Transdisciplinary Knowledge Creation

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Introduction

The focus of this book is thinking about and through transdisciplinarity and professional development *as* an educative process. These three ideas are not normally brought together. Professional development refers to acquiring new knowledge and skills to inform *one's practice* (Jasper 2006). Transdisciplinarity is concerned with creating new, integrative knowledge to address the complex problems of *the world* (Nicolescu 2002). "The educative process is *a series of inner changes* through which an individual is *transformed* from an immature personality to a mature personality. . . .[He or she] is a developing personality which responds to all the external conditions and through his [or her] responses grows into a new and progressively more *complex self*" (Judd et al. 1923, p. 33, emphasis added).

In more detail, through the educative process (series of inner changes), people may experience global changes to their concept of themselves. Indeed, some people recognize and attribute the educative process as the catalyst for their transformative change. The process by which people change while engaged in learning (i.e., the educative process) presupposes the possibility that people might have belief problems (philosophical and pragmatic) that shape their judgement of self. Not surprisingly, the educative process is interpreted by each person based on their own experiences; that is, what and how did they learn and how did that change them (Campbell-Higgins 2000).

This chapter frames the transdisciplinary enterprise as an educative process by which people become a more complex self as they engage in transdisciplinary work using the transdisciplinary methodology. In turn, this complex self, who has experienced a series of inner changes (paradigmatic, intellectual and philosophical), can better contribute to solving the problems of the world using the transdisciplinary methodology.

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To begin to weave these three ideas together, note that professional development is considered to be a process of *personal* growth through programs, services and activities designed to enable people, individually or collectively, to enhance their professional and disciplinary practice (Jasper 2006); it is an educative process. From a non-transdisciplinary perspective, Jasper (2006) explains that "the main ways we develop professionally. . . are through the practice of *our* profession [and discipline] itself, and the stimulation from the practice world that makes us continually build on *our* existing knowledge, *seek out* new knowledge and skills, make connections between *our* knowledge base *and* the challenges we encounter in *our* practice, and learn from *our* experiences" (p. 2, emphasis added). Professional development from this perspective is a very personal and private experience.

In contrast, from a Nicolescuian transdisciplinary perspective, professional development would expand to include developing professionally through the practice of one's profession and discipline *in concert with* others, instead of alone. Instead of just become a more learned person, people from a myriad of professions, disciplines and societal sectors would collaboratively work to address complex problems. They would creatively co-generate new knowledge by integrating multiple perspectives using an inclusive logic (to be discussed shortly). Concurrently, people would grow personally and develop professionally (possibly couched within their discipline) through this transdisciplinary enterprise.

To echo Judd et al.'s (1923, p. 33) definition of the educative process, transdisciplinary knowledge creation would help participants "grow into new and progressively more complex" global selves and into collaborative, complex problem solvers. To develop this idea, this chapter introduces the concepts of *transdisciplinary self* and *transdisciplinary maturity* (reflecting Judd et al.'s conception of the educative process). The genesis of transdisciplinarity is briefly discussed, followed with a detailed overview of Basarab Nicolescu's transdisciplinary methodology.

The Genesis of Transdisciplinarity

Transdisciplinarity was introduced to the world in 1972 at a Parisian seminar held by the Organization for Economic Cooperation and Development (OECD). Conceived as a concept in the early seventies (Apostel et al. 1972; Jantsch 1972; Kocklemans 1979; McGregor 2010), it has only just recently gained momentum and grudging acceptance as a necessary paradigmatic, methodological and intellectual innovation. Transdisciplinarity is a relatively new, nascent approach to knowledge creation, competing with longstanding multi- and interdisciplinarity (Du Plessis et al. 2013). Transdisciplinarity remains "a rather elusive concept" that continues to evolve (Jahn et al. 2012, p. 1).

Recognizing that there are two dominant transdisciplinarity camps (Augsburg 2014; Klein 2004), this chapter showcases the approach championed by physicist Basarab Nicolescu (and philosopher Edgar Morin); hence, the moniker *Nicolescuian transdisciplinarity*. They view transdisciplinarity as *a new methodology* to create

knowledge, with attendant axioms for what counts as reality, logic, and knowledge (to be discussed shortly). The other camp (frequently referred to as the Swiss, Zurich or German school) emerged from an *International Transdisciplinary Conference* held in Zurich in 2000 (see proceedings at Klein et al. 2001). The Zurich camp conceptualizes transdisciplinarity as a *new type of research*, called Mode 2 research (see Gibbons et al. 1994), informed by the post-normal science perspective (see also Nowotny 2003). New knowledge is not the express intent, nor does it advocate axioms for knowledge generation, as does the Nicolescuian methodological approach.

Regarding the Nicolescuian approach, an editorial committee at the *First World Congress of Transdisciplinarity* (Portugal, in 1994) drafted a *Charter of Transdisciplinarity* (de Freitas et al. 1994). This charter contains 14 articles referring to the notions of multiple realities, different types of logic, the complexity of the world, and the need for a *transdisciplinary attitude* for those engaged in complex problem solving between and beyond disciplines. Nicolescu (2002) further develops these ideas in his book titled *Manifesto of Transdisciplinarity*. In the spirit of a manifesto, it promotes a new idea (i.e., transdisciplinarity) with prescriptive notions for carrying out the changes he felt should be made in knowledge creation; that is, a new methodology in its own right.

