



Philosophical Underpinnings of the Transdisciplinary Research Methodology

Sue L. T. McGregor, ATLAS Fellow, Professor Emerita (MSVU), McGregor Consulting Group (Principal Consultant), 11565 Peggy's Cove Road, Seabright Nova Scotia Canada B3Z 2Y1, Email:sue.mcgregor@msvu.ca or www.consultmcgregor.com

Received 5 October 2018; Accepted 10 December

Copyright ©2018 Sue L. T. McGregor. This is an open access article distributed under the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Available online 28 December 2018 at www.atlas-journal.org, doi: 10.22545/2018/00109

This paper is predicated on two assumptions. First, many scholars do not appreciate the philosophical underpinnings of their research, commonly grounded in three dominant methodologies - empirical, interpretive and critical. Second, if scholars were more familiar with a newcomer - transdisciplinary (TD) research methodology - they would be more inclined to embrace it in their research. The paper begins with an explanation of four philosophical axioms (ontology, epistemology, logic and axiology) shaping the aforementioned dominant research methodologies. Then, each Nicolescuian TD axiom is described: (a) multiple levels of Reality mediated by the Hidden Third (ontology); (b) knowledge as complex, emergent, cross-fertilized and embodied (epistemology); (c) inclusive logic (logic of complexity) to facilitate contradiction reconciliation; and (d) transdisciplinary value formation (axiology). The paper concludes with a preliminary overview of Nicolescuian TD research methodology in action. When used in concert with the three longstanding research methodologies, the Nicolescuian approach holds promise for addressing the complexities facing humanity.

Keywords: Transdisciplinary, research methodology, Nicolescuian, philosophy, epistemology, ontology, axiology, logic.

1 Introduction

Most research involves creating new knowledge, understood to be familiarity, conversance or acquaintance with facts, truths, principles or insights gained from study, investigation or experience (“Knowledge,” 2018 [1]). Each of knowledge production, construction and creation entails an appreciation for *research methodologies*, the philosophical underpinnings of scholarship. Methodology comprises two words, *ology*, Greek for a branch of knowledge or science and *methodos*, Greek for the pursuit of knowledge (Harper, 2018 [2]). Put simply, methodology means “a branch of science that studies the pursuit of knowledge” (McGregor, 2018, p. 29 [3]). For clarification,

methods are the tasks involved in collecting and analyzing new data. *Methodology* is the philosophical assumptions underpinning research, assumptions that inform how these data are interpreted, leading to new knowledge. Methodology determines methods, not the other way around (McGregor, 2018 [3]).

Over time, three dominant research methodologies anchored in philosophical axioms have emerged (i.e., empirical, interpretive and critical) with transdisciplinarity a recent innovation (to be discussed) (McGregor, 2015b [4]). For clarification, qualitative and quantitative research methodologies differ in assumptions not axioms (McGregor, 2018 [3]). Each dominant research methodology is grounded in its unique understanding of four philosophical axioms (self-evidently true propositions or tenets): ontology, epistemology, logic, and axiology (to be discussed). This paper strives to position Professor Dr. Basarab Nicolescu's (1985 [5], 2002 [6], 2008 [7], 2010 [8], 2014 [9]) transdisciplinary (TD) research methodology, the newcomer, in relation to the three relatively longstanding approaches to research.

The intent is to showcase Nicolescuian transdisciplinarity as a methodological orientation to knowledge creation while appreciating the three well-established research traditions. With deeper insights into the TD research methodology, people may be more inclined to embrace and employ it to address the complex problems facing humanity (e.g., climate change, uneven human development, inequitable resource distribution, human aggression, unsustainability). Despite being around for nearly 40 years, transdisciplinarity is an underutilized approach to knowledge creation (Segalas Coral & Tejedor Pappell, 2016 [10]), although it is growing in popularity (McGregor & Volckmann, 2011[11]; Nicolescu, 2010a [8]).

2 Transdisciplinarity

Nicolescu (2002 [6], 2014 [9]) grounded his formulation of transdisciplinarity in complexity science, chaos theory, and quantum physics. For him, transdisciplinarity meant being, at the same time, between, among and beyond disciplines (Nicolescu, 2005 [12]). *Trans* means across, zig-zag, moving into another state or place (Harper, 2018 [2]). Succinctly, the intent of the TD research methodology is to understand the world by unifying scientific (academic/disciplinary) knowledge and human knowing.

Nicolescu referred to this as “the unification of the world” (2014, p. 59 [9]). This comprehensive unity of knowledge would better ensure action towards addressing the complex problems of modern civilization. Transdisciplinary research relates to issues that do not primarily arise from scientific disciplines. Instead, it addresses the societal need for complex issue orientation and action strategies that cannot be dealt with adequately by just disciplinary experts. A ‘unity of knowledge’ is required in the context of twenty-first century societal problem posing and solving (Hirsch Hadorn, Pohl, & Scheringer, 2009 [13]).

Pohl and Hirsch Hadorn (2008) [14] explained that this type of knowledge is required to help people deal with incredibly complex situations, “specific types of life-world problems [where] those involved have a major stake in the issue, when there is a societal interest in improving the situation and when the issue at hand is under dispute. Those involved neither agree on the relevance of the problem, nor on its causes, nor on the solution strategy required. [Yet something must be done]” (p. 112). Schäfer, Ohlhorst, Schön, and Kruse (2010) [15] conceived these complex situations as constellations (i.e., an arrangement of parts or elements) comprising four key elements: (a) social actors who are involved in the process of dealing with the problem, (b) technical artifacts at hand to address the problem, (c) natural phenomena, and (d) ideas, concepts, ideologies, laws, and communicative acts. When attempting to bridge different knowledge and truth claims and perspectives, all four elements are treated as equal with the people involved focused on identifying situation-specific profiles of the elements and interrelations among them using the “logic of constellations” (Schäfer et al., 2010, p. 120 [15]). As they work collaboratively to address the complex situation, academic researchers and lay experts relate different perspectives to each other and attempt to clarify points of consensus and dissent.

Due to the power of positivism, which favours the scientific method while rejecting metaphysics (philosophy concerned with abstract concepts, like reality) and theism (belief in the existence of god(s)) knowledge has become very fragmented, specialized and compartmentalized. Ways of knowing aside from disciplinary knowledge (especially empiricism and science) are undervalued, meaning spiritualism, wisdom, aesthetics, and everyday knowing have a

minimal role in knowledge creation (Bergmann et al., 2012 [16]; Nicolescu, 2014 [9]). This development has led to a crisis of knowledge and an inability to effectively and efficaciously solve the world's complex problems. Depending on one way of knowing is not enough anymore. Although the interpretive and critical research methodologies emerged to challenge positivism (McGregor, 2018 [17]), they are not enough either. A new methodology is needed that respects the integration of scientific and academic knowledge with that of civil society (Bergmann et al., 2012 [16]; Nicolescu, 2014 [9]), with the latter often referred to as "life-world knowledge" (Schäfer et al., 2010, p. 119 [15]).

Transdisciplinary research strives to create integrated knowledge arising from cross-fertilization, a process whereby the interaction and interchange among two or more entities leads to mutually-beneficial and productive outcomes ("Cross-fertilization," 2018 [18]). However, "there are no clearly specified methods and procedures that researchers can follow to generate syntheses" and enable cross-fertilization (Hoffmann, Pohl, & Hering, 2017, p. 1 [19]), see also Pohl and Hirsch Hadorn (2008) [14] and Schäfer et al. (2010 [15]). Bergmann et al. (2012) [16] published a book about methods for integrative transdisciplinary research but their ideas were based on the Zurich approach to transdisciplinarity not the Nicolescuian approach, and they focused on *methods* rather than methodology. For clarification, the Zurich approach is in many ways based on existing (mainstream) ontology, epistemology, axiology and logic while Nicolescu's transdisciplinarity is not (see McGregor, 2015a [20] for a very detailed comparative analysis of the two approaches). The defining feature of Nicolescu's methodology is ontology - Reality with a capital R - and this understanding informs his approach to the epistemology axiom (Nicolescu, 2014 [9]).

