

Conferences

The Intelligence of Complexity

Do the ethical aims of research and intervention in education and training not lead us to a “new discourse on the study method of our time”?

Faculty of Psychology and Educational Sciences
of the University of Lisbon, on 15th February, 2007

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‘Since the Cartesian Method undermines ingenium and ingenium was given to human beings in order to understand, that is, to act intentionally’

G. Vico, 1710

“A new paradigm for ‘lifelong’ educational policies”¹: With such a challenge even last year Teresa Ambrósio invited us to assume our civic responsibilities, both individually and collectively, towards “restoring all the solidarities among all the phenomena”² we continuously face... all through our lives: “Acquiring an open rationality, taking into account the imaginary dimension of ‘governance’, vivifying opportunities for dialogism, for the recreation of sense, for the permanent reevaluation of communities’ historical and durable convictions (values), which is required by the changes of our times and by the new worldwide problems we have been tackling”.

Do these few lines not characterize the core of what might be expected from this new epistemological paradigm? As early as 1934, G. Bachelard had already identified this “*new scientific spirit*” by inscribing it in the heart of *non-Cartesian epistemology*³. By that time to define a new paradigm by the negative was somewhat disturbing. Yet, on reading it today, we are profiting from the multiple constructive developments that have been occurring since then, so well synthesised and notably documented in the six volumes of Edgar Morin’s *La Méthode*⁴. From now on, let’s take this non-Cartesian epistemology – which brings us back “*the ideal of complexity of contemporary science*”, in G. Bachelard’s words – as the *epistemology of complexity* so that we can exert our intelligence of complexity without previously having to reduce it to mere conformity to the unique imperative methodological prescriptions of the principles of the Cartesian *Discourse on Method* (1637).

Imperative methodological prescriptions which would rapidly assume an ethical value during the last three centuries by postulating criteria of scientificity (scientific *logic and objectivity*) which are held as unique and exclusive with truth value and therefore of moral recititude. Shouldn’t we remind that *Port Royal Logic (Logic or The Art of Thinking)* by Arnaud and Nicole, 1684, has been made the European teachers’ basic manual for two centuries because on retaking the Cartesian principles it justified them on the basis of Aristotle’s axioms of perfect syllogism? Thereafter, the scientifically true (assumption) became the (indubitably) morally good in our cultures, while ethics became no longer considered as the object of individual and collective deliberation but as a direct result from some form of perfect syllogistic reasoning (independent of the subject who reasons). In our schools we are still suffering some residual effects of such a scientism, which A. Comte’s *Positivist’s Catechism* (1852), and G. Boole’s *Laws of Thought* (1854, *Logic made Algebra*) would somehow sacralize in teaching if not in cultures. Clearing both Rhetoric and Topics from almost all European syllabuses in the early 1900’s means the officialization of this symbolic removal of ethical deliberation and its argumentation from school systems.

These perverse effects, which will be deeply diagnosed further on, raised the awareness that would revitalize the brave efforts of researchers and technicians who from 1950 onwards would exert their own epistemological criticism⁵, thus enabling us, as responsible and solidary citizens, to question the ethical and epistemic legitimacy of education and training sciences and practices.

Since it is now possible to describe the *Paradigm of Complexity* in all its features, which are carefully argued in the form of an alternative paradigm solidly built and epistemically legitimated, the traditional paradigm – even yesterday prevailing in our academies and so

frequently known as Cartesian-positivist — can then be defined by contrast as the *Paradigm of Complication* (or as the *Paradigm of Reductionism*, as epistemologists prefer). It will certainly not be necessary to reproduce here a description of both unless in the form of a graphic tool (fig. 1) displaying side by side the epistemological (I) and methodological (II) concepts each paradigm privileges in its development.

To be able to fruitfully understand the paradigm of complexity in its contemporaneous cultural matrix all you need, I think, is to restore its roots to our cultures and let us enrich ourselves with the astonishing cognitive experience formed and transformed in the human

adventure melting-pot which is simultaneously the *adventure of human knowledge*: “True newness always springs up in the way back to the origins” as E. Morin reminds us. The paradigm of complexity and the constructivist epistemologies did not emerge in the early 1950 *as a fully armed Athena*. Its teachable and practicable three-millenary heritage is at least as rich (and not less pertinent) as the one claimed by Cartesian-positivist paradigms, still prevalent in the culture of our academic institutions. A discussion on the contributions of G. Vico (1668 – 1744) and Leonardo da Vinci (1453 – 1519) might allow us those *other looks* that can enrich and stimulate technicians’, teachers’ or researchers’ intelligence.

