On the Road IV.3

The dialogue between science and art in the construction of knowledge: a proposal for higher education

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CONNECTING THE DISCONNECTED. SCIENCE AND ART IN THE KNOWLEDGE ADVENTURE

The challenge facing a new systemic, complex paradigm in our universities is to connect the disconnected. To do this we need to escape from the maze created by the separation between elements whose original vocation was and continues to be unity in diversity.

Addressing the relationship between science and art requires these two forms of knowledge to be understood as the two extremes of a continuum. The nomothetic sciences occupy the position of the highest possible objectivity, whereas art occupies the position of minimum objectivity and maximum subjective involvement. Located in between are the idiographic sciences, with philosophy, in its own right, occupying the midpoint of the continuum.

The possible link between them all is to be found in, for example, María Zambrano's concept of *poetic reason* – the wisdom born from the merging of the visible and the invisible and the encounter between intuition, creativity and reason. Poetic reason incorporated in knowledge theory is reconciliatory: it reintegrates and restores the human unity long lost to European culture (Zambrano, 1987, p. 54).

THE ASSUMPTIONS OF SCIENCE

Let us begin by talking about science. To build scientific knowledge in any of its variants, we must be as objective as possible, yet aware that there will always be an element of subjectivity in this knowledge. This necessary application of the precautionary principle to our conclusions is no less than a lesson in humility. As mentioned above, objectivity varies between the nomothetic (natural) sciences and the idiographic (social and human) sciences. In either kind of science, however, we are forced to acknowledge what is undoubtedly one of the greatest contributions of contemporary epistemology: the knowledge that knowledge has limits.

One of the most important of these limits is a blind faith in the congruency and rigour of mathematical language. In 1932, Gödel stated that it was impossible to prove the congruency of a mathematical system from its axioms and that theoretical mathematics was therefore open to uncertainty and indecision. This does not mean we have to renounce mathematical description, but we do need to recognize that even the rigour of description has its limits and that uncertainty flourishes even where we thought there was certainty (Mayer, 2002, p. 71).

Not to feel very secure in our certainties seems to be, then, the road that lies ahead. This does not mean we must deny scientific truths, but we must recognize that they can be superseded and that our knowledge is incomplete. Indeed, complexity invites us to take account of the fact that the greatest certainty of the 20th century is the impossibility of eliminating uncertainty not just in actions but also in knowledge (Morin, 2003, p. 72).

This change in vision, this opening up of perspective that comes from complex thought, suggests that our universities, in their task of explaining the world, need to rely on an equally complex approach, based on interdisciplinary and transdisciplinary models that not only link the various sciences but also link these with art and ethics. It is a question of gradually integrating scientific knowledge with the arts of living, philosophizing and imagining, and of reconstituting compartmentalized knowledge as an integrated whole. Boundaries no longer separate; they are interstitial areas that promote more fruitful encounters. It is a question of accepting the proposition that 'life is a work of art' as a statement of fact, not as an assumption or an admonition (Bauman, 2008, p. 68).

With a view to seeking points of encounter, let us examine some of the features of science and art, taken as the two extremes of a fuzzy continuum. Science, in its most nomothetic version, has four fundamental pillars:

1. The search for the greatest possible objectivity.
2. The establishment of laws or general principles.
3. The need for intelligibility.
4. The principle of falsifiability or dialectics.

The first three laws express, in a synthetic or compressed manner, the systems or phenomena they represent. Thus, the more compression, the better the understanding. As for the fourth law, knowledge, being scientific, runs the risk of being falsified, that is, of being dismantled by new experiences, theories or laws that better explain a phenomenon.

However, not even the faithful application of these principles can lead to irrefutable certainties. Science can point us to closed-off directions, but never to mandatory directions; as Max Weber said, science tells us how to get from one place to another, but it cannot tell us where to go.

Thus, when science lays claim to the universality of its laws or principles, we need to remind ourselves that the laws of nature are fundamentally probabilistic: they express what is possible, not what is true (Prigogine, 1997, p. 109). As Bateson (1982, pp. 24, 26) pointed out, science may improve or refute, but it 'can never prove some generalization'; because it investigates but cannot prove, its truths are, by definition, temporary and susceptible to improvement. Herein lies one of the outstanding features of the scientific endeavour: it is probably the only human activity that is based on the systematic recognition of errors and on criticism and improvement.