The Zurich approach to knowledge creation still assumes that "the science system is the primary knowledge system in society; [people] just need to do *science differently* so it can deal with complexity. [Zurich-based transdisciplinary research is concerned with] the interaction of disciplines *within* social constraints" (McGregor, 2015a [20]). It is not based on philosophical axioms but on "the science-technology-society triad" with a special concern to "tear down the barriers between the various sciences" but not between the sciences and the arts and humanities or the

rest of the world (McGregor, 2015a [20]). This approach runs the risk of integrative transdisciplinary research becoming 'just another' specialization, leading to more fragmentation (Bergmann et al., 2012 [16]). Focusing on philosophical axioms mitigates that risk because it reflects an entirely new research methodology for creating knowledge.

3 Philosophical Research Axioms

Many scholars do not appreciate that their research is grounded in philosophy, the study of the fundamental nature of knowledge, reality and existence. Just as in the normal course of living, a person's research behaviour is also guided by a philosophy, knowingly or not (Dudovskiy, 2018 [21]; Pathirage, Amaratunga, & Haigh, 2008 [22]). "A research philosophy is a belief [and set of assumptions] about the way in which data about a phenomenon should be gathered, analysed and used [given the research question shaping the study]" (Davison, 1998, p. 3-1 [23]). Both those conducting and critiquing research can benefit from an appreciation of the power of philosophical axioms (McGregor, 2018 [17]). "Failure to think through philosophical issues . . . can seriously affect the quality of research [and resultant knowledge]" (Pathirage et al., 2008, pp. 5-6 [22]).

Latin *axioma* refers to that which commends itself as evident and worthy (Harper, 2018 [2]). In lay terms, an axiom is a saying or expression, a maxim, which is widely accepted on its own merits. Examples of maxims include "It's better to be safe than sorry. You are never too old to learn. It is easier to ask for forgiveness than permission." Philosophers understand an axiom to be an established, accepted or self-evident truth, proposition, tenet or principle that never needs to be questioned (i.e., no proof of its veracity is necessary - it is taken as a given) (Cicovacki, 2009 [24]). In particular, *philosophical* axioms are authoritative statements about what counts as reality (ontology), knowledge (epistemology), logic, and the role of values (axiology), representing four branches of philosophy (Rohmann, 1999 [25]) (see Figure 1 and the following discussion).

3.1 Ontology

Ontology (Greek *ontos*, 'to be') is a branch of philosophy that studies the nature of reality (having existence or substance), the world, and being and

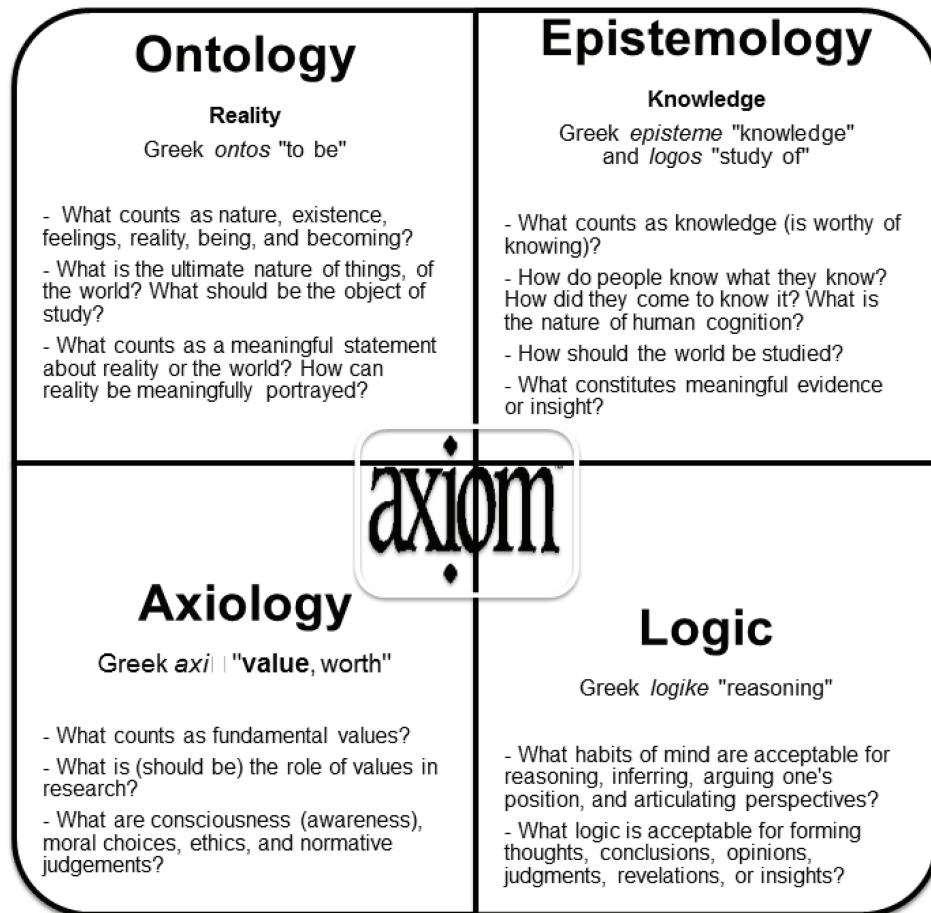


Figure 1: Four philosophical research axioms.

becoming. It is part of metaphysics, a branch of philosophy concerned with abstract ideas, and the essence of life. Those focused on ontology want to know what should be the object of study, what is human nature, and what does it *mean* to be human? The ontology axiom is concerned with how people make choices, how can reality be meaningfully portrayed, and what counts as a meaningful statement about reality (Harper, 2018 [2]; McGregor, 2018 [3], Rohmann, 1999 [25]; Ryan & Cooper, 2007 [26])?

3.2 Epistemology

Epistemology (Greek *episteme*, 'knowledge') is a branch of philosophy concerned with the nature and scope of knowledge and how people come to know it. This axiom also queries what is the nature of human cognition (i.e., the mental process of getting to know something), and how do people know what they know? Epistemology defines knowledge as 'the truth' with attendant concern for what counts as criteria for evaluating knowledge and truth (e.g., re-

liability, validity, trustworthiness, social robustness). Those focused on epistemology want to know how the world should be studied, how knowledge arises, and what constitutes meaningful evidence or insight (Harper, 2018 [2]; McGregor, 2018 [3], Rohmann, 1999 [25]; Ryan & Cooper, 2007 [26]).

3.3 Axiology

Axiology (Greek *axioma*, 'what is thought fitting') is a branch of philosophy that studies values (worthy, important, significant), especially 'how fitting is the role of the researcher's values in the research process?' Should the research be value free, value laden, value driven, or value derived? As well, axiology is concerned with what counts as fundamental values, what is consciousness (i.e., moral choices, ethics, and normative judgements), and what is the nature of 'good' (i.e., what does morally right and virtuous look like)? Axiology also encompasses the role of perceptions in research (awareness of something through one's senses) as well as intuitive understand-

ings and insights (Harper, 2018 [2]; McGregor, 2018 [3]; Rohmann, 1999 [25]; Ryan & Cooper, 2007 [26]).

3.4 Logic

Logic (Greek *logike tekhnē*, 'the art of reason') involves the study of valid argument forms, truth claims (statements that people hold to be true; things exist or they do not), and perspectives (Nicolescu, 2014 [9]). The philosophical logic axiom is concerned with 'habits of the mind' considered acceptable when (a) reasoning and making inferences (i.e., drawing conclusions) while developing arguments, (b) taking a position, or (c) interpreting a situation (McGregor, 2015b [4]). Research is shaped mainly by deductive and inductive logic or reasoning (sometimes abductive logic), with transdisciplinarity concerned with exclusive and inclusive logic. *Truth claims* are statements or propositions that a particular person or an ideological system holds to be true. *Argument forms* refer to statements (both premises and conclusions) combined to form an argument (i.e., a set of reasons to support an assertion). *Perspectives* (Latin *perspectiva*, 'the science of optics') pertain to people's view of or lived experience with a phenomenon (Harper, 2018 [2]; McGregor, 2014 [27], 2018 [3]; Rohmann, 1999 [25]; Ryan & Cooper, 2007 [26]).