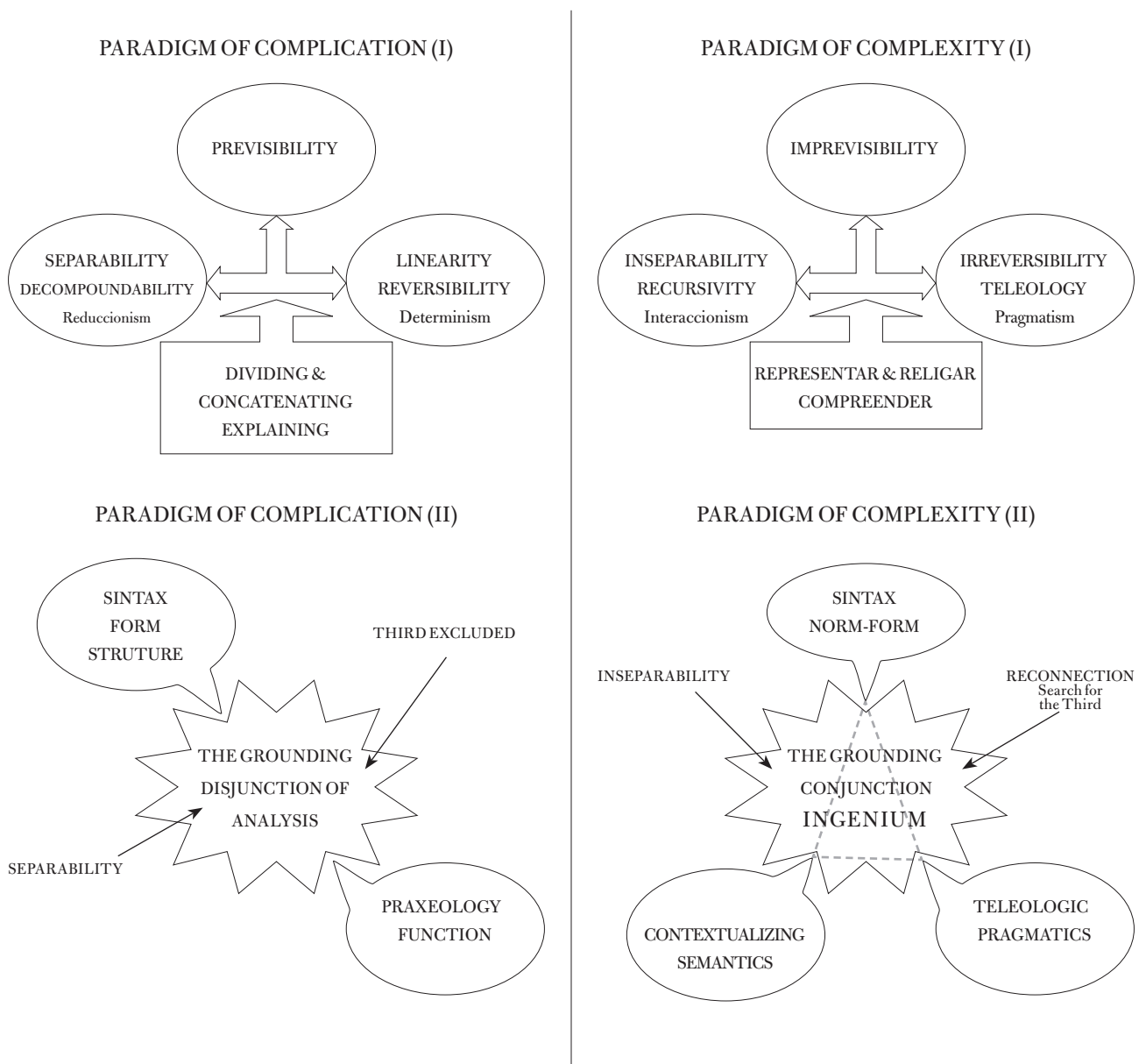


Figure 1
Two Epistemological Paradigms

BACK TO THE “DISCOURSE ON THE STUDY METHOD OF OUR TIME”

Mainly in French-speaking cultures, which are proud of their Cartesian legacy (wasn't the *Discourse on Method* primarily published in French, its use being so rare in 1637 for such a treaty?) we usually forget that from 1708 onwards (when it was being disseminated by all European Universities) this *Discourse* has been subjected to critical, though constructive, discussion fostered by a professor from the University of Naples, Giambattista Vico. A discussion which was invested with a relatively solemnity at the time being, considering it was the opening discourse of the 1708 academic year and it was targeted to all civilian and academic authorities of the reign of Naples and to the students as well. Uttered in latin as traditionally, it was published shortly afterwards and thereafter quoted in its original title *De nostri temporis studiorum ratione*. This title was properly translated into French as *La Méthode des Études de Notre Temps*, a title that values the particularly up-to-date resonance of our times, as Alain Pons so fairly highlights, he who notably translated and presented this other *Discourse on the study method and therefore on the method of rightly conducting the reason*. Allow me to recall some lines of his presentation⁶:

In fact, in this text Vico wonders on the direction studies and thought in general had been taking in Europe, since Descartes (and his followers even strongly) imposed a kind of intellectual dictatorship. On aiming to extend to all knowledge fields the method of geometric analysis, Cartesianism drove young people away from the tradition of rhetoric humanism and tried to repress in them everything that stems from the field of sensitiveness, memory and imagination, which means youth's prevailing faculties. As Vico said in a letter dated 1729, it filled their head with “mouthful words like ‘demonstrations’, ‘evidences’, ‘proven truths’, thus preparing them to enter a men's world made of lines, numbers and algebraic signs”... To this abstract and dry Cartesian world, threatened by what he would call the “barbarity of reflection” later on in his *New Science* (1744) Vico opposes the real human world, in its richness and complexity, the world created and “invented” by the human beings themselves — creation and invention which rely upon all their faculties, particularly upon genius, which is not a mere tool for deduction, but an inexhaustible source of innovation. In this sense, no wonder that present constructivist epistemologists rightly claim they are Vico's followers since they try hard to look for methods and paradigms that allow to better witness the complexity of reality than positivist epistemologists do since Descartes.

On reading Vico's pages – we shouldn't forget they were written three centuries ago – it is easier to under-

stand Teresa Ambrósio's invitation to develop a *new paradigm for 'lifelong' educational policies*. Will it not be necessary to primarily *acquire an open rationality*...?

To briefly illustrate this argument, let's analyse side-by-side the Cartesian principles expressed by Vico who, contrarily to R. Descartes, did not try to progress from *Tabula Rasa*, rather being concerned with enriching himself with contributions both from his contemporaries (whether R. Descartes or Francis Bacon⁷, a man of incomparable wisdom, he would say) and from masters of Greco-Latin tradition, from Aristotle to Cicero.

THE PRINCIPLE OF EVIDENCE, CRITERION OF TRUTH?

The central argument of G. Vico is that of the criterion of truth which all human beings can reasonably and mutually recognize: lets accept what we can effectively do. *Verum et Factum*, “the true is the made”. The argument forces man to intellectual humility and, above all, to a great moral responsibility. It is not because we can pragmatically *make the true* that we can ethically *make the good*. The two-way correspondence postulated Cartesianism, between the scientifically true and the morally good, is a priori arbitrary, and there is no High Priest (even of the positivist religion) who holds *the true truth*, unique and liable to be imposed on all human beings. The criterion of truth imposed by the first of the Cartesian principles, that of the universal evidence of the *clear and distinct in our spirit*, does not manifestly have any imperative evidence. Let us compare the texts:

EVIDENCE by CLARITY R. Descartes	RELEVANCE by FEASIBILITY G. Vico
“The first (<i>Evidence</i>) is never accept as true what cannot be <i>evidently</i> recognised as such, which means carefully avoiding haste and anticipation and incorporating in my mind anything more than <i>what is so clearly and so distinctly presented to my mind</i> that I will never have the opportunity to put into doubt.”	“From all that has been said, it can be concluded that the criterion of truth, and the rule to <i>recognise it, is having made it</i> ; Consequently, <i>the clear and distinct idea we have of our mind is not a criterion of truth</i> , and is not even a criterion of our mind; because by knowing itself, the mind does not make itself, therefore, as it does not make itself, it is not aware of the way it knows itself...” ⁸

THE PRINCIPLE OF DISJUNCTION, METHODOLOGICAL PRINCIPLE?