In more detail, drawing from quantum physics (and other aligned sciences), Nicolescu (2002) describes transdisciplinarity as multidimensional and supported by the following three pillars (philosophical axioms) : (a) knowledge as complex and emergent (epistemology); (b) Multiple Levels of Reality mediated by the Hidden Third (ontology); and, (c) the Logic of the Included Middle, which contrasts with Classical exclusive logic (Nicolescu 2008). Although Nicolescu eschews the addition of a fourth axiom dealing with values (i.e., axiology) (see Nicolescu 2011a, p. 37), others believe it should be included (see Du Plessis et al. 2013) and Cicovacki (2009) and McGregor (2011) who have developed arguments for its inclusion in the transdisciplinary (methodology). This chapter will focus on Nicolescu's three axioms.

Three Axioms of Nicolescuian Transdisciplinarity

The basic premise of this chapter is that professional development (emerging into a new complex self) can happen through the transdisciplinary practice of one's profession and discipline *in concert with* divergent others who are co-generating new knowledge. Conversely, transdisciplinary knowledge creation would help participants grow into new and progressively more complex global selves and collaborative, complex problem solvers. This rich, reciprocal relationship necessitates being open to very different notions of longstanding approaches to the axioms of knowledge, logic and reality. Without this *methodological openness*, people will not be able to engage in transdisciplinarity and will remain relegated to their particular disciplines. This *methodological segregation* will affect the educative process, compromising the ability to become a more complex intellectual self, and by association, one's ability to engage in transdisciplinary problem solving.

For clarification, conventional approaches to knowledge creation include empirical, interpretive and critical methodologies, which are inspired by Habermas' (1984) theory of communicative action and what constitutes knowledge (i.e., empirical, interpretive and critical lines of inquiry). These approaches fall within the positivistic/post-positivistic and quantitative/qualitative methodological camps. In particular, scientific, empirical approaches tend to be framed as positivistic and quantitative. Interpretive and critical fall more into the post-positivistic and qualitative camps, although one can engage in positivistic qualitative work if numerical measurements are involved (McGregor and Murnane 2010). Table 1 summarizes the main differences between how these three methodologies conceive reality, knowledge and logic, juxtaposed against Nicolescuian transdisciplinarity. It is evident that the transdisciplinary methodology goes far beyond the other methodologies, yet it depends upon them and complements them as well (de Freitas et al. 1994). The rest of the paper spells out the nuances of Nicolescu's three pillars (axioms) of transdisciplinarity (see primer in the right-hand column of Table 1).

Ontology—Multiple Levels of Reality Mediated by the Hidden Third

The development of more complex, transdisciplinary selves, who could engage in jointly addressing complex problems, would involve profound changes in the way people view reality. They would have to first acknowledge how they *do* view reality and then let that go for a more progressive and radical approach. Because of the power of the Western, positivistic, empirical world view (Du Plessis et al. 2013), most people align with reality as understood by positivism and empiricism (see Table 1). They assume there is *one single reality* that people cannot see, yet believe is *out there*. It is made up of discrete elements that have been in existence since the beginning of time. This approach presumes the building blocks for everything (for life) *already* exist, and are just waiting for someone to *reconfigure them*. When all of these elements are found through the scientific method, a full picture of reality will exist. This view of the world also presumes that reality follows a predetermined path. The principle of determinism (aiding predictability) holds that any event is completely determined by previous events (linear cause and effect). This principle rids people of any agency or free will (i.e., purposeful actions or conscious participation). Also, it is assumed reality is external to our consciousness; it is not a product of our minds (Bullard 2011; Heylighten 2006).

Nicolescuian transdisciplinarity evokes a profoundly different notion of reality, one that better accommodates the complexity, diversity and contradictions in perspectives in the world. Rather than just one reality, transdisciplinarity holds there are multiple levels of realities, with interaction and movement amongst them mediated by, what Nicolescu (2002) calls, the Hidden Third.

In a major push back against Newtonian dualism and the singular notion of matter-based reality, Nicolescu proposes that transdisciplinary (TD) ontology encompasses

Table 1 Comparison of methodological axioms

	Empirical	Interpretive	Critical	Transdisciplinary
Reality (Ontology)	The *one reality* is *out there*, a single reality that people cannot see	Reality is *conditional* upon human experiences	Reality is *of the world*, not imagined, and never fully understood	Multiple realities (upwards of 10) evident along three levels (internal, external and the Hidden Third)
	It is made up of discrete elements; when we find them all through the scientific method, we will have a full picture of reality	Reality is socially and collectively constructed via the lived experiences of people	Reality is *here and now*, shaped by politics, social, gender, values and culture, and deeply mediated by power relations	Reality *is plastic* and always *in flux*, always *moving*
	Reality is external to our consciousness (not a product of our minds)	Reality can be a product of a person's mind OR a product of interactions with others or one's context	Reality is constructed within an oppressive context and reconstructed after challenging the status quo	Interaction amongst the internal and external levels happens in the quantum vacuum (not empty but ripe with potentials)
				Interaction in this fecund vacuum is lubricated by the Hidden Third, creating a zone of non-resistance to others' views on reality (where multiple and contradictory perspectives can be integrated; what appears to be contradictory can temporarily be joined)
Knowledge (Epistemology)	The *one truth* is out there waiting to be discovered	Truth is *created* and there is more than one truth (perspectives)	Truth is grounded in the context, in social, political and historical practices	Knowledge is based on cross-fertilization; that is, it is co-created through an emergent, iterative process amongst those from the academy and civil society
	Knowledge is discovered using the scientific method	There are many ways of knowing aside from the scientific method	Knowledge is created through critically questioning the way things "have always been done"	Resultant knowledge is characterized by complexity, emergence, (re)organization and embodiment (rather than complicated, static and discipline-bound)
	knowledge is objective (bias free)	knowledge is constructed by people	knowledge is transformative, consensual and normative (dialectic)	knowledge is alive; it is 'in-formation', created from intellectual fusion and integrative synergies