3.4.1 Longstanding Research Methodologies' Conceptualizations of Axioms

Together, these four philosophical axioms constitute the essence of the three longstanding research methodologies (Kim, 2003 [28]). Each one has a different understanding of what constitutes reality, knowledge, logic and the role of values (see Table 1, adapted from McGregor, 2015b [4], 2018 [3]). In brief, researchers employing the scientific, empirical methodology believe they can find the truth (new knowledge) if they use an objective (value free) mindset while employing the scientific method. There is only one reality, comprising discrete elements external to the human mind. Using deductive logic, they assume truth is out there, existing already, waiting for them to find it.

Researchers using an interpretive methodology assume that the truth (new knowledge) is conditional upon how humans experience a phenomenon. Upon interpreting the divergent perspectives articulated by people living an experience (i.e., their lived real-

ity), researchers subjectively (grounded in reflexive practice) strive to use inductive logic to discern participants' notions of the truth. Scholars drawing on the critical methodology assume that people's lived reality is constructed within an oppressive context. Accessing people's notions of the truth entails the use of inductive logic, with the researcher's values key to the creation of new knowledge. By helping people gain insights into how they are being exploited by ideologies, social institutions (e.g., structural violence) and power relationships, researchers strive to help people find their inner power (empowerment) and use this new knowledge to take liberating social action (see Table 1).

Assuming that readers have a rudimentary familiarity with these three research methodologies, the discussion now turns to the Nicolescuian transdisciplinary research methodology, with intellectual nods to the other approaches when relevant.

4 Transdisciplinary Research Methodology Axioms

As noted, Nicolescu's (1985 [5], 2002 [6], 2008 [7]) point of departure when formulating his transdisciplinary research methodology was complexity science, quantum physics, and chaos theory. These sciences and theories employ such concepts as emergence, self-organization, fuzzy logic, complexity, the quantum vacuum, and chaos as order emerging, just not predictably. Researchers turning to this methodology would assume that the problems being addressed in their work are so complex that knowledge from just scientists and academics or just the life world is not enough. Nicolescu (2014) [9] proposed that the longstanding approaches to research are sufficient for relatively simple cases but inadequate (even harmful) when applied to complex situations.

For the latter, a research methodology is required that accommodates the integration of multiple, value-laden perspectives and varied interests leading to new knowledge emergent from fused intellects and perspectives. To respect this, Nicolescu (2002 [6]) 'worked out' new formulations of the longstanding philosophical axioms, excluding axiology because he believed that values are inherent in the knowledge creation process. Cicovacki (2009) [24] and McGregor (2011 [29]) respectfully took issue with this premise, developing solid arguments for including axiology when dealing with the transdisciplinary

research methodology. Their thoughts are included here as well.

4.1 Transdisciplinary Ontology (Reality)

Instead of accepting classical logic's assumptions that there is just one reality, or there are different realities operating separately from each other and failing to communicate, Nicolescu (2014) [9] formulated reality as a "multileveled structure" (p. 31) that will eventually be revealed in all of its complexity (substantive and abstract). In his mind, transdisciplinary ontology views the world as "that of universal interconnectedness, of relationship, of interaction [where] discontinuity and continuity co-exist harmoniously" (p. 27). As a caveat, Nicolescu capitalizes the word Reality, a convention followed in the following description of his approach but not throughout the rest of the paper.

Nicolescu (1985 [5], 2002 [6]) worked out that Reality exists along two levels (see Figure 2). Although each Reality is characterized by its incompleteness, in unity, their integration generates new transdisciplinary knowledge. Reality exists in (a) the internal world of humans, where their consciousness and perspectives flow - *the TD-Subject* - comprising political, social, historical, and individual Realities. This is referred to as 'the flow of spiritual information' (Nicolescu, 2014). (b) External to humans are Realities where information flows - *the TD-Object* - comprising environment, economic, and cosmic/planetary. (c) Nicolescu (1985 [5], 2002 [6]) proposed that a mechanism is needed to ensure that flows between internal human consciousness and perceptions and external nonhuman information can interface (i.e., a meeting of disparate minds). He called this the Hidden Third - the *unifier* of spiritual and natural information.

To understand the term 'the Hidden Third,' it is useful to appreciate that 'hidden' means invisible and 'third' typically refers to a neutral third party mediating between two entities in dispute. Succinctly, Nicolescu (2011) [30] suggested that the Hidden Third refers to a zone of nonresistance to others' views on Reality (i.e., in the quantum vacuum) that plays the mediating role of 'a third' between external information and internal consciousness and perceptions. It acts like a secretly included middle agent (i.e., the unifier) that allows for temporary unification of, what are normally, contradictory ideas (Nicolescu, 2005 [12]).

This mediating interface comprises culture and art (aesthetics), religions and faiths, and spiritualities and the Sacred, which cross all levels of Reality, mitigating fragmentation and fostering cross fertilization (Nicolescu, 2014 [9]). I would like to take this opportunity to clear up a misunderstanding. In my previous work, I counted religions, spiritualities and cultures as a third level of Reality. I recently stumbled across an email from Nicolescu wherein he clarified that these are not levels of Reality; instead, they belong in the Hidden Third where there is no resistance. Actually, they lubricate movement among the levels of Reality that are rife with resistance (Basarab Nicolescu, personal communication, August 12, 2008) (see Figure 2).

In more clarifying detail, while religions are viewed as external socio-cultural phenomena, spirituality refers to a person's inner life shaped by introspective practices such as prayer and meditation. The Sacred refers to an absolute respect for others. It is the root of people's awareness of being linked by a shared common life. Dismissing the Sacred leads to atrocities such as genocide and assaults on Mother Earth (Nicolescu, 2014 [9]). Peoples' experiences, intuitions, reflections, interpretations, descriptions, representations, images and formulas meet in this mediating zone of no resistance (Nicolescu, 2005 [12]). The Hidden Third (i.e., the invisible unifier) constitutes "spirit-opening modalities" making it possible for knowledge integration to occur (personal communication, Eric Reynolds, August 15, 2018). In sum, transdisciplinary ontology comprises the TD-subject, TD-Object, and the Hidden Third (Nicolescu, 2014 [9]).

4.2 Transdisciplinary Logic

Nicolescu (1985 [5], 2002 [6]) held that a special type of logic (mode of reasoning) is needed that focuses on two aspects of transdisciplinary knowledge creation: (a) the complexity of the situation and (b) the need to reconcile contradictory mindsets operating on different levels of Reality (e.g., anthropologists, engineers, businesses, bureaucrats, politicians, artists, social workers, and indigenous elders). In opposition to contemporary sciences' use of exclusive logic, which negates the possibility of coexisting contradictions and antagonistic ideas, Nicolescu (2014 [9]) proposed *inclusive logic*, also called the "logic of complexity" (p. 124) or, ill-advisedly, as he claims, the "logic of contradiction" (p. 123).

Table 1: Comparison of methodological axioms (adapted from McGregor, 2015b [4], 2018 [3]).