Questioning the metaphysical criterion (whether platonic or theological) of teachable and practicable truth does not lead to any resignation, on the contrary: very pragmatically, it incites us to open the *superb range of human*

reason, instead of closing it at the farthest, the sharpest and therefore the most harmful end, the one that requires the practice of the *perfect analytical syllogism*. For this, Descartes created an almost sacred formula under the name of scientific analysis or *reductionism of method*, upheld for two centuries as they were consubstantial with science. G. Vico became rapidly aware of the cognitive impoverishment brought about by this exclusive supremacy of division and disjunction and became concerned with opening the above mentioned range by exploring innumerable works of the human mind, from the moment it dedicates itself to firstly and foremost exercising its *Ingenium, a strange faculty of mind, that of reuniting*.

ANALYSIS according to Descartes	INGENIUM according to G. Vico
“The second, (Reductionism) <i>dividing</i> each difficulty to be examined in as many <i>parts possible</i> so as to resolve it in the best way”.	“The mental faculty, which allows a rapid, suitable and agreeable <i>reuniting</i> of separated things, <i>synthetic and opposed to Analysis</i> : permits <i>invention and creation</i> ” (De Ratione, trans AP-NS)
Illustration <i>Disjointed analysis – decontextualizes</i> To describe a tree, it is rationally necessary to turn it into a sawdust heap.	Illustration <i>Conjunct ingenium – contextualizes</i> To visualize a tree, one needs to visualize – or to represent – the background that puts the tree in evidence.

The complete works of G. Vico can be presented, from *De Ratione* (1708) to *Scienza Nuova* (1744), in the form of a masterly illustration of the *Power of Ingenium* (or *Culture of Imagination*, as Ennio Floris⁹ happily said) in the production and study of human knowledge. From Greeks’ *Métis* (or *The Shrewdness of Intelligence*) to Edgar Morin’s *Complex Thought*, and H. Simon’s *Procedural Rationality*, we often find, on the adventure of human knowledge, the same features of the innumerable forms of the pragmatic evolution of the *good customs of reason*: we find the same awareness of risks to be taken in any decision, the same critical capacity to exert deliberation so well and often better than demonstration. Considering that the faculty of reuniting is concerned with understanding by contextualizing, rather than with reducing to a dismountable explanation, shouldn’t this recognition of the creative capacity of the *faculty of reuniting* be in the centre the *studies of our time*, as G. Vico emphasized?

Now I quote with pleasure some lines from *Essays in Tektology* by A. Bogdanov¹⁰, the still hardly known pioneer of *systemic modelling*, a Russian researcher at the beginning of the twentieth century, who deserves much

greater attention. These lines highlight the universal character of the supremacy of conjunction in human experience. “*Conjunction takes first place*”.

It has been established for a long time that in his practical or cognitive activities, man can do only two things: unite or separate.

However, research shows that these two actions, junction and disjunction, do not play an equal role in human activities: one of these functions, the act of joining, conjunction, is precedent, the other is always derived and the outcome, the act of separation, disjunction. In cognition as in the rest.

Unite first, therefore intentionally contextualize: I cannot think of a better way to define ingenium’s role and operating mode.

THE PRINCIPLE OF LINEAR CAUSALITY, DETERMINING CRITERION?

The exercise of ingenium is not restricted to an exercise of spatial contextualization (the representation of this tree in its context *here and now*); very spontaneously, the human mind prefers to manifest itself in multiple temporal conjunctions. Memorization is at the centre of human cognitive activity. E. Floris also highlighted this facet of the activity of ingenium restored to our culture by G. Vico¹¹.

Whilst with F. Bacon memory, imagination and reason were listed according to a hierarchical scale of values where reason is supreme, with Vico the order is broken by ingenium which becomes the polarizing centre for memory and imagination.

Conjunctions among processes are at least as important as conjunctions among the forms which are stable enough to become a *cliché*: nobody can bring a wave breaking on the shore to a standstill, but all the same, people think they can describe it intelligibly. It brings to mind the dream of Mr. Palomar so perfectly described by Ítalo Calvino¹²: at the same time irreversible and recurring, the incessant breaking of the wave is unstoppable by a trifling mode of *long currents of simple reasons* gliding in line, pleading that the movement of a wave does never affect the movement of the waves that follow and is never affected by the breaking of the preceding wave. A basic principle with no legitimating evidence? Why would it be necessary to impose it to reason better?

Aren’t we able to reason through understanding *the recursive conjunction of the end to the means and of the means to the end*? When Leonardo da Vinci drew the formation of whirlpools and the opposing currents that form a watercourse, was he not proposing a judicious measure to interpret these recursive phenomena, which

today are known as the hydrodynamic of non-linear phenomena? Irreversibly, when functioning, the phenomenon under consideration becomes transformed, and being transformed, it functions differently. The subsequent wave, like the one before, transforms the functioning of the wave Mr. Palomar tried to immobilize when he was observing it on the shore. From then on, preferably to invoking a *determining reason* imposing on it a decisive, unique, universal end, couldn't the human mind exercise its ingenium, its *reflective* pragmatic (or groping) *reason*, in the intentional (or critical) exploration of the *field of possibilities that opens up at each step*?

Linear causalism according to R. Descartes	Intelligent pragmatism according to G. Vico
<p>“The third, following the order of my thoughts, beginning with the simplest objects and the more accessible to know, to climb slowly, step by step, to the most compound ones, and presuming order even between those that are in no way precedent on one another. These long currents of very simple and easy reasons, which geometers are in the habit of using to reach their most difficult demonstrations, had given me grounds to imagine that all the things that can fall within the jurisdiction of men’s knowledge follow one after the other in the same way.”</p>	<p>“As if you did not see caprice, the fortuitous, opportunity, and chance, ruling in human things, wanting to carry on through the anfractuosités of life, wanting to follow the method of geometers in a political discourse, means to not employ any ingenium, to say nothing more beyond what is in front of you, to treat one’s listeners like children to whom food is not given without first being masticated.” (<i>De l’Antique Sagesse de l’Italie</i>, 1710, trans. Michelet, 1835),</p> <p>“<i>The order of ideas should follow the order of things</i>” (Scienza Nuova, 44, 238, p. 108).</p>

“Above the subject, beyond the immediate object, modern science is based on the project. In scientific thought, the meditation of the object by the subject always takes the form of a project”: The famous formula of G. Bachelard invites us to recognize the teleological character of the intelligent exercise of human reason, which assumes the recursive inseparability of the interactions of the subject and the object, successively observed and observer. In other words, to endlessly specify the projects or points of view in relation to which we can, on acting, understand our actions.