Table 1 (continued)

	Empirical	Interpretive	Critical	Transdisciplinary
	Knowledge is viewed through the lens of reductionism, determinism, disjunction (separation), predictability, and linear causality	Knowledge is subjective and value ladened		Knowledge is transcendent in that those involved give up sovereignty of their domain to create a temporary fecund space for the emergence of new knowledge
Logic	Deductive, rational, formal logic	Inductive logic	Inductive logic (more inclusive than empirical)	Inclusive logic (Logic of the Included Middle)
	Clear distinction between facts and values	Concerned with discerning how people understand and make sense of their world by observing them in their world	Inductive logic is used to *induce*; that is, to persuade or lead people to new insights, especially to reveal ideologies and power relationships that are keeping them oppressed	Accommodates the eventual, possible, creation of new, integrative knowledge that does not *yet* exist
	Exclusive logic, which involves cause and effect, linear thinking, reductionism, and either/or approaches (dualism) with no room for contradictions	Inductive logic *suggests* truth but does not ensure it		This logic enables people to imagine that the space between things is alive, dynamic, in flux, moving, perpetually changing and full of potential and eventualities
		The truth generated using inductive logic is *probable* (not certain, as with deductive), based upon the given evidence (there is a chance it can be proven false)		Inclusive logic is used to move through the different types of reality in the zone of non-resistance, leading to unlikely integration of realities and perspectives
				Tensions between people are assumed to hold things together as they emerge through synergistic chaos

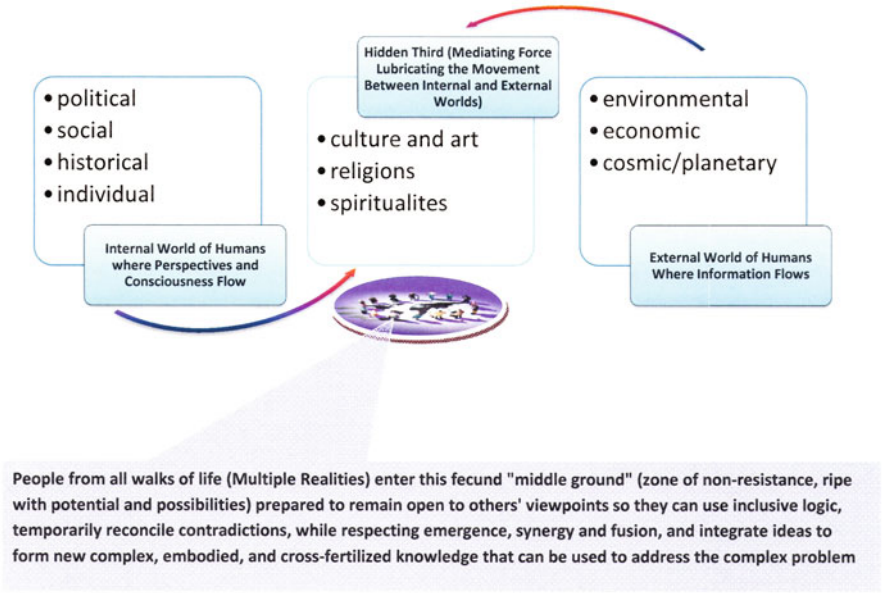

Fig. 1 Transdisciplinary knowledge creation

at least 10 different Realities (disciplinary and sectoral perspectives and view points), aside from just the physical, material reality. Per his convention, this chapter capitalizes the word Reality when referring to his approach. These 10 Realities are organized along three levels. Level one is the internal world of humans, where *consciousness* and *perspectives* flow—the TD-Subject (comprising four Realties: political, social, historical, and individual). Level two is the external world of humans where *information* flows—the TD-Object (comprising three different Realities: environmental, economic, and cosmic/planetary). Interaction and movement amongst the previous two levels are mediated by the Hidden Third level. Peoples' experiences, intuitions, interpretations, descriptions, representations, images, and formulas meet on this third level. As well, three additional Realities exist in this intuitive zone of non-resistance to others' ideas, this mediated interface: culture and art, religions, and spiritualities (Nicolescu 1985, 2002), see Fig. 1.