Philosophical Axiom ↓	→ Methodology			
	Empirical	Interpretive	Critical	Transdisciplinary
Ontology (reality)	assumes one reality is out there in the universe waiting to be discovered. It is made up of discrete elements and is external to the human mind. Assumption is that if we do enough studies and collect enough data, eventually, a full picture of reality will emerge	assumes reality is in here (in people’s minds); reality can be either a product of a person’s mind, interactions with others or with one’s context; reality is socially and collectively construed via lived experiences of a phenomenon; multiple realities are conditional upon human experiences	assumes reality is material (of the world, not imagined); it is here and now, shaped by ethnic, cultural, gender, social and political values, often in an oppressive context. Reality is mediated by power relations; reality is (re)constructed within an historical-social context before, during and after challenging the status quo	assumes Reality is multifaceted and in flux. There is a (1) TD-Subject level (inner human world - subjective consciousness and perspectives) and a (2) TD-Object level (outer objective information) whose interface is mediated by (3) the unifying, potential-rich Hidden Third zone; a new Reality is contingent on contradictions being temporarily reconciled
Epistemology (knowledge and knowing)	the one truth is out there waiting to be discovered by using the scientific method (through the lens of reductionism, determinism, linear causality, and predictability); knowledge is objective and bias free	there is more than one truth (perspective) because there are many people’s realities; knowledge is constructed or created by people; truth is based on people’s interpretations and meanings of their world; knowledge is subjective and value-laden	knowledge and truths are grounded in context; knowledge is created through critically questioning the status quo; this new truth is liberating and in flux; knowledge is transformative, consensual and normative (dialectic - investigates the truth of opinions)	knowledge creation occurs in the fecund middle ground where contradictory perspectives are set aside (people temporarily give up sovereignty) to create a space for the intellectual fusion and integration of ideas and perspectives leading to the emergence of new, in vivo TD knowledge; knowledge is emergent, complex, embodied and cross fertilized

The logic of complexity lets people cross and connect different ways of knowing in a creative and coherent way (Nicolescu, 2014 [9]). In contrast, exclusive logic assumes that antagonistic ideas cannot

Table 1: Comparison of methodological axioms (adapted from McGregor, 2015b [4], 2018 [3]) *Table 1 continued.*

→ Methodology				
Philosophical Axiom ↓	Empirical	Interpretive	Critical	Transdisciplinary
Logic (arguments, claims, positions, perspectives)	deductive logic (rational, formal, objective); clear distinction between facts and values, privileging the former; this exclusive logic leaves no room for contradictions, seeking consistency instead	inductive logic (patterns, meanings, multiple interpretations); per epistemology, inductive logic suggests truth but does not ensure it; truth is probable and capable of being proven false	inductive logic (leads or persuades people) in hopes of revealing ideologies, power and influence leading to personal autonomy, empowerment and liberation (symbolically and/or literally)	inclusive logic (also logic of complexity) is applied in the included middle, a dynamic space where potential exists, ready to emerge; this logic assumes that contradictions can temporarily coexist leading to the unexpected but welcomed integration of facts and perspectives to create TD knowledge
Axiology (values)	deductive logic (values neutral; there is no place for the researcher’s feelings, opinions, values, perceptions, or expectations; however, researchers can study other people’s values	values laden; bias, hopes, feelings, expectations, perceptions of participants and researcher (reflexive) play a central role in research	values driven and values oriented; the researcher’s proactive values concerning social justice are key to the research as are the participants’ values)	ubiquitous disparate and conflicting values must be heard and reconciled leading to the formation of transdisciplinary values for the issue at hand, engendered in the mediated interaction in the unifying Hidden Third

be connected (Brenner, 2008 [31]). Nicolescu (1985 [5], 2002 [6]) knew that in order to deal with deeply complex problems there had to be a logic that accommodated the need to reconcile disparate mindsets. For example, both the engineer and indigenous elder must be able to retain their identity while gaining some new insights from their interaction involving the exchange of disparate ideas and positions.

To that end, Nicolescu conceived inclusive logic for situations when “that which appears to be disunited

is united, and that which appears to be contradictory is perceived as noncontradictory” (2008, p. 7) [7]. This logic facilitates the “explosion of immense energy” that occurs when people temporarily set aside their positions and become open to something new to emerge - when contradictory viewpoints are synthesized (Nicolescu, 2014, p. 123 [9]). This reconciliation of antagonistic views happens in the quantum vacuum, which is actually not empty at all but ripe with potential. McGregor (2015b, p. 21) [4]

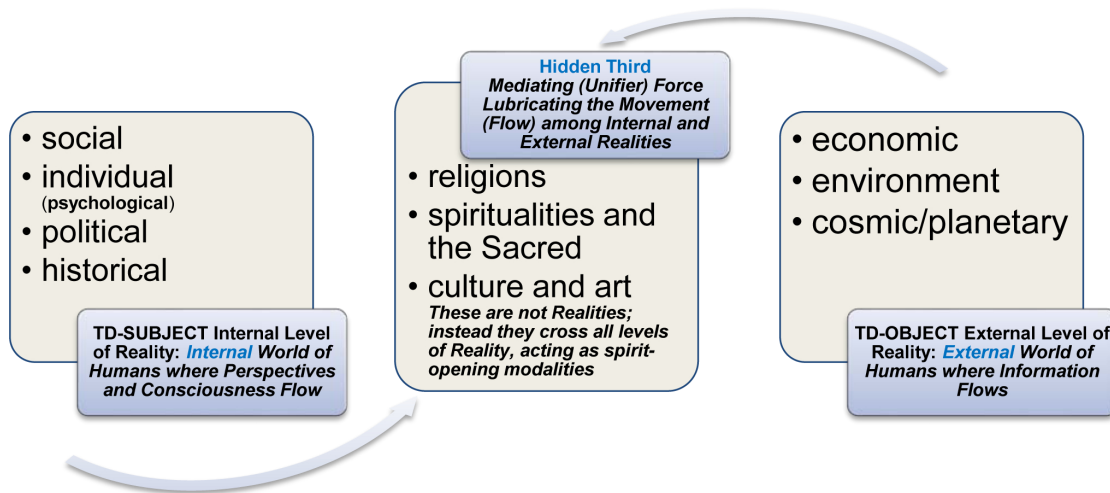


Figure 2: Nicolescuian transdisciplinary ontology.

referred to this space as “the fecund middle ground” (i.e., highly fertile and able to produce off spring).

Nicolescu (2014, p. 122) [9] affirmed that “transdisciplinary quantum logic” assumes that contradictions are resolved at higher levels of Reality or complexity than those initially held by people when they entered the zone of nonresistance to each others’ ideas. This new state represents the result of two contradictory things interacting and coming to a temporary resolution (Ramadier, 2004 [32]) (e.g., the engineer and indigenous elder agreeing to a contentious point by temporarily setting aside their positions for the sake of the common good - the Sacred).

4.3 Transdisciplinary Epistemology (Complexity) (Knowledge)

The defining feature of Nicolescu’s methodology is ontology - Reality with a capital R - and this understanding informs his approach to the epistemology axiom. He believed that “the totality of levels of Reality is a *complex* structure” necessitating an epistemological axiom that respects complexity (Nicolescu, 2010b, p. 7) [33]. He now calls his original complexity axiom “the epistemological axiom” and describes it thus: “the structure of the totality of levels of Reality appears, in our knowledge of nature, of society, and of ourselves, as a complex structure: every level is what it is because all of the levels exist at the same time” (Nicolescu, 2014, p. 207) [9]. As an example, without other religions as a context, a particular religion would not be what it is. A reli-

gion is what it is because other religions are there at the same time. The word *transreligion* captures this transcending premise - at the same time between, among and beyond all religions (Nicolescu & Volckmann, 2007) [34].

Nicolescu formulated his epistemological axiom from a complexity perspective because he maintained that complexity is the ancient principle of universal interdependence (universal means applicable across all cases and interdependence means people rely on each other). He held that this approach to knowledge creation entails the maximum possible *simplicity* that the human mind can imagine. This simplicity takes shape through symbolic language rather than mathematical formulations. The former is reflected in people’s thoughts, feelings and body - “the totality of the human being” (Nicolescu, 2006, p. 154 [36]). Universal interdependence also holds that complexity is, paradoxically, “embedded in the very heart of simplicity” (Nicolescu, 2014, p. 100 [9]). In a nut shell, everything is simple, unified and subordinate to general principles until people try to explain their world - then things become complex (Nicolescu, 2006 [36]).

He went on to explain that the ‘universal interdependence’ paradox is an example of transdisciplinarity’s intent to move beyond “duality opposing binary pairs” (Nicolescu, 2000 [36]). He later clarified that “transdisciplinarity means transgression of opposing pairs” (Nicolescu, 2014, p. 209 [9]) with one example being simplicity/complexity. They do not oppose each other but are interdependent. To elaborate on this idea, he employed the term *simplicity*, which

refers to the process of striving towards a simple end by way of complex means (simplexCT, 2013 [37]).