To illustrate this argument, I can quote some lines from Volume One of *The Method* by E. Morin, taken from a paragraph titled “The problem of the observer-conceptualizer?”

The problem of the observer-conceptualizer – should we say the subject? – appears to us now as essential, critical, decisive. ... Let’s take the whirlpool: it will have to be isolated in its existence and in its own organization, but

also placed in the stream, of which it is an integral part, which in its turn is part of a wild mechanical cycle. The flame can be isolated from a candle, beautiful little engine, wild in its nakedness, civilized in its regularity: the fact is, this is wild engine does not exist unless in function of the civilized candle and the whole flame/candle constitutes a small polysystem, while, in isolation, the flame is an energetically open system, and the candle a closed system; together they constitute something else, multiple and ambiguous, where the candle appears as the reservoir of energy of the flame system, in which the flame can be conceived as the process of disintegration of the candle system, where the candle can be conceived as a small light-producing machine making part of the mega anthrop-social machine. ... Now, in each of these examples, we see the description of the machine change, sometimes radically, depending if the point of view changes.

Hence the problem of the observer/describer/conceptualizer: She should have a method whereby the multiple points of view can be conceived, then progressing from one to the next point of view; S/he should have theoretical concepts which, instead of closing and isolating the entities (physical, biological, sociological), might allow them to circulate productively ... In reality, the development of praxical complexity... is therefore necessary, since it respects the complexity of the real and develops the complexity of thought.

The observer should not limit him/herself to only one method of passing from one point of view to another... s/he still needs a method to reach the meta point of view on the different points of view, including his own point of view of a subject circumscribed and rooted in a society. The conceptualizer is in a paradoxical situation: it is no longer the concept originating from the mechanistic thought of the 17th and 18th centuries, nor that of Wienerian cybernetics. It is a graduated concept and no longer degrading to the being or existence to which it is applied. It revolutionises the old notion of machine. This new concept, instead of hiding the big problems and mysteries, brings them into question.

No wonder then that the exercise of ingenium (contrarily to analysis through linear currents) is to do with our capacity to identify these various points of view, according to which we can represent and interpret the phenomena we consider to be in the flame’s action: from the candle to the classroom or to the organization of a journey. Isn’t this what Teresa Ambrósio reminded us of when inviting us to *acquire an open rationality*?

THE PRINCIPLE OF ENUMERATION, HYPOCRITICAL CRITERION?

Here, we intentionally propose to contrast the fourth and last hypocritical principle of the Cartesian Discourse with an almost official recommendation recently put forward

by the French CNRS (Centre National de la Recherche Scientifique) instead of one of G. Vico’s developments on the *topical-critical method*, with the aim of extolling the opportunity of the *Discourse on the study method of our time*.

The principle of enumeration – R.D	The principle of the projective opening – G.V
<p>“And the last (principle): to make such complete enumerations and such general reviews everywhere, that I would be <i>certain of omitting nothing</i>.”</p>	<p>“Binding yourself to complexity, ... is recognizing that modelling is constructed like a point of view on the real, from which a work of partial and continually adaptable ranking can carried out. ...From this perspective, the exploration of complexity is presented as a project of permanently open work of scientific explanation of the recognition of the dimension of imprevisibility.” Establishment project of the 2002 of the French CNRS</p>

Though this CNRS document was supposed to constitute CNRS researchers’ epistemic-civic reference, unfortunately most still ignore it, not admitting to recognizing *the dimension of imprevisibility* linked to teachable and practicable scientific knowledge. However, this document added¹³:

Only taking into consideration the ‘interactions between the elements’ is no longer sufficient. It will be necessary to develop new instruments of thought (we add: often rather old as G. Vico’s texts well show), which permit the appropriation of the phenomena of retroaction, recursive logics, situations of relative autonomy... It is a real challenge to knowledge, as much in the empirical plan as in the theoretic plan.

Was this not the *challenge to empirical and theoretical knowledge* that the author of *La Scienza Nuova* incited us to accept three centuries ago, on exercising his *ingenium* on the history of the complex formation of the *Wisdom of the Nations*... or of *common sense*? One distinguished professor, a contemporary of G. Vico, D. Luglio, proposed the use of the “topical-critical method at the service of scientific reconstruction”¹⁴. On developing a *concept of Topics as an epistemological instrument*, G. Vico restores the energy of the Topics illuminated by the flame of the Critique. Thus he invites us to pragmatically assume the complexity of any method of scientific research: “But if we covered all the places of Topics with the flame of Critique, then we would be certain to recognize the object... proposed...And in this successive examination even topics is critical”¹⁵.

This brief exploration of one of the sources of the appeal for the restoration of the paradigm of “open rationality, giving life to the places for dialectics, for the recreation of sense, for the permanent revaluation of the long-lasting and historical convictions...” enriches the project of a collective effort to *reopen the studies of our time*, exercising the resources of *ingenium* and helping to understand “the changes of our time and ... the new problems at world level with which we are confronted”, that is, to exercise our *Intelligence of Complexity*. Shouldn’t researchers and technicians in Education Sciences be among the pioneers of the *epistemic work* this task requires today? These questions are as ethical as they are pragmatic.

THE POWER OF “DISEGNO” FOR THE INTELLIGENCE OF COMPLEXITY

The second principle of the Cartesian discourse, which made of the almost exclusive need for analysis (*to split into the greatest number of pieces possible*) the utmost virtue of any teachable science (*everything that can fall within the jurisdiction of human knowledge*) lead to a delay in the identification of: The *details* of the problems that humans should deal with are *a priori* held as data by the analytical method (whence the name in French “*donnée*”, which curiously translates the Latin ‘*datum*’). Moreover, though implicitly, this method is presumed to be unique and independent of the subject who uses it. Precious postulate for all teachers since they all should do nothing but teach the *good methods of resolution or calculation* of the problems given to the students, providing them *a priori* with *the data of these problems*... which are precisely those to which such presumable *data* can be applied.