Of deep significance to Nicolescu's approach to transdisciplinarity is that while each of the 10 Realities is characterized by its incompleteness, in *unity*, they generate new, infinite transdisciplinary knowledge (Nicolescu 2005). This approach to Reality (ontology) is profoundly different from the Newtonian notion of *one* level of reality, the empirical (physical) reality, materialism, predicated on the notion of *matter.* TD transreality includes matter *as well as* consciousness, perspectives, emotions and various approaches to what counts as knowledge and ways of knowing (far beyond Newtonian exclusionary dualism and disciplinarianism).

More about the Hidden Third. Nicolescu needed a concept to accommodate people resisting other people's world views, and a way to allow for the integration of these

world views to create new knowledge. Being a quantum physicist, he was inspired by the quantum vacuum, which is actually *not* empty, it is just at its lowest energy point, ready for emergence and potential. With this inspiration, he coined the term the Hidden Third. The word 'hidden' obviously means it is invisible. The word 'third' typically refers to someone playing a mediating role between two entities. Succinctly, Nicolescu (2011a) suggests that the Hidden Third (the quantum vacuum) refers to a zone of non-resistance to others' views on Reality that plays the mediating role of a third between information and consciousness and perceptions. It acts like a *secretly included* middle agent that allows for temporary unification of, what are normally, contradictory ideas (Nicolescu 2005).

Still inspired by the quantum vacuum, Nicolescu (1985, 2011a) posits that the Hidden Third is a way to conceive of people moving to a place where they become open to others' perspectives, ideologies, value premises and belief systems, inherently letting go of aspects of how they currently *know* the world. To that end, he assumed Reality is always in flux, that it is plastic (Cillier and Nicolescu 2012; Nicolescu 2011b), meaning it is malleable and pliable. Transdisciplinarity is deeply concerned with the dynamics created by the simultaneous action of several Levels of Reality; that is, the *movement* of Reality, facilitated by the lubricating role of the Hidden Third (Nicolescu 1999). The result of this *transmovement* is the emergence of new transdisciplinary knowledge, possible because people's eyes and minds have been opened to other points of view, which can be integrated using the Logic of the Included Middle.

Inclusive Logic of the Included Middle

Per Table 1, positivistic, empirical approaches rely on deductive, formal logic. And, "[d]espite the limitations of classical, binary logic that have been laid bare by modern physics, contemporary scientific and western cultural thinking is still dominated by the Aristotelian tradition of *exclusive*. . . logic" (Cole 2006, p. 11, emphasis added). It is called exclusive because it *negates* the possibility of co-existing contradictions, striving instead for consistency. Classical deductive logic holds that something is consistent if it does not have contradictions (see more below). Presuming that contradictions compromise both regularity and consistency negates (pun intended) the possibility of connecting diverse ideas to create necessary complexity, this exclusive logic precludes inclusive solutions to humanity's complex problems.

In more detail, Classic linear logic (Newtonian exclusive logic) is based on three fundamental axioms (i.e., self-evident truths, not susceptible to proof or disproof): (a) the axiom of identity: A is A; (b) the axiom of non contradiction: A is not non-A; and, (c) the axiom of the excluded middle, meaning there is no third term **T** (Latin *tiers*), which is simultaneously A and non-A. Classical, exclusive logic says A and non-A cannot exist at the same time; classical scholars call this idea *consistency*. In classical logic, a *contradiction* exists when people try to say A (he is brave) and non-A (he is not brave) *exist at the same time*. In simple language, there is no *third*

possibility of, for example, being brave and not brave, at the same time (Cole 2006; Nicolescu 1985). Suggesting such a thing is *illogical*; he is either brave or he isn't. Something is either true or it isn't. We all know of people who are brave in some situations and not in others, but exclusive logic denies this possibility of co-existing contradictions. Exclusive logic assumes that ideas that are antagonistic cannot be connected (Brenner 2005, 2008).

Brenner (2005) coined the term *transconsistent logic* to accommodate the inclusive nature of transdisciplinary logic. If Classical science is predicated on consistency, transdisciplinarity must expand to include *transconsistency*. Brenner understood this to mean the "realm beyond the consistent" (2008, p. 161), where new knowledge can emerge because potential was released and acted upon. He explains that when A is *actualized* (exists in fact), non-A is *potentialized* (has the capacity to exist in the future) and vice versa, alternately, without either ever disappearing completely (Brenner 2005, 2008). Both the scientist and the indigenous elder retain their identity while a new insight is gained from their interaction. "[T]hat which appears to be disunited is united, and that which appears to be contradictory is perceived as noncontradictory" (Nicolescu 2008, p. 7). "Opposing aspects of a phenomenon that are generally considered independent can thus be understood as being in dynamic relationship" (Brenner 2005, p. 3).

Brenner, explains that "the law of the excluded middle [is] a limiting case. . . only instantiated in *simple* situations" (2005, p. 3), and also introduces the idea of *logic in reality* (LIR) (Brenner 2011). He purposely intends LIR to reflect complexity, and views it as a "logical principle of dynamic opposition, an antagonistic duality inherent in. . . all real physical and non-physical phenomena" (Brenner 2011 p. 3). Nicolescu (1985) refers to the logic required for emergent, complex situations as the *Logic of the Included Middle*. Inclusive logic accommodates the eventual, possible, creation of new integrative knowledge that does not yet exist. It does so by permitting each of (a) empty domains, (b) worlds that do not exist, and (c) worlds that might eventually exist (Nolt 2010). To exclude any of these domains, realities or worlds negates complex solutions to transdisciplinary problems.