In more detail, transdisciplinary knowledge creation *depends* on people talking to each other and overcoming resistance to each other's ideas. Symbolic language (which reflects people's thoughts, feelings and emotions) is indispensable to maintaining this universal interdependence (Nicolescu, 2006 [35]). The new simplicity arises as an outcome from the process of many interdependent people working across many complex levels of reality, achieved via *simplicity* - a new simple end by way of complex means. Nicolescu (2006 [35]) believed that a defining feature of his epistemology (complexity) axiom was the respect for the interdependence present among individuals operating in all walks of life; they depend and rely on each other.

Nicolescu (2000 [36]) further characterized the TD subject (human) as one of infinite simplicity while the TD Object (external to humans) has infinite complexity. Transdisciplinary complexity (epistemology) pertains to "a new order and a new kind of simplicity" (Nicolescu, 2014, p. 101 [9]) dependent on reconciliation of contradictory views of reality informed by different levels of Reality. To reiterate, the TD Subject is internal to humans, totally dependent on the mind for existence, influenced by personal feelings, values, beliefs and perceptions. The TD Object is the external world and not dependent on the subject's mind for existence. Knowledge creation is dependent on a deep appreciation of these distinctions and a corresponding respect for the fact that they can be reconciled.

Explaining that current theories of complexity cannot accommodate his notion of ontology (i.e., levels of Reality and zones of non-resistance), Nicolescu (2010b [33]) identified three types of complexity as they pertain to epistemology and ontology. Transversal complexity focuses on crossing different 'levels of organization' within one level of Reality (e.g., classical, ecological, feminist and behavioural economics). He explained that levels of organization correspond to different ways of structuring the same fundamental laws governing that level of Reality (Nicolescu, 2014 [9]). *Horizontal complexity* concerns one single level of Reality and the connections of complex phenomena within that Reality (e.g., economics). *Vertical complexity* refers to crossing several levels of Reality (e.g., economics, social, and historical) (Nicolescu, 2006).

When transiting from one level to the other, people gain glimpses of different Realities that "generate reciprocal enrichment that may facilitate the understanding of complexity" (Max-Neef, 2005, p. 15 [38]). Nicolescu (2006 [35]) also described it as human perceptual complexity.

Nicolescu (2010b [33]) also drew on and distinguished between restricted and generalized complexity. The former is a mathematical tool to study complex systems and the latter pertains to thinking and action. He proposed that levels of Reality serve as a bridge between these two approaches. Using the newer notion of Trans-reality, he proposed that "one level of Reality is the *simplexus* of the *complexus* present in Trans-reality" (p. 8 [33]). *Simplexus* means 'with one fold' and *complexus* means intertwined (Gélalian, 2018 [39]). By *complexus*, Nicolescu (2010b [33]) meant the unification of different types of complexity. He called the latter *transcomplexity* but did not elaborate further, inviting future detailed studies of this concept. Luna and Alfonzo (2016 [40]) subsequently asserted that transcomplexity enables people to break away from dominant ontological visions that can restrict knowledge awareness. They proposed that it promotes the introduction of levels of reality that establish transrelations. The latter lead to the creation of new meanings that allow a "cognitive-sensitive understanding" (p. 11 [40]). With this concern for meaning, Nicolescu (2008a [41], 2014[9]) held that transdisciplinarity must accommodate hermeneutics.

4.3.1 Transdisciplinary Hermeneutics

Nicolescu (2008a [41]) acknowledged that the term transdisciplinary hermeneutics was first coined by John van Breda in 2007 [42]. The word hermeneutics derives from the Greek god Hermes whose task it was to interpret the messages of the gods and make them understandable to the people - make them meaningful (van Breda, 2007 [42]). Hermeneutics is all about the art of interpretation to create meaning. It is about "what exactly happens in the act(s) of interpretation... when there is a claim of 'shared' understanding" (van Breda, 2008, p. 95 [43]). Transdisciplinary hermeneutics is about *what* happens when people cross boundaries while engaging in transdisciplinary dialogue and *how* this happens (van Breda, 2007 [42]). van Breda (2007 [42]) argued that this type of hermeneutics is necessary if people truly want to understand the present world

Table 2: Transdisciplinary secondary ternaries (Nicolescu, 2008a [41]).

Levels of organization – Levels of structuring – Levels of integration
Levels of confusion – Levels of language – Levels of interpretation
Physical levels – Biological levels – Psychical levels
Levels of ignorance – Levels of intelligence – Levels of contemplation
Levels of objectivity – Levels of subjectivity – Levels of complexity
Levels of knowledge – Levels of understanding – Levels of being
Levels of materiality – Levels of spirituality – Levels of non-duality

by striving for unity of knowledge, Nicolescu's (2002 [6]) vision of transdisciplinarity.

Transdisciplinary hermeneutics is concerned with what, if any, conditions and methodologies have to be followed for true understandings to emerge (van Breda, 2008 [42]). This matters because the understandings emergent from transdisciplinary discourse lead to unity of knowledge by way of the fusion of horizons (Nicolescu, 2014 [9]). These horizons are not disciplinary boundaries; instead, horizon means the limit of a person's mental perceptions of something. By refusing relativism and skepticism, transdisciplinary hermeneutics manifests in the fusion of prejudices and perceptions leading to more powerful understandings of self and others (Nicolescu, 2008a [41]). Nicolescu (2014 [9]) called this "*homo sui transcendentalis*" (p. 201), explaining that this Latin term does not mean new man; rather, it means "a person who is born anew" (Nicolescu, 2002, p. 144 [9]). They are new because they have transcended previously-held viewpoints and fused their knowing with others to create new knowledge - a fusion of horizons opening towards truth. He presented this idea as a way to accommodate and avoid the deadlock that arises when science and non-science try to talk to each other, what he called *homo economicus* and *homo religiosus*, respectively (Nicolescu, 2014 [9]).

Nicolescu (2008a [41]) viewed transdisciplinary hermeneutics as a key aspect of the transdisciplinary approach, asserting it consists of ternaries to stave off the crippling power of dualities. Ternary means three parts. TD Hermeneutics involves both (a) the basic ternary of transdisciplinary Reality and (b) one or more secondary ternaries. The former comprises the TD Subject, TD Object and the Hidden Third (see Figure 2). The secondary ternaries are considered to be basic tools for understanding and interpreting transdisciplinary discourse, invaluable on

the ground (see Table 2, Nicolescu, 2008a, p. 21 [41]). They deal with key aspects inherent in dialogue and discourse around complex problems. These aspects include but are not limited to confusion, ignorance, knowledge, language, contemplation, understanding and integration. Note that the information in Table 2 can be read by row or column.

Respecting that transdisciplinary hermeneutics is about interpretation, understanding and meaning making among a disparate collection of stakeholders, Nicolescu (2014 [9]) proposed yet another ternary - three types of meaning. *Horizontal meaning* refers to interconnecting at one level of Reality, what most of academic disciplines do without thinking. *Vertical meaning* pertains to interconnections involving several levels of Reality (e.g., what poetry, arts and quantum physics do). *Meaning of meaning*, the absolute intent of transdisciplinary research, refers to interconnections involving all of Reality; the basic ternary (TD Object, TD Subject and the Hidden Third). Instead of focusing on fragments of levels of Reality, seeking meaning of meaning would entail focusing on internal perceptions and external information and their mediated interface (Nicolescu, 2006 [35]). Hermeneutically speaking, the ontological Hidden Third transforms shared TD Object and Subject knowledge into shared understanding, meaning "fusion of knowledge and being" (Nicolescu, 2014, p. 212 [9]).

4.3.2 Characteristics of Transdisciplinary Knowledge.

Nicolescu's formulization of the epistemology (complexity) axiom paved the way for his accompanying notion of transdisciplinary knowledge as complex, emergent, cross-fertilized and embodied. The knowledge created from both the use of inclusive logic and the unifying action of the Hidden Third in the fertile middle ground, which facilitates movement within

the structure of multiple levels of Reality (reconciling disparate mindsets), is called “in vivo” (alive) TD knowledge (Nicolescu, 2005, p.3 [12]). “The [resultant] unity of knowledge can only be an open, complex, and plural entity” (Nicolescu, 2014, p. 201 [9]).