But the teaching situations and collective actions where the origin of these data is revealed and criticised are rare. However, anyone knows that these *facts*, which are accepted as *data*, to become *facts* they had to *be made*, and that these data representing *the made* (more than facts) had to be *built or modelled* under the form of systems of artificial symbols. G. Bachelard reminds us of this from the first pages of *Nouvel Esprit Scientifique*:

And, contrarily to what is said in scientific life, problems are not put to themselves. It is precisely this the sense of the problem that leaves the mark of the truly scientific spirit. For a scientific spirit, all knowledge is an answer to a question. Without a question, there can be no scientific knowledge. Nothing is isolated. Nothing is given. Everything is built.¹⁶

Is it not then legitimate to wonder about the methods of identification and formulation of the problems that

scientific researchers put to themselves when they are not yet familiar to the Cartesian principles *to rightly conducting their reason and seeking for truth in the sciences* (1637)? G. Vico would gladly quote here the *Novum Organum* by F. Bacon (1620): “What is sought, through the same operation of mind, is what is invented and what is judged”, that is what is represented (or modelled) and what is interpreted (or understood): Human ingenium does not function in a different way when it describes or interprets. Nearer to us, H. Simon would have repeated in 1989 for the programmers who were too inattentive to the elaboration of the data they insisted on treating through frequently sophisticated algorithms: “Modeling’ is neither more nor less logical than ‘Reasoning’”¹⁷.

It is, we believe, in the 6000 pages of the manuscripts of Leonardo da Vinci’s *Notebooks* that we will find an explanatory reply to this question which should always be preliminary: How can we intentionally model the phenomena we are interested in? We know that the scientific work of Leonardo da Vinci is manifestly notable and is concerned with practically all fields of knowledge, sciences of nature and life, sciences of the universe and engineering science. But it is not emphasized enough that it was produced before 1519 by a self-taught person who had worked 150 years before the diffusion of the Cartesian *Discourse on Method*. On reading the pages of the *Notebooks* we can reach a thought in progress and transformation, *we see the thought about the work as much as about a finished work*. When P. Valéry read these *Notebooks* in 1894, he emphasized it very well in his *Introduction à la Méthode de Léonard da Vinci*.

Today we have a better understanding of the key concept by which Leonardo characterized this *modelling method*, thanks to the work of historians of art and science: The “*Disegno*”, which in brief means *intentional design*. Here it is necessary to Anglicise this Italian Word, admirably presented not long ago in its historical context by Joselita Ciaravino under the title of *A Paradoxal Art: the notion of disegno in Italy (15th–16th centuries)*¹⁸. If Leonardo was not the inventor of the *Disegno* it was certainly he who most admirably emphasized its cognitive power.

To restore the symbolic status of this *sixth sense* the *disegno* shows in our all too Cartesian cultures, J. Ciaravino invites us to explore deeply and passionately the texts which mark out the construction and recognition of the notion of *Disegno* in Renaissance Italy, in this “complex context of a cultural renovation that considers the visual arts from a scientific point of view” (2004, p. 15). Since its origin, this word designates “a means of expression placed between practice and theory” (p. 17). But this instrument would rapidly “exceed that which prolongs or reinforces man’s action. In the strongest and most literal sense of the term, it is the ‘incarnation of the spirit’, the ‘materialization of thought’ as A. Koyré would write”(p. 18).

The *disegno* will then become “the place where the fundamental functions of communication and expression are released... via a more intense process of symbolization: to represent an idea by a figure which participates in the universality and the idealization of its object (R. Klein)” (p. 111). One then enters into a fascinating adventure which one still lives today. “It is the concept of reality what is thus put into question: Man finds himself on earth interacting with the nature he interprets, judges, represents at the same time that he rediscovers it. Related to this explicative system about the world, the *disegno* is developed under the aegis of the pre-established analogy between the macrocosm and the microcosm, the universal and the singular, but also as a vision always in process, which betrays the effort made to truly understand this correspondence beyond the recognition of its existence. The *disegno* is of the order of activity, of the potential production of images... But nothing prevents us from seeing it according to the explicative scheme retained to explain the symbol. As an idea’s visible form, the *disegno* can transmit a thought... what is stronger in this renewed conception of *disegno* is the fact that its intellectual value is no longer exclusively metaphysical, but more intrinsic, of the order of its own materiality, as if to be the spirit had the need of a support for its intelligibility” (p. 112).

Here, we cannot prolong this meditation on the interweaving *between pragmatics and episteme* inspired by the *disegno*, a meditation we can easily continue today, safeguarding in some way the symbolic legitimacy of its birth in human cultures, those of the Renaissance of the 14th and 15th centuries that did not learn more than today about the *paradoxes of knowledge*, whether of art or post-Cartesian science.

Otherwise, it is undoubtedly in Leonardo’s writings that we can find the richest perception of *Disegno*’s intelligence of complexity. I. Ciaravino dedicates an excellent chapter to Leonardo’s meditations on the *disegno* in his *Notebooks*. The title of this chapter is one of Leonardo’s formula¹⁹ which we think constitutes the most emblematic motto of complex system modelling.

The *Disegno* (the representation) is of such an excellence that it not only shows the works of nature, but it also produces from it infinitely more varied forms. And therefore, we conclude it is more than one science²⁰...It overtakes Nature because her elementary forms are limited, at the same time that the works that human vision demands from human hands are unlimited.²¹

This restoration of the concept of *Disegno* to our cultures continues nowadays little by little. As an example, we cite K. Basbous’ essay *Avant l’œuvre, Essai sur l’invention architecturale*²² where the main chapter is entitled “Le pari du *Disegno*”: Thus, he indirectly

proposes a good definition of what we mean when we want to present the method of systemic modelling by accounting for the phenomena perceived in their context in a projective way.

The notion of disegno evokes simultaneously a movement of thought, its direction, and the representation in which it is recognized. This ambivalence between intention and design, which would disappear from the French language in the Age of Enlightenment, confers a semantic wealth on the Disegno giving it the right to enter the pantheon of fundamental notions. ... The disegno gains form in a close complicity between the thought that proposes, the eye that witnesses the quality of relationships and begins the displacement of the lines and the hand that accompanies and receives the smallest movements of the spirit (p. 13).

