

UNITY OF KNOWLEDGE AND TRANSDISCIPLINARITY: CONTEXTS OF DEFINITION, THEORY AND THE NEW DISCOURSE OF PROBLEM SOLVING

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Summary

When Roderick Lawrence and Carole Després introduced a special issue of the journal *FUTURES* on the topic of transdisciplinarity in 2004, they called it a word “à la mode.” This historical overview examines the growing currency and major definitions of the word. While broad in scope, it emphasizes the theme of EOLSS—sustainability. The earliest scholarly definition was a common system of axioms for more than one discipline. From the beginning, differing strands of interest were apparent: one focused on internal dynamics of science, the other on external social purpose. Over time, the concept has appeared in multiple domains and become associated with overarching paradigms, such as structuralism, general systems, Marxism, feminism, and

sociobiology. The concept is also a descriptor of synoptic fields, and a new transcendental form of science. It is associated with educational reform and critique of knowledge. And, recently it has become aligned with sustainability in a new discourse of problem solving.

The core idea of the new discourse is that all sectors of society must cooperate to solve complex problems in both the North and the South. The ancient quest for unity is replaced by integrative practices that recognize the multidimensionality of reality. Comparable to the concept of "post-normal science", transdisciplinary research focuses on unstructured problems with complex cause-effect relationships. Inclusion of normative social values also dismantles the expert/lay dichotomy, fostering new partnerships between the academy and society.

The current heightened interest in transdisciplinarity is occurring in the midst of significant changes in the character of knowledge. New approaches have altered disciplinary relations, interdisciplinary fields have evolved, and new hybrid communities are addressing tasks situated at the boundaries of traditional structures. The values of plurality and relationality inherent in new social and cognitive communities beckon a truly human science of sustainability that incorporates normative issues and humanistic approaches. New forms of education are emerging as well, going beyond interdisciplinary programs to include problem-oriented research with stakeholders. Ultimately, a new "transdisciplinary attitude" is needed, capable of sensitizing all social actors to more comprehensive, inclusive modes of knowing and acting in the world.

1. Definition

At the simplest level of definition, the prefix "trans" denotes something that goes across, beyond, or through. Whether talking about the Trans-Siberian railway, a transcendent being, or a social transformation, something further or greater is at stake. Etymology furnishes more precise clues. The Oxford English Dictionary and many scholars trace the origin of "transdisciplinarity" to the first international conference on interdisciplinarity, held September 7-12, 1970 in France. Sponsored by the Organization for Economic Cooperation and Development (OECD), the event was a seminar on the role of "pluridisciplinarity" and "interdisciplinarity" in the modern university.

This point of origin remains prominent. However, transdisciplinarity has been traced to other sources. It is linked with Gibbons et al.'s theory of Mode 2 knowledge production and Basarab Nicolescu's theory of an open structure of unity in complexity. It is a label for comprehensive frameworks, such as general systems theory, Marxism, and feminist theory. It is a descriptor of broad fields, such as philosophy and area studies. It designates a reformulation of the curriculum and a team-based, holistic approach to health care that synthesizes specialist views of the "whole" patient. It connotes a general capacity or value, and, increasingly, a new approach to problem solving.

The epistemological problem that transdisciplinarity presents is the search for unity. The quest is long-standing, spanning ancient Greek philosophy, the medieval Christian *summa*, the Enlightenment quest for universal reason and project of the

L'Encyclopédie, Transcendentalism, Umberto Eco's speculation on a perfect language, the Unity of Science movement, the search for unification theories in physics, and E. O. Wilson's theory of consilience. Dubbed "euphoric interdisciplinarity," the search for a universal explanatory theory has focused on unity of knowledge and unity of the world (Eisel 1992, 246 in Klein 1996). Today, the premise of universal knowledge is widely disputed, though transdisciplinarity still implies the possibility of holism (see, *Unity of Knowledge in Transdisciplinary Research for Sustainability*).

The idea of holism has circulated in biology, physics, social theory, systems theory holism (see, *Holism in the Sciences*), and philosophy (see, *Philosophical Holism*). Any metaphor, concept, or theory—a material object, a social phenomenon, or an ecosystem—implies a whole that cannot be adequately explained by reduction to the properties of its parts. Nor is it the simple sum of those parts. At a colloquium on the concept of transdisciplinarity held in 1998 at Royaumont Abbey in France, David Rapport suggested it is akin to Arthur Koestler's idea of the "holon", rather than the classical formulation of unity. Koestler recognized the contradictory properties of being both a whole and part of larger wholes. Relations are embedded within a hierarchy of systems, characterized by a complex interplay of factors and relationships at each level and point of intersection. (See *Royaumont* for all references to the colloquium.)