Transdisciplinary knowledge is considered cross-fertilized, complex, emergent, and embodied. McGregor (2009 [44], 2015b [4]) employed a lava map metaphor to explain this characterization. She explained that when motivated people from different disciplines and sectors come in contact with each other (*cross fertilization*) on the undulating floor of the lava lamp (zone of nonresistance to each other’s ideas - the fertile middle ground), an energizing force is generated. The resultant synergy (i.e., the combined effect is greater than the sum of people’s individual effects or capabilities, like a jazz ensemble) leads to the *emergence* of knowledge, rising to the top of the lava lamp. Synergy represents advanced effectiveness as a result of cooperation. This ‘bubble’ of new knowledge is created from the burst of intense energy emanating from intellectual fusion and perspective integration (i.e., the fusion of horizons). This new knowledge falls back into the lava stream and becomes part of everyone (*embodied*), meaning they all own the new knowledge because it was co-created.

To continue, this in vivo knowledge is *complex* because the people and systems that were involved adapted and reorganized. Their behaviour emerged from a few simple rules applied locally, with far reaching effect. Order in the knowledge creation process emerged without central control. Small changes were allowed to leverage big effects. And, the people involved trusted that things could emerge from unpredictable events (chaos theory) (McGregor, 2015b [4]).

4.4 Transdisciplinary Axiology (Values)

In sum, because Reality is such a complex structure, the knowledge emergent from using inclusive logic to move among the levels of this ontological structure cannot help but be complex, cross-fertilized and embodied. But what of the axiology axiom, concerned with values? Knowledge creation has historically been linked with values, with the three longstanding research methodologies each having an axiology axiom (see Table 1). However, Nicolescu (2010a, 2014) [8, 9] unequivocally asserted that an axiologi-

cal component of transdisciplinarity is not necessary because values are *derived* (originate) from epistemology, ontology and logic. He believed that values arise from, are *engendered* in, the interactive region of the Hidden Third. The resultant transdisciplinary values’ are what matter, not each individual’s value schema as he or she enters and sustains activities during knowledge creation (i.e., in the lava lamp).

That being said, it can be argued that engenderment and derivation is not the same thing as coming to the process *with* existing values, likely conflicting, needing to be addressed, managed and reconciled, at least temporarily. McGregor (2009) [44] offered the idea of an *integral value constellation* (i.e., an arrangement of values) to tease out this axiom. Integral is Latin *integralis*, ‘forming a whole.’ *Constellation* is Latin *constellatus*, the position of planets (‘stars’) in regard to one another on a given day’ (Harper, 2018) [2]. McGregor (2009) [44] explained that “these Latin roots intimate shifting value positions over time, with the potential to converge into an integral collection of values that privilege transdisciplinary tenets,” what Nicolescu (2010a) [8], in effect, called transdisciplinary values. They are considered *integral* because, without them, contradiction reconciliation could not have happened. The new whole that was formed in the Hidden Third would not exist without these particular TD values.

There is no consensus to date about whether the transdisciplinary research methodology should have an axiology axiom. But there is a consensus that values accommodation and reconciliation is an imperative when addressing complex problems. Any “intense exchange requires a deeper knowledge of one another’s positions and a flexible attitude with regard to one’s own position” (Pohl & Hirsch Hadorn, 2008, p. 116) [14]. In order to develop the necessary tolerance of different viewpoints and value stances so that people can stay engaged in conversations about complex problems, values have to be respected, managed and led. They are often the missing link to strategic solutions.

This all means that researchers must remain cognizant of this methodological issue. Even though Nicolescu (2010a) [8] held axiology as unnecessary, epistemology and ontology always involve aspects of axiology (Engle, 2009) [45], whether acknowledged or not. Axiology tells people what is important to them, what to pay attention to, and it helps clarify prejudices and biases contributing to resistance and

pushback. Axiology studies how people think and perceive things and *why* rather than *what* they are thinking, with the former deeply shaping the latter (Hartman, 1967) [46].

5 Transdisciplinary Research Methodology in Action

In short, those who embrace the Nicolescuian transdisciplinary research methodology would assume that understanding and unifying the world involves accepting many levels of Reality where both information and consciousness and perspectives flow. The contradictory nature of this flow (reflecting disparate viewpoints, mindsets, values, positions, interests and worldviews/paradigms - i.e., horizons) dictates an appreciation for the need to lubricate and facilitate a temporary ‘meeting of the minds’ using a unique logic called inclusive logic and the logic of complexity. All views on the problem must be *included* and any contradictory positions must be temporarily reconciled so strategic and innovative solutions to the problem can be formulated, agreed to and implemented.

To continue, researchers would appreciate that although each level of Reality is incomplete on its own (i.e., not enough to address the problem), unity is more readily achieved when people move to higher levels of complexity while interacting with others (i.e., gain more complex insights into the problem and possible solutions). Disciplinary as well as life-world knowledge are relevant, just insufficient. The intent of the research enterprise is to create *in vivo*, *integrated* knowledge that is owned by everyone involved. This happens with complexity materializes in concrete form with tenable solutions. Although people are asked to temporarily give up sovereignty, each person’s identity is retained with room for transformation if desired or emergent. Values are viewed as key kinks to viable solutions or outcomes with researchers respecting individuals’ values as well as the possibility of the formation of transdisciplinary values (see Figure 3).

When employing the TD research methodology, researchers could still use the fundamental basic and applied research design approaches (McGregor, 2018 [17]) but with the *explicit* intent of creating integrated, complex, embodied knowledge. The TD methodology would inform the research questions, which would be identified and decided upon both

by disciplinary scholars and those living or involved with the problem (with the latter including industry, governments, non-government and non-profit organizations, and citizens).

Through rich but demanding collaboration (with its many challenges, see for example McGregor, 2017 [47]), all stakeholders (dubbed *stakeholders* by Torkar and McGregor, 2012 [48]) would identify any relevant theories (if they exist) to underpin the research, or develop new ones if required, decide on which literature and best practice to review pursuant to the complex problem, and develop a method for sampling, collecting and analyzing data and reporting the integrated, synthesized results and findings. Moreover, they would create an implementation scheme for diffusing, disseminating and applying any agreed-to strategies and processes to address the complex problem (Hoffmann et al., 2017 [19]; van Breda & Swilling, 2018 [49]), standing solidly in the newly co-created, embodied knowledge.

Learning how to co-design the research process through co-producing knowledge and then implementing strategic interventions to address the problem entails a deep appreciation for the contributions of disciplines (mono, multi and interdisciplinary) as well as local contextual dynamics (van Breda & Swilling, 2018 [49]). Indeed, the TD research methodology is characterized by “joint problem formulation, analysis and transformation” (van Breda & Swilling, 2018, p.1 [49]). When the joint research enterprise comes to a close, those involved will likely go their separate ways but personal learning will stay with the individual team members. Any subsequent research initiatives would have to organize the research process anew, possibly by including those involved in previous initiatives, but not necessarily.

Nicolescu claimed that “large avenues are open for rich and diverse transdisciplinary research” (2006, p.146 [35]). In addition to well-established TD research in the field of education, he suggested other areas of scholarship including (a) bringing transdisciplinarity to higher education institutions and curricula, (b) working towards a human model of health, (c) conducting scientific studies of consciousness, (d) facilitating dialogue between disciplines and worldviews, (e) creating networks of networks, (f) building models for ‘living sustainability’ and (g) building a new spirituality.