BUT WHAT IS THE WORTH OF “A STUDY METHOD” WHICH DOES NOT CALL FOR AN “EXERCISE OF ETHICAL MEDITATION”?

And what would be the worth of an ethical reflection that would not call for an exercise of *internal epistemological criticism* (J. Piaget) of the teachable and usable knowledge produced by our teaching and research systems.

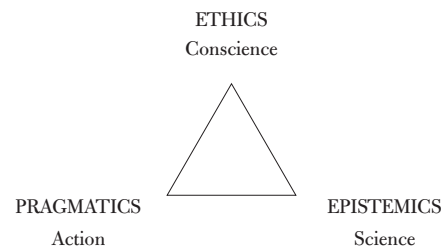
In the heart of these questions, we find the same calls for a *réforme de l’entendement* (or of *understanding*, J. Locke, or of the *intellectus* B. Spinoza) which invites us to reflect on our collective search for a “New paradigm for ‘lifelong’ education policies”. Does this search not stem from the multiple perverse effects, which from now on we can better identify, of the two-way correspondence postulated by Cartesianism between the scientifically true and the morally good?

This scientific (and post-scientific) belief, in which we recognize the arbitrary character again, was perhaps very comfortable, because it legitimised the resignation of the citizens: why do you need to ask yourself at each step whether something is or is not morally good if the scientific experts have a Cartesian method that helps to determine morally good behaviour in a “very true and certain way because reason so determines”²⁵?

An illusionary comfort for the citizens who today know that they need to invert the motto of the scientific experts who guarantee without modesty: “The citizen is blind without the expert’s glasses”. From now on, we do not wish to submit any more to this theo-scientism and we want and we can assume, with humility and pragmatism, our responsibilities in the development of this *New Reform of Understanding*. A reform Edgar Morin often proposes to call *Reform of Thought*: “A way of thinking which is capable of collecting and joining disjointed knowledge is also capable of being prolonged in an ethics of conciliation and solidarity among humans”²⁴: At stake

is recognizing that the “scientific expert is blind without the glasses of the citizen” he also is; Which increases his responsibility and his awareness of risks (and thus uncertainty and imprevisibility) of the fascinating adventure of knowledge in which he finds himself involved in the front line.

We can no longer resign ourselves to such a simplistic image of human knowledge that reduces ethics to epistemics. Not only knowledge commands action. The pragmatic is not *determined* by the epistemic, the pragmatic is *reflected* by the epistemic, who, in his turn, is teleologically reflected by the pragmatic. The scientific paradigm was binary (Epistemics and Pragmatics) separating *those who know from those who do*, without autonomous ethical questioning. The paradigm of complexity is ternary, unceasingly challenging each one to unite Pragmatics and Ethics, obviously through Epistemics.



Here then is ethics with no other foundation than itself, though needing external support: it needs to be fed by faith, to be backed up by anthropology and to know the conditions and situations of practice: ... It is an ethics of understanding...an ethics which is imposed on us both by self-demand and by indulgency towards others and not the inverse...Ethics should mobilize intelligence to face the complexity of life, of the world, of ethics itself²⁵.

Edgar Morin adores reminding us of this conjunction of intelligence (*Let us then work on thinking well*) and ethics (*the principle of the moral*): “The moral is a blaze that needs to be explained by intelligence and intelligence is a blaze that needs to be explained by the moral. Ethics should mobilize intelligence to face the complexity of life, of the world, of ethics itself”²⁶. But he invites us to understand it in its movement, in its dialectic action: «*It is practised*» and so we can understand it as an ethics of understanding which is recognized primarily in its capacity of *working to understand the other*: “An ethics which would enrol us in an earthly fraternity”²⁷.

Is not this courage of intelligence, this wish for lucidity, what we recognize when we try to understand our own history, that mysterious and intelligible adventure which brought us here and now to reflect together on the ethics of understanding in the planetary era? Since the evidence of so many catastrophes (rather lived through

and announced or explained by the media than explanatory for our intelligence) incites us to a wise resignation, let us not persist in *transforming each one of our experiences in science with conscience*: The intelligence of action explaining conscience (ethics) and ethics explaining the intelligence of action (understanding).

Thus, tenaciously and without hope of finishing, let us try to understand the human adventure through the adventure of knowledge. As early as 1932, Paul Valéry, who we believe was one of the most powerful epistemologists of the 20th century, reminded us of this ethical demand of the epistemic asceticism (“the sharpness of intellect”) that gives sense to the extraordinary adventure of humanity still trying to civilize the Planet-Earth-Motherland.

We should keep in mind and in heart the desire for lucidity, sharpness of intellect, feeling of greatness and of risks, of the extraordinary adventure in which the human race got involved, perhaps withdrawing from the primordial and natural conditions of the species, going who knows where!²⁸

Our ethical questions on the sense and legitimacy of each one of our acts, on the sense of human action, in a world we would like to be more and better civilized, make us also recognize the infinite spiral of complex ethics which cannot be understood dissociated from its active practice: how can it be explained and what does it explain?

Ethics is not separable from human experience, which it should clarify, ceaselessly inciting it to transform itself into science, and to transform this science so that it blends with its internal critic, being careful, in the first place, to doubt its own presumed objectivity and recognizing the teleological processes which form it: “Desire for lucidity”, ethics expresses itself through our awareness of the epistemic limits of the science that clarifies ethics and of the pragmatic outlines which ethics clarifies.

It is therefore necessary to understand, step by step, the intelligible and evolutionary complexity of this indivisible ternary link, which permanently joins reflection and meditation in action.

All come together: “The three threads of an eternal garland” – Pragmatics, Epistemics, Ethics. The experience of human action (*ecology of action*) is wisely and skilfully transformed in symbolized knowledge, a science that relies on self-criticism to organize itself teleologically in moral awareness, which is re-clarified and potentially re-transforms the exercise of action and the perception of experience.

Was it action what existed in the beginning (Goethe)? Or was it the verb (System of symbols)? Perhaps the answer is of no interest here since we understand them as

an inseparable whole? Are not perception, sensation, emotion, memorization, actions exercised irreversibly throughout time?

