable conflicts; definitively separating interior from exterior life.
The transcultural, transreligious, transpolitical and transnational attitude can be learned. To the extent that in each being there is a sacred, intangible core, it is innate. Yet, if this innate attitude is only potentially there, it can forever remain non-actualized, absent in life and in action. In order that the norms of a collectivity be respected, they must be validated by the interior experience of each being.
The transcultural, transreligious, transpolitical and transnational attitude permits us to better understand our own culture, to better defend our national interests, to better respect our own religious or political convictions. Just as in all other areas of nature and knowledge, open unity and complex plurality are not antagonistic.

Learning to be appears at first like an insoluble enigma. We know how to exist but how can we learn to be? We can begin by learning that the word 'exist' means, for us: discovering our conditioning, discovering the harmony or disharmony between our individual and social life, testing the foundations of our convictions in order to discover that which is found underneath. To question, to question always; here too, the scientific spirit is a precious guide for us. Learning to be is also a permanent apprenticeship in which teachers inform the students as much as students inform the teachers. The shaping of a person inevitably passes through a trans-personal dimension. Disrespect for this necessary process goes a long way towards explaining the reason for one of the fundamental tensions of our era, that between the material and the spiritual.
There is one very obvious inter-relation between the four pillars of the new system of education: how to learn to make while learning to know, and how to learn to be while learning to live together with? In the transdisciplinary vision, there is a transrelation connecting the four pillars of the new system of education, which has its source in our own constitution as human beings. A viable education can only be an integral education of the human being – an education that addresses the open totality of the human being and not just one of its components.

At present, education favors the intellect, rather than sensitivity and the body. This was certainly necessary in the previous era, in order to permit the explosion of knowledge. But this bias, if it continues, sweeps us away in the mad logic of efficiency for efficiency's sake, which can only end in our self-destruction.

The experiments done by the Nobel Prize winning physicist Leon Lederman with children from the most disadvantaged neighborhoods of Chicago, demonstrates what we have been saying. The Chicago experiment shows well that the intelligence assimilates knowledge much better and much more rapidly when this knowledge is also understood with the body and feeling. This is a prototype of the emergence of a new type of intelligence, founded on equilibrium between analytic intelligence, feeling, and the body. It is only in this way that the society of the 21st century can reconcile effectiveness and affectivity". (B. Nicolescu, 1996, pp.154-162)

ADDENDUM II

THE OUTCOMES OF PRE-ACADEMIC EDUCATION IN ROMANIA:

- Developing the functional competences that are essential for social accomplishment: communication, critical thought, decision-making, contextual use and processing of complex information;
- Developing the active integration capacity in different socio-cultural groups: family, professional environment, friends etc.;
- Developing expressivity and sensitivity, in order to achieve personal fulfilment and promote quality life;
- Developing moral autonomy.
- Developing the capacity to reflect on the world, to formulate and resolve problems by linking knowledge from various domains;
- Adding value to the personal experiences, in order to choose the best professional orientation for the labour market and/or for academic education.