In more detail, realizing that in order to address the complex problems facing humanity, there *had* to be way to reconcile the co-existing (a) certainty of consistencies and (b) possibilities opened up with contradictions, Nicolescu (1985, 2011b) proposes a change to the third classical linear logic axiom, submitting that a third term **T** *can* exist, which is simultaneously A and non-A. The Logic of the Included Middle informs the third "T", which stands for *tiers inclus*, the included third (Nicolescu 1985), that which can co-exist in contradiction.

In these instances (for example in the contentious social, economic and political spheres), topics, ideas and people that should logically be excluded or antagonistic *can* be connected (Brenner 2008). Transdisciplinary quantum logic assumes that when A and non-A *do* co-exist at the same time, when a **t**hird temporary state *does* emerge, a *contradiction* is resolved at a higher level of reality or complexity. This new state represents the result of two contradictory things interacting and coming to a temporary resolution (Ramadier 2004) (e.g., the scientist accepting insights gained from a narrative reflecting an indigenous wisdom tradition).

Brenner (2011) actually proposes the term *included emergent middle* for these sorts of reality, explaining that the "logic of an *included* middle consist[s] of axioms and rules for determining the state of the three dynamic terms involved in a phenomenon" (Brenner 2005, p. 3); that is, A, non A and an emergent, more complex, **t**emporary **T**hird state. This inclusive logic best describes a transdisciplinary picture of reality, where solutions emerge in the fecund middle, the vacuum. In conclusion, the existence of this inclusive logic and related principles, and the ontology based on them (what counts as reality), bears directly on the problem of the unity of knowledge.

Knowledge as Complex, Emergent, Embodied and Cross-fertilized

The third basic tenet of Nicolescuian transdisciplinarity is complexity. In some documents, he actually refers to *the epistemology axiom* (e.g., 2010), but he usually calls it the *Complexity Axiom: The Universal Interdependence* (see Nicolescu 2011a, p. 36). He believes that complexity is a modern form of the ancient principle of universal interdependence, in that "everything is dependent on everything else, everything is connected, nothing is separate" (Nicolescu 2004, p. 48). Morin (2006) concurs, referring to the "generalized interdependence of everything and everyone" (p. 21). Nicolescu recently recognized the need for a "future detailed study of *transcomplexity*" but he did not define the term except for saying it "unifies different types of complexity" (2010, p. 8). In particular, he commented on horizontal, vertical, transversal and restricted complexity. He has elected to use Morin's notion of *generalized complexity* (1999, 2005, 2006), claiming it comes the closest to what is needed to deal with transdisciplinary problems. This is likely because Morin (2006) views complexity through an *epistemological lens* that respects chaos, disorder, uncertainty, (re)organization, and emergence, rather than within the epistemology of classical science (see left column in Table 1).

Disciplinary science isolates disciplines from each other and isolates them from their environments. The breaking up of knowledge into separate disciplines "prevents [knowledge] from linking and contextualizing" (Morin 2006, p. 14). To offset this effect, he urges us to "recognize the inseparability of the separable" (p. 16). That is, even though disciplines *can* be separated, if we hope to address the complex problems of the world, they have to be re-conceived as inseparable. Morin explains that "everything that is separated is *at the same time* inseparable" (p. 16, emphasis added). This premise is especially true from the Nicolescuian transdisciplinary perspective, which holds that the academy and the rest of the world are inseparable, and their disparate viewpoints must be voiced and integrated to solve complex human problems. But Morin (2006) also realizes that "our aptitude for connecting is underdeveloped and our aptitude for separating is overdeveloped. . . .[O]ur atrophy of the capacity to connect is increasingly serious in a globalized world" (p. 21).

So, it goes without saying that creating transdisciplinary knowledge is all about connecting, all about complexity, emergence and the intellectual fusion of disparate world views into new integral knowledge (McGregor 2004). Complex transdisciplinary knowledge is created in the fertile middle ground between the mediated Multiple Levels of Reality, using inclusive logic. Professional development is a *cognitive* process, pertaining to knowledge (Jasper 2006). This means those engaged in transdisciplinary work must learn to embrace complexity thinking as part of their cognitive personal growth. Complexity is based on a collection of powerful assumptions: (a) people and systems can adapt and reorganize, (b) complex behaviour can emerge from a few simple rules applied locally, (c) order can emerge without central control, (d) small changes can leverage big effects, (e) events are unpredictable meaning people must trust that things will emerge, and (f) co-evolution of life proceeds through constant tension, chaos and balance (McGregor 2012). Indeed, Nicolescu (2010) describes the totality of all of the levels of Reality as a *complex structure*, which necessitates a non-classical understanding of the terms complexity and knowledge.