This ring that grounds the understanding of our relationship with the world and with ourselves does not describe our *desire for lucidity*, our refusal to be resigned *to doing without understanding*, since we know that *to try to understand, it is necessary to do* and that *to do assuming the responsibility for our acts, it is necessary to try to understand*. The intelligent action demands the recognition of the third included in the relation action and reflection, between experience and knowledge, between Pragmatics and Epistemics: Ethics, that teleological crucible which is needed to be consciously stimulated so that the experience which ethic clarifies can be transformed into *new knowledge which transforms the knowledge that created it*.

A HUGE EPISTEMOLOGICAL REVOLUTION... OUR FUTURE IS GIFTED WITH ESSENTIAL IMPREVISIBILITY

Our meditations of historical appearance on the exercise of ingenium, this strange faculty of the human spirit which our *lifelong* training systems can inspire to exercise, are they not truly up-to-date when we explore any *study method of our time*, the beginning of the 21st. century? The experience of disegno – or of systemic modelling — and that of ingegno – or pragmatic intelligence — invite us to try and finally bring together “our means of investigation and action with our means of representation and understanding”. Should we resign to that terrible diagnosis which P. Valéry formulated in 1941²⁹? “Our future is gifted with essential imprevisibility ... it is the only forecast we can make... our means of research and action leave our means of representation and understanding well behind”.

We are not unarmed, we can develop our understanding, our capacity to understand, our aptitude to represent ourselves intelligibly, under different points of view, the situations we face and which we also transform. At stake is *mapping out the way*³⁰, which means to develop strategies of elaboration and representation of actions that might as well be informants, capable of generating at least one possible sense for behaviour.

Edgar Morin often recalls: “Complexity calls for strategy. Strategy is all that is left to progress through uncertainty and randomness... The method of complexity obliges us... — to think without ever closing concepts ... — to re-establish the links between what is disjointed ... — to think with singularity, locality, temporality...”³¹

And since complexity calls for strategy, the *study method for the present time* will then be strategy, a unifying and not sectioning exercise of our ingenium.

I have never believed in “explanations” — P. Valéry insists — but I believed that it was necessary to look for “representations” (or *disegno*) on which one could work as if working on a map or as an engineer works on a project, etc. (or *ingegno*) and which might be of help for action.

Therefore, the method will be primarily of representation or modelling, “*Disegno*”, construction of symbolic representations of problems perceived as acts and through acts. We only reason on models. Is it not necessary to first give form to contextualizing models?

It is also interpretation, argumentation or critical and teleological judgement, or simulation, heuristic conceptions of possible solutions “*Ingegno*”, exercise of *reflective reason* or *deliberating reason* rather than just *determining reason*. H. von Foerster questioned: Can we not hold on to reasoning in terms of “in order to” rather than in terms of “because” when we want to answer the question “why...?” which could then be formulated as “what for...?”

Since the field has widened, the relevance of the question “Why not?” becomes legitimate. Why should scientific knowledge accept or reject it? “People usually see things as they are and ask ‘what for?’. I dream about things that don’t exist and ask ‘why not?’”.

Did G. Bachelard not invite us to accept the challenge five centuries after Leonardo da Vinci had invented the helicopter?: “Shall we show that the old philosophy of ‘as if’ is followed by the philosophy of ‘why not’ in scientific philosophy?”. In the world of thought (how) in the world of action (...) we can make reason proceed from ‘what for?’ to ‘why not?’”³².

The recognition of our human freedom capable of intelligently exploring *the field of possibilities* incites us then to an aesthetic effort of *sharpness of intellect*: The more the field of possibilities broadens, the more the field of ethically unacceptable possibilities broadens. We

cannot hide behind the scientific experts to diagnose the morally good under the cloak of presumable scientific truth. We should assume our solidarizing responsibility of “citizens of Mother Earth”. “Ethics should mobilize intelligence to face up to the complexity of life, the world and ethics itself”.

All we have is this weapon, the intelligence of complexity, ingenium, but it is so precious that we should keep it with passion, step by step, pragmatically, obliging us to ceaselessly deliberate, “unendingly facing up to uncertainty and contradiction” and being therefore capable of exercising the human capacity of consciously elaborating our future behaviour. *Human action demands ethics, which demands epistemology, which demands action...*

Is this not what B. Pascal invited us to meditate on the parable of the thinking reed?

Man is but a reed, the most feeble thing in nature, but he is a thinking reed...

Our whole dignity is therefore thought. It is from there that we should raise ourselves and not from the space or time we would not know how to fill. Let us then work hard on thinking well: here is the principle of moral³³.

Is this not what we understand when we exercise our “intelligence of complexity” in the situations in which we intervene? It is always *transforming our experiences in science with conscience* without ever separating *pragmatics, ethics, and epistemics*: “Let us then work hard on thinking well”.

Let us then borrow from Leonardo da Vinci’s *Method* one of its mottos that serves as viaticum to humbly re-elaborate any *study method for the present time*:

A sacred furor of *doing to understand and understanding to do* which transcends any philosophy³⁴

1. Let's go back to the wonderful article with which Teresa Ambrósio concluded the work she directed with F. Lerbet-Sereni, *Chemins de Formation: inscrire dans la société les chemins de l'auto-organisation, de l'autonomie et de l'identité* (Ambrósio, T. & Lerbet-Sereni, F. (dirs.) (2006), *Les sciences de l'éducation à la croisée des chemins de l'auto organisation*. Paris: L'Harmattan, Coll. Ingenium, pp. 185-203).

2. These were the terms used by G. Bachelard to express *the ideal of complexity of contemporary science* (Bachelard, G. (1934), *Le nouvel esprit scientifique*, Paris: PUF).

3. Title of the last chapter of "NES".

TN: NES means "Novel Esprit Scientific" abridged.

4. We know that UNESCO asked E. Morin to carry out a work where the strictly educational components should be valued. This work was supposed to take the form of a brief manual entitled *Les Sept savoirs nécessaires à l'éducation du futur*.

TN: The book in English is entitled *Seven complex lessons in education for the future* (cf. E. Morin, 1999, *Seven complex lessons in education for the future*. Paris: UNESCO).