THE ASSUMPTIONS OF ART

Art is another form of knowledge, different from but complementary to science, and vital to accounting for the world in all its complexity. With art it is possible to feel, grasp, express, imagine and communicate complexities that are incomprehensible from a scientific perspective (Wagensberg, 1985).

Art, like science, is inspired by wonder, questioning, doubts and fears, but it departs from a different hypothesis and seeks results that cannot be objectified. In essence, art is based on the principle of the subjectivity and communicability of artistic creation. Beyond its revelatory function, art as film, literature,

painting, and so on enables us to create, and not just know, reality. It is, in fact, the only human activity where there is creation in the pure sense of the word. For this reason it is said that art imitates nature.

Paul Klee (1976) said that art makes the invisible visible. Art enables us to see what is there but is not immediately evident. It facilitates a reorganization of the imaginary with the real. It enables us to connect reason to feelings, intuitions and emotions.

In contrasting art and the artist with science's drive for universality (the construction of general laws and principles), we see that art, unlike science, seeks the expression of what is diverse, unique and unrepeatable. The work of art is not subject to any law, but rather creates a law unto itself. In that sense it is original.

With regard to the necessary scientific separation between the observer and the observed, in art, unlike science, this is based on the artist's involvement with his/her work, whether from a position of distance or creative silence or when the artist as creator-sender seeks communication with the interpreter-receiver. This link reflects what is known as reception or reader-response theory: the viewer, reader or listener is dynamically involved in the realization of a work of art and his/her answers and interpretations are an essential part of its meaning (Steiner, 2001, p. 72).

As for the scientific notion of intelligibility (and compression), art does not attempt to reduce complexity; rather, it accepts, expresses and transmits complexity. Art derives from the complexity of the artist and his/her unique perception of the complexity of the environment. A work of art is not constructed once and for all (like laws and theories) but is built each time anew, and explanation is left to the unique encounter with the interpreter. A work of art is, therefore, always alive and never finished.

Finally, because it lays no claim to the truth, art, unlike science, is not falsifiable. A work of art is, by definition, evocative; unlike science, which is denotative, art is connotative. This means that a work of art can be recreated, that it can have more or different meanings to those attributed to it by the artist (it is one and manifold at the same time, hence its complexity). Art is thus a sphere where diversity flourishes, where initial chaos gives rise to a certain order.

If, as has been said, the artist is someone who brings order to a disordered cosmos, a work of art functions as a dissipative structure that self-organizes in non-equilibrium conditions and resists increasing entropy (Novo, 2002). The emergence of order from initial chaos is an experience familiar to every artist, from the moment the act of creation commences until the moment when – as expressed by Heidegger (1973) – 'towering up within itself, the work opens up a world, and keeps it abidingly in force.'

SCIENCE AND ART AS COMPLEMENTARY FORMS OF KNOWLEDGE

As part of a new paradigm of complexity, our universities today have the opportunity to view science and art, not as in conflict, but as complementary forms of knowledge and language. As a starting point, we can accept, for example, that our knowledge of even scientific reality is full of exercises in intuition and even metaphor – a semantic transposition mechanism that confirms that meaning is a semantic burden that can be shifted (Chamizo, 1998). Therefore, recognizing the imprint of metaphor across different fields leads us to accept that creativity, imagination and intuition, as constitutive qualities of art, can be recognized and appreciated in other systems of understanding the world (Rábade, 2002, p. 61).

The acknowledgement, then, that our knowledge of even scientific reality is replete with intuition and metaphor opens doors to a model of transdisciplinary knowledge in which the guiding metaphor for truth is not an incomplete attempt to capture or map reality but the fact of living itself (Vattimo, 1997). The act of knowing is shaped, not just by its scientific dimension, but also as a moral and poetic act. As Hölderlin (1977) appropriately stated, man dwells poetically on this Earth.