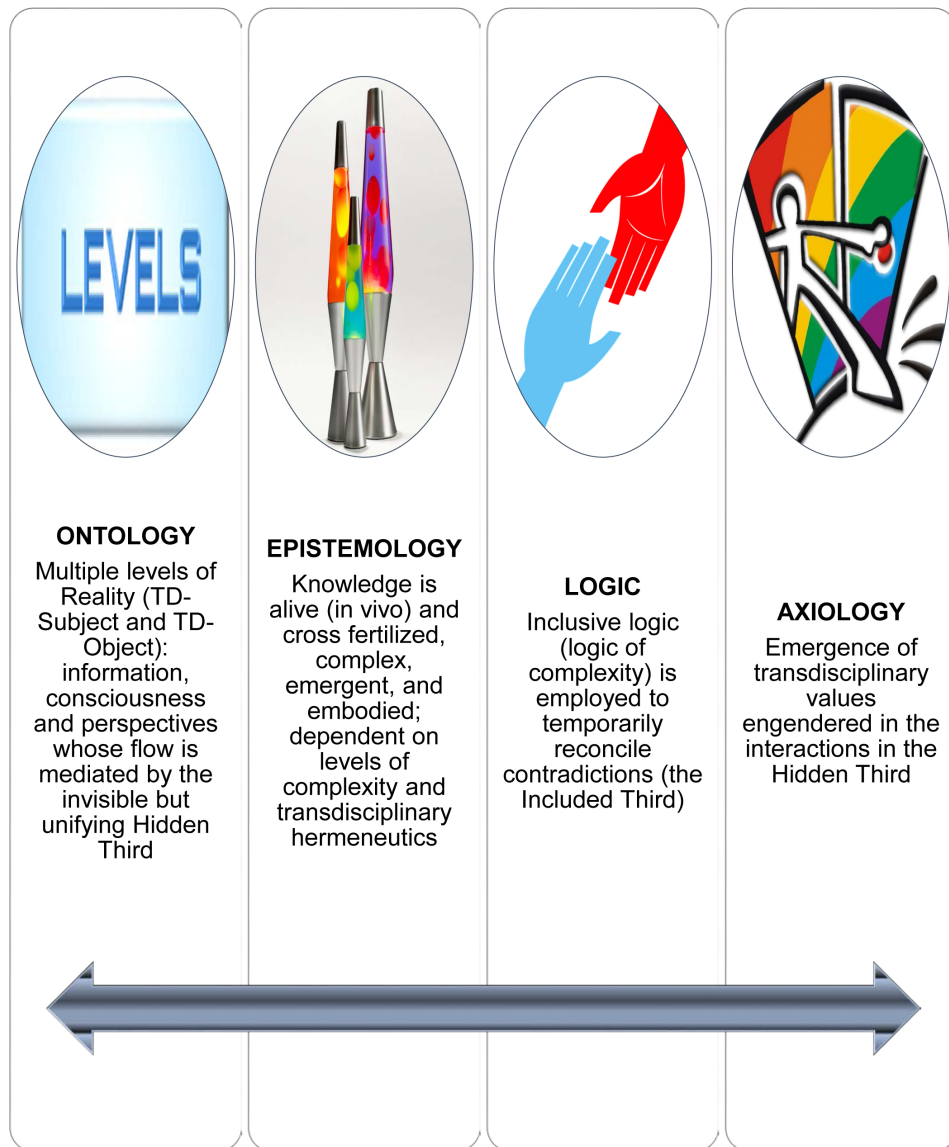


Figure 3: Nicolescuian transdisciplinary methodological axioms.

6 Conclusions

All research is grounded in philosophical axioms, whether people realize it or not. Three longstanding research methodologies (empirical, interpretive and critical) each have their own notions of epistemology, ontology, logic and axiology. A more recent research methodology, transdisciplinarity, also has its own approach to these axioms, with axiology still under contention (see Table 1 and Figure 3). The fragmentation of contemporary knowledge, due to so many separate disciplines distanced from life-world knowledge, has created a crisis of knowledge. Just using the disciplinary (academic) way of knowing is not enough given the complexity of today's prob-

lems. The integration of many points of view is required to develop truly effective and efficacious solutions. The TD research methodology promises such an approach.

The premise of this paper was that if scholars were more familiar with transdisciplinarity, they would be more inclined to embrace it in their research. Their scholarship would focus on the common good (a Sacred, normative framework); respect the diversity of perspectives; honour and accommodate complexity; and strive to integrate abstract (academic) with case-specific (life-world) knowledge. Their research protocols would privilege the Nicolescuian tenets of (a) complexity (in vivo, embodied, emergent, cross-fertilized knowledge); (b) many levels of Reality and

the quantum vacuum (the unifying Hidden Third) where potentialities arise and integration occurs; (c) inclusive logic that embraces complexity and contradiction reconciliation; and (d) value accommodation and integration to create transdisciplinary values. Their overarching goal would be to create a deeper understanding and more comprehensive map of the nature of Reality, one that incorporates different levels into a larger, integrated model. This is possible when researchers accept that TD in vivo “*knowledge is forever open*” (Versluis & Nicolescu, 2018, p. 15) [50].

Research is grounded in philosophy. The Nicolescuian transdisciplinary research methodology is philosophically rich and sophisticated. When used in concert with the three longstanding research methodologies, it holds deep promise for addressing the complexities facing humanity.

Funding: This research received no external funding.

Conflicts of Interest: The author declare no conflict of interest.

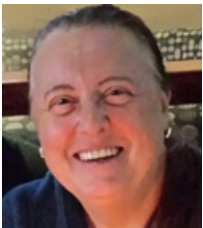
References

- [1] Knowledge. (2018). In Random House online dictionary. Retrieved from <http://www.dictionary.com/browse/knowledge?s=t>
- [2] Harper, D. (2018). *Online etymology dictionary*. Lancaster, PA. Retrieved from <http://www.etymonline.com/>
- [3] McGregor, S. L. T. (2018). *Understanding and evaluating research*. Thousand Oaks, CA: Sage.
- [4] McGregor, S. L. T. (2015b). Transdisciplinary knowledge creation. In P. T. Gibbs (Ed.), *Transdisciplinary professional learning and practice* (pp. 9-24). New York, NY: Springer.
- [5] Nicolescu, B. (1985). *Nous, la particule et le monde* [We, the particle and the world]. Paris, France: Le Mail.
- [6] Nicolescu, B. (2002). *Manifesto of transdisciplinarity* (K-C.Voss, Trans.). Albany, NY: SUNY Press.
- [7] Nicolescu, B. (Ed.). (2008). *Transdisciplinary theory and practice*. Cresskill, NJ: Hampton Press.
- [8] Nicolescu, B. (2010a, June 16-19). *Disciplinary boundaries - What are they and how they can be transgressed?* Paper prepared for the International Symposium on Research Across Boundaries. Luxembourg: University of Luxembourg.
- [9] Nicolescu, B. (2014). *From modernity to cosmopolitanity*. Albany, NY: SUNY Press.
- [10] Segalas Coral, J., & Tejedor Papell, G. (2016). The role of transdisciplinarity in research and education for sustainable development. In W. Lambrechts & J. Hindson (Eds.), *Research and innovation in education for sustainable development* (pp.197-210). Vienna, Austria: Environment and School Initiatives.
- [11] McGregor, S. L. T., & Volckmann, R. (2011). *Transversity*. Tuscan, AZ: Integral Publishing.
- [12] Nicolescu, B. (2005, June 4-8). *Towards transdisciplinary education and learning*. Paper presented at the Metanexus Institute Conference. Philadelphia, PA.
- [13] Hirsch Hadorn, G., Pohl, C., & Scheringer, M. (2009). Methodology of transdisciplinary research. In G. Hirsch Hadorn (Ed.), *Unity of knowledge (in transdisciplinary research for sustainability, (Vol. II)* (pp. 1-29). Paris, France: UNESCO Encyclopedia of Life Support Systems.
- [14] Pohl, C., & Hirsch Hadorn, G. (2008). Methodological challenges of transdisciplinary research. *Natures Sciences Sociétés*, 16, 111-121.
- [15] Schäfer, M., Ohlhorst, D., Schön, S., & Kruse, S. (2010). Science for the future: Challenges and methods for transdisciplinary sustainability research. *African Journal of Science, Technology, Innovation and Development*, 2(1), 114-137.
- [16] Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., & Schramm, E. (2012). *Methods for transdisciplinary research* (R.C. Faust, Trans.). Frankfurt, Germany: Campus Verlag GmbH.
- [17] McGregor, S. L. T. (2018). *Understanding and evaluating research*. Thousand Oaks, CA: Sage.
- [18] Cross-fertilization. (2018). In *Random House online dictionary*. Retrieved from <http://www.dictionary.com/browse/cross-fertilization>
- [19] Hoffmann, S., Pohl, C., & Hering, J. G. (2017). Methods and procedures of transdisciplinary knowledge integration: Empirical insights from four thematic synthesis processes. *Ecology and Society*, 22(1), Article 27. doi.org/10.5751/ES-08955-220127
- [20] McGregor, S. L. T. (2015a). The Nicolescuian and Zurich approaches to transdisciplinarity. *Integral Leadership Review*, 15(3). Retrieve from <http://integralleadershipreview.com/13135-616-the-nicolescuian-and-zurich-approaches-to-transdisciplinarity/>
- [21] Dudovskiy, J. (2018). *The ultimate guide to writing a dissertation in business studies* [e-Book]. Retrieved