Pre-empting the discussion of transdisciplinarity epistemology, consider that, based on Newtonian thinking, positivism assumes that everything that exists now (i.e., all matter) has existed since the beginning of time and will continue to exist, just in different configurations (due to humans exerting forces and repositioning the matter in time and space). Discovery of new knowledge is therefore not a creative process; it is merely an *uncovering* of distinctions that were waiting to be observed. The premise that knowledge is out there, waiting to be discovered, leaves little room for novelty or creation when solving complex problems (Bullard 2011; Heylighten 2006). Morin (2006) recounts two examples of unintended negative consequences when people solved complex problems using a techno-economic mindset, which is predicated on classical science notions of what counts as knowledge (separate, fragmented, disconnected, static; the damming of the Nile river and the deviation of rivers in Siberia).

To reiterate, transdisciplinary knowledge is emergent, complex, embodied and cross-fertilized. Emergence refers to novel qualities, properties, patterns and structures that appear from relatively simple interactions among people, qualities that did not exist when presented in isolation. These new qualities are layered in arrangements of increased complexity (Morin 2005; Nicolescu 2008). In fact, the process of emergence manifests when people pass through the zone of non-resistance (accepting there are many Realities) and enter the fertile, temporary *middle ground* to problem solve using inclusive logic. The resultant transdisciplinary knowledge is characterized as embodied, a part of everyone who co-created it, rather than discipline-bound or sector-bound.

McGregor uses a lava lamp metaphor to express this idea. Inclusive logic enables people to imagine that the space between things is alive, dynamic, in flux, moving, perpetually changing and full of potential and eventualities (like a lava lamp). When people from different disciplines and sectors come in contact with each other and are motivated, an energizing force is generated—a synergy is created. This synergy leads to the generation of *embodied knowledge* created from the energy emanating from *intellectual fusion.* Everyone involved now *owns* the new knowledge because it

was co-created (McGregor 2004, 2009). Horlick-Jones and Sime (2004) coined the phrase *border-work* to refer to the intellectual work that occurs when people living on the borders of the academy (university disciplines) and other sectors (civil society, industry, government) engage in knowledge generation to address wicked problems. This new knowledge is open and alive because the wicked problems the knowledge addresses are alive, emerging from the life world (Nicolescu 2005).

Finally, cross-fertilization of transdisciplinary knowledge results from the iterative convergence of different actors and their fuzzy-edged balls of knowing, shaped by their respective disciplinary or sectoral expertise (McGregor 2004). Cross-fertilized knowledge emerges through the process of *transintegration*, understood to mean opening things up to all disciplines and to civil society- and other sector-knowing so that something new can be created via synthesis and the harmonization of ideas and perspectives (Nicolescu 1997). Cross-fertilized knowledge is also *transcendent* in that those involved temporarily give up sovereignty of their domain to create a fecund space for the emergence of new knowledge (Somerville and Rapport 2002). Cross-fertilization (transcending disciplines and embracing sectoral knowledge) can lead to an enlarged vision of the issue at hand, the fusion of ideas from different sources, and innovative and inclusive solutions.

Summary and Conclusion

This chapter conceived transdisciplinary problem solving as an educative process that affects professional development whereby, while engaged in transdisciplinary work, individuals are transformed from immature to mature co-participants. In this case, the focus is on people's maturity vis-à-viz the transdisciplinary methodology. To move toward *transdisciplinary maturity*, people must be willing to engage with non-classical approaches to creating knowledge (including reframing what constitutes reality and logic). This chapter showcased Nicolescuian transdisciplinarity (see also Table 1).

As an overview, Nicolescuian transdisciplinarity holds that actors and agents would crisscross disciplinary and sectoral boundaries with the intent to change, remove, or go beyond the borders while integrating perspectives and practices emanating from this intellectual and pragmatic migration. People would recognize that transdisciplinary problem solving for humanity happens in the fertile *middle ground*, encompassing border crossing *within* higher education (disciplines) *and among* higher education, civil society and other sectors. These transdisciplinary border activities are informed by the logic of inclusion and the mediated interaction amongst Multiple Levels of Reality. People would find new respect for tension and chaos, especially as they manage the value-laden transdisciplinary dialogue inherent in intellectual fusion and perspective integration. People would appreciate that resultant transdisciplinary knowledge is complex, emergent, cross-fertilized and embodied.

Drawing on Judd et al.'s (1923) definition of the educative process, we can also suggest that the *transdisciplinary educative process* is profoundly shaped by external

factors as well as the degree of a person's transdisciplinary maturity. The external factors are the deep, complex problems being addressed *and* their contexts (local, regional, national and global). Judd et al.'s (1923) theory helps us suggest that, through people's responses to the multidimensional contextual factors, they grow into a new, and possibly more complex, version of themselves. We could say that the transdisciplinary educative process is the catalyst for the emergence of a new, more mature *transdisciplinary self,* couched in the transdisciplinary methodology.

Notions of reality, logic and knowledge would continually morph and emerge for a *maturing transdisciplinary self*. People would (re)organize their personal growth until they became comfortable with, and competent at, integrating diverse, seemingly contradictory, perspectives using inclusive logic while interacting in the fecund middle ground. This transdynamic process leads to knowledge that is emergent, complex, embodied and cross-fertilized. As far as professional development goes (the focus of this book), I conclude that embracing transdisciplinary maturity in the Nicolescuian methodology greatly informs the process of people's *personal* growth, thereby enhancing their professional and disciplinary practice and, by association, better ensuring sustainable, tenable solutions to humanity's complex problems.