The reconciliation of science and art, facilitated by the emergence of a new paradigm, is undoubtedly an innovative approach that can and is functioning as a proposal for higher education in the 21st century, a road that leads towards a new vision of the world that no longer appears to be a prosaic program-operated machine, but a complex interweave of intricate relationships. The encounter between science and art will, for once and all, break down the walls raised by modernity between subject and object, humans and the biosphere, cognition and emotion.

Developing an educational model for our universities based on these premises is an opportunity to recover what seemed lost: the unity of knowledge. In this context, the transdisciplinary fusion between scientific and artistic vision opens the door to a model of knowledge (and of teaching and learning) based on the recognition that science and art are not separate, watertight compartments; instead, the points of encounter and reciprocal influences between them are many. Science solves problems, improves our quality of life and enhances human and social development. Art shows us how to imagine, create and interpret reality beyond the limits of reason. Combined, science and art can build and deliver the innovative and creative systemic knowledge necessary to move towards sustainability.

But the encounter between science and art goes even deeper. It occurs within the emerging post-Cartesian paradigm that recognizes and validates other forms of reasoning and of knowledge that, throughout history, have formed the basis for sustainable living. In a decisive transition from fragmentation to cohesion, it articulates what for centuries have been disconnected, namely, logos and pathos.

Higher education in the 21st century can thus be encouraged to embrace the certain and the uncertain and to accept the complexity of the world. In many cases, this is already happening. We have the conceptual, ethical and artistic tools that will enable us to redraw our paths. Our institutions have endless possibilities for ensuring that education – the adventure of teaching and learning – is a point of encounter and a celebration of diversity and of a scientific and artistic awareness or conscience.

TOWARDS A SYSTEMIC AND COMPLEX HIGHER EDUCATION MODEL

It is evident that we need to rethink higher education both in terms of epistemological criteria for generating and constructing knowledge and in terms of methodological approaches and the organization of university structures in the 21st century.

The challenge of educating from a paradigm of complexity – in which scientific, ethical and artistic visions are given equal weighting – may seem well nigh impossible, given the changes required; yet groups that have embarked on this task confirm its viability and relevance. Promoting a culture of complexity would lead to an exploration of issues relevant to the educational process but, unfortunately, often absent from the classroom. For whom and with whom do we build knowledge? What are its limits? How do we identify and create links? How can we make decisions in risk societies? How can we educate in socially and environmentally responsible action?

To do this, we need to step beyond the kind of simplistic thinking that is incapable of conceiving a conjunction between the one and the many (*unitas multiplex*), and develop a more complex thinking that can absorb knowledge from many different dimensions. But from the outset, we need to be aware that complete knowledge is impossible: one axiom of complexity is the impossibility, even in theoretical terms, of omniscience. Complex thinking implies the recognition of incompleteness and uncertainty (Morin, 1994, p. 23).

Accepting these proposals means developing an open epistemology in which object and subject are no longer isolated entities and where the norm is not perfect balance but order from fluctuation; the play between balance and imbalance, irregularity, randomness or uncertainty (Novo, 1997, p. 39). This view greatly complicates the educational task, but it should not be taken as an impediment. It should, rather, be viewed as a stimulus that guides teaching and learning for integrated knowledge, built, like any living process, through advances and setbacks and through impulses and attractions between and across disciplines.

Developing this kind of knowledge is no easy task. Deepening specialist knowledge is unavoidable in a scientific panorama as complex as that of today, where the hold of discipline-based organization is powerful. We can, however, aspire to interdisciplinarity – recognizing that we can be interdisciplinary precisely because we have disciplines (Toulmin, 2003, p. 208). But it is crucial, not to mention truly innovative, to create the mechanisms that will establish and take account not only of epistemological relationships and links but also of social, ecological and moral interactions. Analysing the parts while failing to reconstruct the whole is no longer a valid approach. The interdisciplinary model does not posit an overnight dismantling of educational systems, but it does require that compartmentalized and disciplinary knowledge not be confused with reality. As Paul Klee (1976, p. 79) said, the knowledge of laws is precious, provided we guard against any simplification that confuses naked law with reality.