5. In French speaking cultures of mid 20th century; I cannot help to name at least J. Piaget, Y. Barel and E. Morin.

6. As his translation from 1983 was completely out of print, A. Pons permitted the site *Réseau Intelligence De La Complexité (RIC)* to publish the full text of his translation and presentation in RIC's series "Les Classiques". It is easily accessible at: http://www.mcxapc.org/docs/conseilscient/0511vico_pons.pdf. A. Pons introduced this re-edition in a short preface from which these lines have been extracted.

7. *Novum Organum* emerges in 1620, shortly before Cartesian discourse, 1637. G. Vico underlines one of its main formulas: "What is sought after is invented and judged by a single and same operation of mind".

8. *De l'Antique Sagesse de l'Italie*, 1993 [1710], translated by Michelet (1835), edited by B. Pinchard, GF Flammarion, p. 77.

TN: Translated into English as *On the most ancient wisdom of the Italians* by L.M. Palmer and edited by Cornell University Press.

9. In the conclusion to his thesis, *La rupture cartésienne et la naissance d'une philosophie de la culture dans les œuvres juvéniles de J.-B. Vico*, 1974 (thesis available in the web at <http://alain.auger.free.fr/t310000.htm#debtit>), cf. § 'Une culture de l'imagination' § available at <http://alain.auger.free.fr/t313040.htm#debtex>.

10. A. Bogdanov, 1981, *Essays in Tektology*, translation by G. Gorelik, Inter System Publications, Seaside, Cal., p. 64. The original in Russian and German was

edited in 1921, but it was completely censored in Russian Stalinist times.

11. In § "Une culture de l'imagination" in E. Floris' thesis, available at <http://alain.auger.free.fr/t313040.htm> *Alors que chez Bacon mémoire, imagination et raison s'ordonnaient sur une échelle hiérarchique de valeurs, dont la raison est le sommet, chez Vico leur ordonnance est brisée au moyen de l'ingenium qui devient le centre polarisateur de la mémoire et de l'imagination*

12. "Le modèle des modèles rêvé par Palomar", short tale by I. Calvino published in *Palomar*, 1985, trans., Seuil § 323. This text serves as exergue to the book F. Lerbet-Sereni, dir., 2004, *Expériences de la modélisation et modélisation de l'expérience*. Paris: L'Harmattan.

13. CNRS strategic scheme, 2002, p. 13. Full text in: <http://www.cnrs.fr/strategie/index.htm>

14. D. Luglio, 2003, *La Nouvelle Science, Connaissance, rhétorique et science dans l'œuvre de GB Vico.*, Paris: PUF, pp. 107-11.

15. G. Vico, 1993 [1710], *De l'antique sagesse de l'Italie*, translated by Jules Michelet, presented by Bruno Pinchard, Ed. GF Flammarion, p. 125.

16. G. Bachelard, 1938, *La formation de l'esprit scientifique*, Ed. J. Vrin, p. 14.

17. H. Simon & C. Kaplan, 1989, *Foundations of cognitive science*, M Posner, ed. MIT Press, Chap. 1.

18. Joselita Ciaravino, 2004, *Un art paradoxal. La notion de DISEGNO en Italie (XVème-XVIème siècle)*, Paris: L'Harmattan. See a detailed reading note in: <http://www.mcxapc.org/cahier.php?a=display&ID=642>

19. A formula that had been already emphasized by an expert on Leonardo's work, M. Kemp in 1987, in the catalogue of the exhibition titled "Leonard da Vinci, Ingénieur et Architecte" (p. 131) which was held in 1987 in the Musée des Beaux Arts de Montréal.

20. Reference: CU, f 50 r. In A. Chastel's translation of *Traité de la peinture*, 1987- Berger Levrault, § 20, pp. 89-90.

21. Reference CU 15 r. v. (A footnote in Montréal edition refers: CU, f.116 r). In A. Chastel's translation of *Traité de la peinture*, 1987, Berger Levrault, § 74, p. 152.

22. Karim Basbous, 2005, *Avant l'œuvre, essai sur l'invention architecturale*, Paris: Les éditions de l'Imprimeur.

23. One should re-read and meditate on the famous parable of the Cartesian discourse about a "Traveller lost in forest" from which we transcribe the last line: The reason Descartes talks about is that of perfect silogism built on a formal axiomatics showing no sign of evidence and rationally imposing itself to human beings, thus determining... their behaviour in a considerable way.

24. Edgar Morin, 1999, *La Tête bien faite. Repenser la Réforme - Réformer la Pensée*. Paris: Ed. du Seuil, p. 111.

25. Edgar Morin, 1994, *Mes démons*, Ed. Stock, p. 136.

26. Volume VI of *La Méthode* de Edgar Morin, *Ethique* (2004, Ed. du Seuil), particularly its excellent

chapter IV, precisely titled “Ethique de la compréhension” (pp. 121-139), where the following conclusion can be read: “Understanding does not mean to understand everything, it also means to recognise that the ununderstandable also exists” (p. 139).

27. Edgar Morin, 1994, *Mes démons*, Ed. Stock, p. 126.

28. Paul Valéry, 1932, Conclusion of *La politique de l'esprit, notre souverain bien*, in O.C. Pléiade I, p. 1040.

29. P. Valéry, 1948, *Vues* (compilation of old articles), Ed de la Table Ronde.

30. M. J. Avenier, dir., 1992, *La stratégie, chemin faisant*, Ed. Economica.

31. E. Morin (with M. Ceruti and G. Bocchi), 1991, *Un nouveau commencement*, Ed. du Seuil.

32. G. Bachelard, 1934, *Le Nouvel Esprit Scientifique*, Paris: PUF, pp. 10-11.

33. B. Pascal, 1963, *Pensées* (Ed Lafuma), Paris: Seuil, pp. 200-347.

34. This formula belongs to P. Valéry when he re-read, in 1938, a new full edition of the English translation

of Leonardo's *Notebooks* (Published in *Vues*, 1948, Ed. de la Table Rond).

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Translated by Filomena Matos

Le Moigne, Jean-louis (2007). **The intelligence of complexity: Do the ethical aims of research and intervention in education and training not lead us to a “New discourse on the study of our time”?** Conference given at the Faculty of Psychology and Educational Sciences of the University of Lisbon, on 15th February, 2007. *Sísifo. Educational Sciences Journal*, 04, pp. 115-126
Retrieved [month, year] from <http://sisifo.fpce.ul.pt>