Broadly speaking, transdisciplinarity is involved in a series of shifts that become apparent in this historical sketch of major definitions and discourses.

- from segmentation to boundary crossing and blurring
- from fragmentation to relationality
- from unity to integrative process
- from homogeneity to heterogeneity and hybridity
- from isolation to collaboration and cooperation
- from simplicity to complexity
- from linearity to non-linearity
- from universality to situated practices.

1.1 Etymology and Typology

Representatives of OECD-member countries who met in 1970 did not claim to be exhaustive. Yet, the post-seminar book became the most-widely cited authority on interdisciplinarity for decades. The book contained reports on discussions, survey data, model programs, and a precedent-setting typology of terms. Some participants wanted "transdisciplinarity" to be in the title of the seminar. Organizers felt that "pluridisciplinarity," connoting juxtaposition of disciplines, and "interdisciplinarity," connoting integration of concepts and methods, accommodated the variety of educational systems worldwide. Yet, the seminar adopted a basic definition of transdisciplinarity: "establishing a common system of axioms for a set of disciplines," such as anthropology defined as a science of humans. Its exact nature was, and still is, a matter of disagreement. Three participants developed the concept further, revealing two major strands of interest. Jean Piaget and Andre Lichnerowicz focused on internal dynamics of science, while Erich Jantsch emphasized external purpose (*Interdisciplinarity* 1972).

1.1.1 Internal Dynamics

Piaget and Lichnerowicz regarded transdisciplinarity as a conceptual tool capable of producing interlanguages. Piaget treated it as a higher stage in the epistemology of interdisciplinary relationships. As a psychologist working on the psychogenesis of mathematical and physical concepts, he was interested in structural interactions or reciprocities between specialized projects. He believed the maturation of general structures and fundamental patterns of thought across fields would lead to a general theory of systems or structures.

Piaget was mindful of earlier attempts, including the Unity of Science movement of the 1930s and 1940s. The effort to integrate scientific statements, with all their discrepancies and difficulties, into a common foundation and terminology for the philosophy of natural and social sciences was influential. Ultimately, though, it became an object lesson in the problem of reductionism. Piaget focused, instead, on reciprocal assimilations, anticipating a transformative relationship between the living organism and physical-chemical structures. The physics of the inanimate were known at the time but not sufficiently understood in a body engaged in the process of living or the nervous system of an individual in the process of thinking. When physics encompassed biology and psychology, he envisioned, it could become a truly "general" science, and "full transdisciplinarity" would be reached.

Andre Lichnerowicz, a physicist and mathematician, was also interested in the internal development of science, though he promoted the "Mathematic" as a universal interlanguage. The Mathematic was a composite of deductive sciences of logic, mathematics, and information theory. Lichnerowicz dubbed his structuralist vision a discourse "without background noise." In addition to a coherent common language, it promised the possibility of finding common elementary structures. The Mathematic was not just an auxiliary tool. It was an instrument of thought. Lichnerowicz regarded the development and adaptation of theoretical activity as a homogeneous process throughout science and technology, a process that assumed and even imposed transdisciplinarity.

1.1.2. External Purpose

In contrast to Piaget and Lichnerowicz, Erich Jantsch focused on a common human and social purpose. Like Piaget, Jantsch treated inter- and transdisciplinarity as organizational principles, but he posited a higher-level coordination of activities. Jantsch's hierarchical model of the system of science, education, and innovation moved from empirical, pragmatic, and normative to purposive levels. He envisioned all disciplines and interdisciplines coordinated by a generalized axiomatics. Interdisciplinary linkages were still needed, producing integrated "blocks" of science such as biochemistry. Yet, they were not enough. The ultimate degree of coordination required mutual enhancement of epistemologies, effecting Ozbekhan's notion of "syneptic" cooperation.