FROM EPISTEMOLOGY TO METHODOLOGY: SOME KEYS TO CHANGE

A prerequisite for progress is the establishment of cohesive interdisciplinary teams composed of professionals from different knowledge fields combining their efforts in the common endeavour of achieving an integrated view of research or teaching topics. But we must bear in mind that interdisciplinarity is not the product of a major science plus subordinate sciences; rather a primordial feature of this approach is that all disciplines are given the same rank (Sinaceur, 1983).

Knowledge, perfect or imperfect, can thus be woven together in an interstitial area that effectively acts as an intellectual no man's land. It is important to recognize that this knowledge at the boundaries (Gusdorf, 1983) poses its own challenge: the need to locate conceptual and linguistic isomorphisms above and beyond the simple juxtaposition of knowledge or proposals.

Interdisciplinary teams and processes are most effective when their encounters take place under the same paradigmatic umbrella and when cooperation occurs with a common vision of knowledge, of science and of what it means to create and share knowledge. When this happens, a transdisciplinary product emerges from a common framework for understanding the world that is based on the use of an integrating meta-language.

We need to underline the need for higher education to encourage the contextualization of knowledge. A problem, a system or a fact is only intelligible when it is related to its environment. This relationship is much more than mere dependency: it is constitutive of the system. Logically, the system cannot be understood without including the environment – simultaneously intimate and strange, and simultaneously part of and outside the system. This linkage is absolutely crucial (Morin, 1994). Indeed, in the various manifestations of our educational work, we should always remember that 'all communication necessitates context, that without context, there is no meaning, and that contexts confer meaning' (Bateson, 1982, p. 16).

A welcome practice, in my opinion, and one that is becoming increasingly widespread in the university system, is that of opening up to the real world. The Bologna Process for the construction of the European Higher Education Area encourages approaches in which universities relate to their environment. But this also means that universities must create knowledge that reflects the interests, problems and needs of the communities in which they operate. This 'local' aspect, in conjunction with 'global' aspects, challenges universities to practise 'glocal' thinking.

In adopting a systemic approach to addressing issues, we need to emphasize relationships, starting with internal relationships in our own higher education models – which, in my view, need urgent reassessment. This requires developing seminars, postgraduate programmes and interdisciplinary courses that enable students to reconstruct holistic knowledge from knowledge parcelled out in different disciplines. This is a matter of either rebuilding the whole from the parts (in full awareness that the whole is both more and less than the sum of the parts) or acquiring knowledge of the parts starting from the whole. Whatever the approach, what is fundamental is to develop a holographic model in which the whole and the parts are inextricably linked.

Carrying out these and other innovations requires imagination, creativity and congruency from the academics who teach and organize knowledge in the higher education system. A major challenge is managing resilience. Provided we understand sustainability to be the ability to create, innovate, test and ensure the adaptability of a system (in this case, higher education) in changing socie-

ties, the principle of resilience will guide us in encouraging innovations, minimizing inhibitions, reducing resistance to change, enhancing training and information networks, adapting timelines to realities and ensuring lasting change in the medium and long term.

Here again the artistic and ethical dimensions come into their own. The innovations required in our universities need to be addressed, in my opinion, by adopting a multifaceted view. We need to recognize that any problem has not one but many solutions, to foster the joy of discovery in students (Feynman, 2000) and to bring values and ethical principles into play that minimize the allure of scientific neutrality – as blind as it is impossible. Our universities need to understand that any effort to imagine a different, sustainable world is at the heart of any educational process (whatever its content) and is, of necessity, linked to creativity and moral reflection. We need to encourage and stimulate, not merely observe, experience and do, and, above all, we need to foster a creative imagination and the development of ethical criteria on what to observe, what to experience and how to do.

Only in this way can we move ahead towards the kind of education that will bring about a transformation of society and humanity. In this task, we are already closer to being able to make proposals for sustainable living and contribute to the latent challenge, which is to master our mastery, as Morin (1984, p. 54) expressed it. We need, ultimately, to revitalize one of the goals of higher education, which is to seek true wisdom, not just information or knowledge.

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