References

Apostel, L., Berger, S., Briggs, A., & Machaud, G. (Eds.). (1972). *Interdisciplinarity, problems of teaching and research in universities*. Paris: OECD, CERI.

Augsburg, T. (2014). Becoming transdisciplinary: The emergence of the transdisciplinary individual. *World Futures, 70*(3/4), 233–247.

Brenner, J. E. (2005, September 19–22). *Knowledge as systems: A logic of epistemology. Paper presented at 6th European Systems Science Congress*. Paris: French Association of Systems Science. http://www.ressystemica.org/afscet/resSystemica/Paris05/brenner.pdf. Accessed 25 Jan 2014.

Brenner, J. E. (2008). The logic of transdisciplinarity. In B. Nicolescu (Ed.), *Transdisciplinary theory and practice* (pp. 155–163). Creskill: Hampton Press.

Brenner, J. E. (2011). *Essay: The transdisciplinary logic of transdisciplinarity*. New York: Metanexus Institute. http://www.metanexus.net/essay/transdisciplinary-logic-transdisciplinarity. Accessed 25 Jan 2014.

Bullard, T. (2011). The problems with Newtonian thinking. *A video presentation at the International Alchemy Conference*. Long Beach, CA. http://www.theresabullard.com/IAC_Part3. Accessed 1 Oct 2014.

Campbell-Higgins, C. (2000). *The educative process as a contributor to self-efficacy in adult education graduate students* (Unpublished doctoral dissertation). University of Toronto, Ontario. https://tspace.library.utoronto.ca/bitstream/1807/14548/1/NQ49806.pdf. Accessed 25 Jan 2014.

Cicovacki, P. (2009). Transdisciplinarity as an interactive method. *Integral Leadership Review, 9*(5). http://integralleadershipreview.com/4549-feature-articletransdisciplinarity-as-an-interactive-method-a-critical-reflection-on-the-three-pillars-of-transdisciplinarity/. Accessed 25 Jan 2014.

Cillier, P., & Nicolescu, B. (2012). Complexity and transdisciplinarity: Discontinuity, levels of reality and the hidden third. *Futures, 44*(8), 711–718.

Cole, A. (2006). *Motueka Catchment futures, trandisciplinarity, a local sustainability problématique and the Achilles-heel of Western science*. Paper presented at the 5th Australasian Conference on Social and Environmental Accounting Research. Wellington, NZ.

http://icm.landcareresearch.co.nz/knowledgebase/publications/public/cole_anthony_17rfc_v2pdf. Accessed 25 Jan 2014.

Du Plessis, H., Sehume, J., & Martin, L. (2013). *The concept and application of transdisciplinarity in intellectual discourse and research*. Johannesburg: Real African Publishers.

de Freitas, L., Morin, E., & Nicolescu, B. (1994). Charter of transdisciplinarity. In G. Tanzella-Nitti (Ed.), *Interdisciplinary encyclopedia of religion and science*. Rome, Italy. http://www.inters.org/Freitas-Morin-Nicolescu-Transdisciplinarity. Accessed 25 Jan 2014.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge*. London: Sage.

Habermas, J. (1984). *The theory of communicative action* (trans: T. McCarthy). Boston: Beacon.

Heylighen, F. (2006). The Newtonian world view. In F. Heylighen, C. Joslyn, & V. Turchin (Eds.), *Principia cybernetica web*. Brussels: Principia Cybernetica. http://pespmc1.vub.ac.be/NEWTONWV.html. Accessed 25 Jan 2014.

Horlick-Jones, T., & Sime, J. (2004). Living on the border: Knowledge, risk and transdisciplinarity. *Futures, 36*(4), 441–456.

Jahn, T., Bergmann, M., & Keil, F. (2012). Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics, 79*(July), 1–10.

Jantsch, E. (1972). Towards interdisciplinarity and transdisciplinarity in education and innovation. In L. Apostel, S. Berger, A. Briggs, & G. Machaud (Eds.), *Interdisciplinarity problems of teaching and research in universities* (pp. 97–121). Paris: OECD, CERI.

Jasper, N. (2006). *Reflection, decision making and professional development*. Oxford: Blackwell.

Judd, C., Bagley, W., Kilpatrick, W., Moore, E., & Chassell, J. (1923). What is the educative process? *Religious Education, 18*(1), 33–51.

Klein, J.-T. (2004). Prospects for transdisciplinarity. *Futures, 36*(4), 515–526.

Klein, J.-T., Grossenbacher-Mansuy, W., Häberli, R., Bill, A., Scholz, R., & Welti, M. (Eds.). (2001). *Transdisciplinarity: Joint problem solving among science, technology, and society*. Berlin: Birkhäuser Verlag.

Kocklemans, J. (1979). Why interdisciplinarity? In J. Kocklemans (Ed.), *Interdisciplinarity and higher education* (pp. 123–160). University Park: Pennsylvania State University Press.

McGregor, S. L. T. (2004). *The nature of transdisciplinary research and practice*. Kappa Omicron Nu Human Sciences Working Paper Series. http://www.kon.org/hswp/archive/transdiscipl.html. Accessed 25 Jan 2014.