The effects would be pervasive. New types of institutions would be needed and a new form of education capable of fostering the capacity for judgment in complex and

dynamically changing situations. In science, technology and industry, long-range thinking would replace short-range thinking. In cities and the environment, negative effects of technology would be reversed and a systems approach would replace linear modes of problem solving. The university would also gain a new purpose. It would assume a strategic leadership role based on feedback among three types of units: systems design laboratories, function-oriented departments, and discipline-oriented departments. Notions of "value free science" and "neutral" technology would dissolve, and normative and psycho-social disciplines, such as law and sociology, would lose their abstract disciplinary identity, becoming aspects of social systems design.

Jantsch conceded that transdisciplinary coordination of a multi-level, multi-goal system was an ideal beyond the complete reach of science. Piaget, likewise, admitted it was "still a dream". Yet, Jantsch urged, the concept of transdisciplinarity could guide science in its development. Of the three definitions, Jantsch's model became the most influential. It has been adapted as a conceptual framework in fields as diverse as fisheries and school education. The intellectual and socio-political climate of the times is evident in all three definitions. Piaget and Lichnerowicz were structuralists. The organizing languages of Jantsch's model were logic, cybernetics planning, general systems theory, and organization theory. Demands for educational reform were also on the minds of seminar participants, and the changing character of knowledge was acknowledged in Jantsch's proclamation of increasing multi- and interdisciplinarity. And, calls for a new relationship between science and society echoed in critiques of traditional notions of "objectivity" and "progress."

In the ensuing decades, both internalist and externalist strands of argument continued to be developed and new meanings emerged.

1.2 Expanding Definition

Two scholars of interdisciplinarity in the USA extended the OECD typology, highlighting the varied particularizations of the concept.

1.2.1 A Philosophical Perspective

A contemporary philosopher and editor of a book on interdisciplinarity in higher education, Joseph Kockelmans (1979) defined transdisciplinarity as an all-encompassing framework that addresses the problem of integration and need for a common conception of the world. This discussion has tended to center on educational and philosophical dimensions of sciences, though Kockelmans also described transdisciplinary "work" as the effort of a group of scientists to make education and research more socially relevant or to focus on concrete problems arising from society. In either case, they would not simply address a particular problem but develop an overarching framework.

Kockelmans was mindful of the plurality of definition. Some authors associate transdisciplinarity with the unification of sciences concerned with humans, seeking a theoretical framework for all empirical research in behavioral and social sciences. Others focus on unity of worldview, seeking a common conceptualization of culture and

the roles of science and education. Kockelmans identified four major viewpoints. The first group brands interdisciplinarity a fashionable approach to reorganizing higher education that fails to address the meaning of the whole of human existence. A second group is more optimistic, calling for renewed philosophical reflection on the presuppositions and unity of theoretical knowledge in all disciplines. A third group appeals to the social relevance of higher education, calling for a reorganization of theoretical knowledge to address basic problems of the modern world and restore the older meaning of "teaching" versus "training." A fourth group focuses on the meaning and function of science in the modern world.

In commenting on the fourth view, Kockelmans called for an all-encompassing philosophy of science that concerns itself with essential aspects of all sciences and disciplines. In the history of searches for unity, interests have varied, ranging from a religious view to a universal philosophy or a common ideology. The proliferation of specialized disciplines and conceptions of the world today means unity does not follow automatically from a pre-given, presupposed order of things. It must be continually "brought about." Transdisciplinarity, Kockelmans proposed, is not a construct but an "attitude," oriented toward comprehending contributions of all disciplines in a critical, philosophical, and supra-scientific reflection.

1.2.2. Expanding Exemplars

Like Kockelmans, Raymond Miller (1982) defined transdisciplinarity as an overarching framework, though rejected Kockelmans's call for an all-encompassing philosophy. It was, he allowed, a laudable goal but an impossible ethical quest. In presenting a typology of interdisciplinary approaches in social sciences, Miller defined transdisciplinarity as "articulated conceptual frameworks" that transcend the narrow scope of disciplinary worldviews. Holistic in intent, they propose to reorganize the structure of knowledge, metaphorically encompassing the parts of material fields that disciplines handle separately. All syntheses, Miller cautioned, are not identical. Some proponents claim to replace existing disciplinary approaches. Some propose alternatives and others sources of coherence for working across disciplines. Proponents also claim differing types of isomorphism with the "real" world they purportedly represent and greater or lesser receptivity to quantitative manipulation and empirical application.