- from <http://research-methodology.net/about-us/ebook/>
- [22] Pathirage, C. P., Amaratunga, R. D. G., & Haigh, R. P. (2008). The role of philosophical context in the development of research methodology and theory. *The Built and Human Environment Review*, 1(1), 1-10.
- [23] Davison, R. M. (1998). *An action research perspective of group support systems: How to improve meetings in Hong Kong* (Doctoral thesis, City University of Hong Kong, Hong Kong, China). Retrieved from <http://www.is.cityu.edu.hk/staff/isrobert/phd/phd.htm>
- [24] Cicovacki, P. (2009). Transdisciplinarity as an interactive method. *Integral Leadership Review*, 9(5). Retrieved from <http://integralleadershipreview.com/4549-feature-article-transdisciplinarity-as-an-interactive-method-a-critical-reflection-on-the-three-pillars-of-transdisciplinarity/>
- [25] Rohmann, C. (1999). *A world of ideas*. New York, NY: Ballantine Books.
- [26] Ryan, K., & Cooper, J. (2007). *Those who can, teach*. Boston, MA: Wadsworth Cengage.
- [27] McGregor, S. L. T. (2014). Abductive reasoning in everyday life: Implications for home economics. *Kappa Omicron Nu FORUM*, 19(1). Retrieved from <http://www.kon.org/archives/forum/19-1/mcgregor4.html>
- [28] Kim, S. (2003). Research paradigms in organizational learning and performance: Competing modes of inquiry. *Information Technology, Learning, and Performance Journal*, 21(1), 9-18.
- [29] McGregor, S. L. T. (2011). Transdisciplinary axiology: To be or not to be. *Integral Leadership Review*, 11(3). Retrieved from <http://integralleadershipreview.com/3388-transdisciplinary-axiology-to-be-or-not-to-be/>
- [30] Nicolescu, B. (2011). Methodology of transdisciplinarity-Levels of reality, logic of the included middle and complexity. In A. Ertas (Ed.), *Transdisciplinarity*, (pp. 22-45). Austin, TX: TheAtlas Publishing.
- [31] Brenner, J. E. (2008). The logic of transdisciplinarity. In B. Nicolescu (Ed.), *Transdisciplinary theory and practice*(pp.155-163). Creskill, NJ: Hampton Press.
- [32] Ramadier, T. (2004). Transdisciplinarity and its challenges: The case of urban studies. *Futures*, 36(4), 423-439.
- [33] Nicolescu, B. (2010b). Methodology of transdisciplinarity - Levels of Reality, logic of the included middle and complexity. *Transdisciplinary Journal of Engineering and Science*, 1(1), 19-38.
- [34] Nicolescu, B., & Volckmann, R. (2007). Transdisciplinarity: Basarab Nicolescu talks with Russ Volckmann. *Integral Review*, 4, 73-90.
- [35] Nicolescu, B. (2006). Transdisciplinarity: Past, present and future. In B. Haverkort & C. Reijntjes (Eds.), *Moving worldviews – Reshaping sciences, policies and practices for endogenous sustainable development*, (pp. 142-166). Leusden, Netherlands: COMPAS Editions.
- [36] Nicolescu, B. (2000). Transdisciplinarity and complexity: Levels of reality as a source of indeterminacy. *CIRET Bulletin*, 15, Article 4. Retrieved from <http://ciret-transdisciplinarity.org/bulletin/b15c4.php>
- [37] simplexCT. (2013, December 26). Simplexity is the process by which nature strives towards simple ends by complex means. – Bruce Schiff [Twitter post]. Retrieved from <https://twitter.com/simplexCTnews>
- [38] Max-Neef, M.A. (2005). Foundations of transdisciplinarity. *Ecological Economics* 53, 5-16.
- [39] Gélalian, S. (2018). *I@HoU (The refraction) [L'Information au coeur de l'Univers]* (S. Gélalian Trans.). Paris, France: L'Harmattan.
- [40] Luna, L. E. P., & Alfonzo, N. (2016). Conocimiento, educacion y transcomplejidad [Knowledge, education and transdisciplinarity]. *Educere*, 20(65), 11-20.
- [41] Nicolescu, B. (2008a). Transdisciplinarity - History, methodology, and hermeneutics. *Economy Transdisciplinarity Cognition (ETC) Journal*, 11(2), 13-23.
- [42] van Breda, J. (2007, June 2-6). *Towards a transdisciplinary hermeneutics: A new way of going about the science/religion debate*. Paper presented at the Eighth Annual Metanexus Conference. Philadelphia, PA. Retrieved from <https://www.metanexus.net/towards-transdisciplinary-hermeneutics/>
- [43] van Breda, J. (2008). Overcoming the disciplinary divide: Towards the possibility of a transdisciplinary hermeneutics. In M. Burns & A. Weaver (Eds.), *Exploring sustainability science: A South African perspective*, (pp. 91-134). Stellenbosch, South Africa: African Sun Media.
- [44] McGregor, S. L. T. (2009). Integral leadership's potential to position poverty within transdisciplinarity. *Integral Leadership Review*, 9(2). Retrieved from <http://integralleadershipreview.com/4758-feature-article-integral-leadership%E2%80%99s-potential-to-position-poverty-within-transdisciplinarity1>
- [45] Engle, E. A. (2009). Ontology, epistemology, axiology. *Appalachian Journal of Law*, 8(1), 103-122.
- [46] Hartman, R. S. (1967). *The structure of value: Foundations of scientific axiology*. Carbondale, IL: Southern Illinois University Press.

- [47] McGregor, S. L. T. (2017). Challenges to transdisciplinary collaboration: A conceptual literature review. *Integral Leadership Review*, 17(1), <http://integralleadershipreview.com/15402-challenges-of-transdisciplinary-collaboration-a-conceptual-literature-review/>
- [48] Torkar, G., & McGregor, S. L. T. (2012). Reframing the conception of nature conservation management by transdisciplinary methodology: From stakeholders to stakeholders. *Journal for Nature Conservation*, 20(2), 65-71.
- [49] van Breda, J., & Swilling, M. (2018, July). The guiding logics and principles for designing emergent transdisciplinary research processes: Learning experiences and reflections from a transdisciplinary urban case study in Enkanini informal settlement, South Africa. *Sustainability Science*. Advance online publication. <https://doi.org/10.1007/s11625-018-0606-x>
- [50] Versluis, A., & Nicolescu, B. (2018). Transdisciplinarity and consciousness: Toward an integrated model. *Transdisciplinary Journal of Engineering and Science*, 9, 12-22.
-

About the Author



Dr. Sue L. T. McGregor (PhD, IPHE, Professor Emerita) is a Canadian home economist (nearly 50 years) retired after 30 years from Mount Saint Vincent University, Halifax NS. She has a keen interest in home economics philosophy and leadership along with transdisciplinarity, research paradigms and methodologies, and consumer studies and education. She is a ATLAS Fellow, a Rhoda H. Karpatkin International Consumer Fellow, and she received the TOPACE International Award (Berlin) for distinguished international consumer scholar, especially as consumer educator using a transdisciplinary perspective. Dr. McGregor is the recipient of Kappa Omicron Nu's (KON) Marjorie M. Brown Distinguished Professor Award (home economics leadership) and is Docent in Home Economics at the University of Helsinki (lifetime appointment in recognition of international leadership). She published *Understanding and Evaluating Research* (SAGE) in 2018. Her scholarship is at www.consultmcgregor.com