McGregor, S. L. T. (2009). Integral leadership's potential to position poverty within transdisciplinarity. *Integral Leadership Review, 9*(2). http://integralleadershipreview.com/4758-feature-article-integral-leadership%E2%80%99s-potential-to-position-poverty-within-transdisciplinarity1. Accessed 25 Jan 2014.

McGregor, S. L. T. (2010). Historical notions of transdisciplinarity in home economics. *KON FORUM, 16*(2). http://www.kon.org/archives/forum/16–2/mcgregor.html. Accessed 25 Jan 2014.

McGregor, S. L. T. (2011). Transdisciplinary axiology: To be or not to be. *Integral Leadership Review, 11*(3). http://integralleadershipreview.com/2011/08/transdisciplinary-axiology-to-be-or-not-to-be. Accessed 25 Jan 2014.

McGregor, S. L. T. (2012). Complexity economics, wicked problems and consumer education. *International Journal of Consumer Studies, 36*(1), 61–69.

McGregor, S. L. T., & Murnane, J. (2010). Paradigm, methodology and method: Intellectual integrity in consumer scholarship. *International Journal of Consumer Studies, 34*(4), 419–427.

Morin, E. (1999). *Seven complex lessons in education for the future*. Paris, France: UNESCO. http://unesdoc.unesco.org/images/0011/001177/117740eo.pdf. Accessed 25 Jan 2014.

Morin, E. (2005). Restricted complexity, general complexity. In C. Gershenson, D. Aerts, & B. Edmonds (Eds.), *Worldviews, science and us: Philosophy and complexity* (pp. 5–29). London: World Scientific Publishing. E-chapter http://www.worldscientific.com/doi/pdf/10.1142/9789812707420_0002. Accessed 25 Jan 2014.

Morin, E. (2006). *Restricted complexity, general complexity* (trans: C. Gerhenson). Paper presented at the Intelligence de la complexité: Épistémologie et pragmatique colloquium. Cerisy-La-Salle, France. http://cogprints.org/5217/1/Morin.pdf. Accessed 25 Jan 2014.

Nicolescu, B. (1985). *Nous, la particule et le monde [We, the particle and the world]*. Paris: Le Mail.

Nicolescu, B. (1997). *The transdisciplinary evolution of the university condition for sustainable development*. Paper presented at the International Congress of the International Association of Universities. Bangkok, Thailand: Chulalongkorn University. http://ciret-transdisciplinarity.org//bulletin/b12c8.php. Accessed 25 Jan 2014.

Nicolescu, B. (1999). *The transdisciplinary evolution of learning*. Paper presented at the American Educational Research Association conference. Montreal, Quebec. http://www.learndev.org/dl/nicolescu_f.pdf. Accessed 25 Jan 2014.

Nicolescu, B. (2002). *Manifesto of transdisciplinarity* (trans: K.-C.Voss). Albany: State University of New York Press.

Nicolescu, B. (2004). Gurdjieff's philosophy of nature. In J. Needleman & G. Baker (Eds.), *Gurdjieff* (pp. 37–69). New York: The Continuum International Publishing Group.

Nicolescu, B. (2005, June 4–8). *Towards transdisciplinary education and learning*. Paper presented at the Metanexus Institute conference on Science and religion: Global perspectives. Philadelphia, PA. http://www.metanexus.net/archive/conference2005/pdf/nicolescu.pdf. Accessed 25 Jan 2014.

Nicolescu, B. (Ed.). (2008). *Transdisciplinary theory and practice*. Creskill: Hampton Press.

Nicolescu, B. (2010). *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. http://basarab-nicolescu.fr/Docs_articles/Disciplinary_Boundaries.htm. Accessed 25 Jan 2014.

Nicolescu, B. (2011a). Methodology of transdisciplinarity-Levels of reality, logic of the included middle and complexity. In A. Ertas (Ed.), *Transdisciplinarity: Bridging science, social sciences, humanities and engineering* (pp. 22–45). Austin: The Atlas Publishing.

Nicolescu, B. (2011b). Transdisciplinarity: The hidden third, between the subject and the object. In I. Chirilă & P. Bud (Eds.), *Ştiinţă, Spiritualitate, Societate [Science, Spirituality, Society]* (pp. 11–34). Eikon, Cluj-Napoca, Romania. http://basarab-nicolescu.fr/Docs_articles/ClujHiddenThird052009Proceedings.pdf. Accessed 25 Jan 2014.

Nolt, J. (2010). Free logic. In E. N. Zalta (Ed.), *Stanford encyclopedia of philosophy*. Stanford: Stanford University. http://plato.stanford.edu/entries/logic-free/. Accessed 25 Jan 2014.

Nowotny, H. (2003). The potential of transdisciplinarity. In *Rethinking interdisciplinarity* (pp. 48–53). Paris: Interdisciplines Project. http://www.helganowotny.eu/downloads/helga_nowotny_b59.pdf. Accessed 25 Jan 2014.

Ramadier, T. (2004). Transdisciplinarity and its challenges: The case of urban studies. *Futures, 36*(4), 423–439.

Somerville, M. A., & Rapport, D. (2002). *Transdisciplinarity: Recreating integrated knowledge*. Montreal: McGill-Queens University Press.

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