Leading examples include general systems, structuralism, Marxism, evolution-sociobiology, phenomenology, and policy sciences. Miller's comparison of the first four examples reveals both similarities and differences. The first three approaches share the assumption that nature is interrelated and interdependent. Structuralism and general systems share an added interest in levels of isomorphic structures with laws of transformation and structures (or systems) manifesting homeostatic self-regulation and holism. General systems theory has been the most prevalent. It has been imported into many disciplines and adopted in research on global change and sustainability (see, *Systems Analysis and Modelling in Transdisciplinary Research*). Structuralists seek underlying formal "deep" structures that reflect a cognitive, biologically-derived pattern of human thought. Marxism, in contrast, emphasizes material forces of production in the formation of human societies, including symbolic manifestations. Marxists fault structuralists for not dealing with empirical observables, especially the Levi-Strauss

variant. General systems has also been faulted for being too mechanistic, structured, prescriptive, cognitive, open to misuse, and not translatable into mathematical relationships.

Sociobiology, a newer example, applies principles of natural selection and evolutionist biology to the study of animal social behavior. Promoted as a "new synthesis," sociobiology is rooted in the theory of genetic inheritance, which holds that genes are selected from a variable pool in interaction with the environment over time, providing maximum fitness for individual and kin survival and reproduction. This is not the first time, Miller recalls, the evolutionary model has been imported into social sciences. E.O. Wilson (1998), a proponent of sociobiology, extended the campaign to integrate natural sciences with social sciences and humanities in his theory of "consilience." The term was first proposed by nineteenth century philosopher of science William Whewell to connote the "jumping together" of knowledge by linking facts and fact-based theory across disciplines, in order to create a common groundwork of explanation. Harkening back to the ancient "Ionian Enchantment" of belief in the primacy of a few natural laws, Wilson crafted an encyclopedic vision of Western knowledge that privileges biochemical explanation. In the end, even consilience does not escape the problem of reductionism.

1.2.3 Critical Perspectives

Implicit, and sometimes explicit, within the foregoing definitions is the critical function of transdisciplinarity. It is not just "transcendent" but "transgressive." Norbert Gilmore called it "heretical" and fellow colloquists used the term "transformation." In describing peace research and education, William Eckhardt spoke of "breaking through disciplinary barriers, disobeying the rules of disciplinary etiquette" (Royaumont; Eckhardt 1974, 280 in Klein 1996). This critical imperative intersects with a particular conception of interdisciplinarity. In fields forged in critique of the existing structure of knowledge and education, new ways of knowing and learning are being constructed. Women's studies, cultural studies, post-colonial studies, and critical versions of science, technology, and society studies are major examples. "Transdisciplinary" is not usually the label, more often "cross-" and sometimes "post-," "non-" or "anti"-disciplinary. Yet, the underlying premise is the same. Combining existing disciplinary tools and concepts is not enough.

Problem choice becomes as important as problem solution. "Instrumental" forms of interdisciplinarity focused on economic and technological problems differ from "critical" forms that problematize the existing structure of knowledge and education (Klein 1996, 14-15). Manhattan Project to build an atomic bomb differs from research on problems of the environment and public health. Bryan Turner (1990) made a comparable distinction in medicine. When interdisciplinarity is conceived as a short-term solution to economic and technological problems, pragmatic questions of reliability, efficiency, and commercial value take center stage. In social medicine and sociology of health, interdisciplinarity emerged as an epistemological goal. Researchers focused on the complex causality of illness and disease. Psychological, social, and ethical factors missing from the hierarchical biomedical model are factored into a holistic biosocial or biopsychosocial model.

The distinction between instrumentalism and critique is not an absolute dichotomy. The field of sustainability, for instance, encompasses both critique and problem solving. An international conference, held February 27-March 1, 2000, was the most explicit alignment of transdisciplinarity and sustainability to date. Nearly 800 people from about fifty countries gathered in Zurich, Switzerland. Participants did not settle on a single definition. Members of industry and the private sector interested in improving product innovation through user feedback sat alongside academics engaged in critique of science and the market economy as well as members of community-based projects focused on controversial social issues. What put them in the same room was a shared realization—all sectors of society must cooperate in order to solve complex problems that are external to the university and involve the participation of a wider range of stakeholders. This imperative is intrinsically linked with a new discourse of transdisciplinarity (for all references, see Workbooks Zurich2000a and Zurich 2000b, and Klein, et al. 2001).

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Biographical Sketch

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