



VOLUME 10 ISSUE 2

The International Journal of

Interdisciplinary Educational Studies

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Dialogue

An Educational Project

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THE INTERNATIONAL JOURNAL OF INTERDISCIPLINARY EDUCATIONAL STUDIES
www.thesocialsciences.com

First published in 2015 in Champaign, Illinois, USA
by Common Ground Publishing LLC
www.commongroundpublishing.com

ISSN 2327-011X

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Ground

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Transdisciplinarity, Autopoiesis, and Dialogue: An Educational Project

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Abstract: Developing strategies, methods, and criteria for changing educational practices requires a methodological and “scientific” warrant. This article explores transdisciplinarity as a methodological basis for working with paradox and contradictions as the inevitable result of reflective human consciousness. Transdisciplinary thinking is discussed as a conscious and concerted effort to conduct scientific inquiry and to develop social theory and educational practice in generative, socially just, and environmentally responsible ways. Autopoiesis is offered as a coherent scientific bridge mediating transdisciplinary insights into the mitigation of paradox and the development of subject/object consciousness in human beings. Bohmian dialogue is then suggested as a method and needed aspect of educational pedagogy through which the goals of a transdisciplinary methodology can be met.

Keywords: Transdisciplinary, Autopoiesis, Dialogue

Introduction

Meaningful education that is responsive to and generative of global concerns of equity, sustainability, and civil society can only be effected (I argue) if we transcend existing disciplinary and ideological boundaries whose origins are constituted and rationalized, in part, in the universal social self. Existing institutional and organizational strategies and policies continue to focus on and privilege abstract and theoretical conceptions of persons, organizations, and politics while generally ignoring the embodied intra and interpersonal connections forged in a “living present” (Stacey 2001) that is continuously and coherently emerging as embodied awareness. The social self as I interpret it is a self-conscious subject in an objective world – a languaged self that is separate and apart from others; identified with its body, and maintained through its social connections (Mead 1934). I will argue here that this “self” is both the process and content of its own communal creation – an autopoietic unity (Maturana & Varela 1980, 1987) that at its best lives in the space between subjective experience and objective thought. Becoming conscious of and adapting behavior to this middle way is the focus of paper. I am suggesting a synthesis of transdisciplinary methodology (Finkenthal, 2001; 2008; Nicolescu, 2008), existential phenomenology (Gadamer 1976; Larrabee 1990; Merleau-Ponty 1962; Todes 2001, & Varela 1996); and pragmatist social theory (James, 1996b; Mead, 1932, 1934, 1938; Rosenthal & Bourgeois 1991). That human beings in general have not found this middle way seems clear.

Humanity is in a time requiring significant adaptation: social, political, and environmental disasters loom (Brand 2009; Bauman 2007, Kolbert 2014, Martin 2006). Possible solutions seem inevitably to entail global, universal, scientific, and apparently impossible political methods. Increasingly fragmented domains of disciplinary knowledge, diverse political perspectives, and lack of economic equality exacerbate the crisis. For the most part culture and education in culture suggest solutions and strategies based on concepts and “plans” communicated through the logic and reason of a highly structured and politically and economically legitimated discourse and through the habitual enactments of historically generated normativity in large part protected and nurtured by the media of the political and economic elites. These structures are increasingly seen as sites of conflicting perspectives and discourses. Globalization – where it is inclusive of non-western non-neo-liberal perspectives, is a fractious and contentious context of multiple perspectives that is continually (and some would argue increasingly) upsetting the policy goals of neo-liberal and putatively first-world democratic regimes. The one great fantasy that continues to

beguile policy makers and citizens alike is one that keeps the developed nations basically as they are with a vision of a gradual and progressive inclusion of all populations in the largesse of late consumer capitalism. Alas this is a mostly unrealistic fantasy and the “science” as well as popular opinion hold this outcome to be vanishingly unlikely. More obvious is the imperative to stabilize and democratize discourses based on a calculus of distributional equality and social justice. However, that too seems unlikely given our current trends in terms of both consumerism and exceptionalism. This above mentioned pathology is, I argue, directly related to current assumptions that hold substance as primary over process and objective thought over feeling or affective states of embodied experience (Emirbayer 1997; Rescher 1996). It is this imbalance and inability to inhabit the middle space between embodied experience and reflective thought that transdisciplinary education can mitigate. The harm done to embodiment, direct experience, and natural ecological and evolutionary processes is incalculable.

In the social sphere the imbalance is most egregious in the colonial, post-colonial, and neo-liberal treatment of women, minorities, indigenous peoples, LGBT people, the poor, the uneducated, and the dispossessed. The violence and injustice is directly related to these groups’ proximity to and encounter with those elements of direct experience; with the sheer facticity of birth, death, blood, relationship, food, hunger, craft, and closeness to the elements (Butler 2004). These groups are constant reminders to the “civilized *man*” that his narratives of power, privilege, and legacy are continually threatened with undoing, refutation, and re-constitution. Nietzsche’s (1995) investigation of the Apollonian and Dionysian struggle of the rational self with the unruly and uncertain body is an explicit recognition of this idea’s historical generativity. A fundamental assumption of this paper is that the current zeitgeist is driven by the logics and scientisms of an Apollonian substantialism that is increasingly incapable of seeing or understanding the nature of the Dionysian and processual body. The Apollonian perspective is evident throughout academic social theory in notions of the “civilizing process” (Elias 1994) the general lack of attention to embodiment (Leder 1990; Shilling 2012) and to Asian and indigenous or “other” ways of knowing and being (Mishra 2012).

In contrast to a world founded on substantialist assumptions built into rational abstractions is the pragmatist derived assumption that all of us live our lives locally and embedded in situations where the scope of our agency and our efficacy is always mediated by our bodies through our relationships. Further, that these situations continually emerge and that the rational abstractions coming out of our embodied experiences and doings are problematic objects of consciousness (social constructions that become psychological realities) that must be, to one extent or another, continually critiqued and reformed so as to maintain some adaptive capacity (see for example, Dewey 1958; James 1996a, 1996b; Mead 1932). But typically we don’t critique and reform but placidly exist amidst an assumed social order and regularity. Assuming one does subscribe to the belief that there is need to question the general order then there is some merit in creating educational practices toward that end. However, before we discuss specific methods for achieving this it is important to address the larger problem of methodology.

Transdisciplinarity

The notion of the “transdiscipline” as interpreted and discussed here is the contemporary result of an evolution of ideas. Altman & Rogoff’s (1987) assessment of this development and their relating it to Dewey’s (1958) and Dewey and Bentley’s (1949) conclusions concerning the unity (non-dual nature) of embodied experience are foundational for conceiving a transdisciplinary methodology. Their work (Altman & Rogoff 1987) charts the evolution in human communities from entity and trait perspectives to “either/or” logics, to both/and ways of thinking, and finally to a Deweyan “transactional” perspective¹. More recent work by the physicist’s Nicolescu (2008)

¹ For an excellent overview of how perspectives and consciousness are related to historical and evolutionary analysis see Gebser’s (1985) monumental work the Ever-Present Origin.

and Finkenthal (2001; 2008) have situated the conversation in terms of difficulties arising in the physical sciences in dealing with the paradox of observers achieving objectivity. A cursory and naïve interpretation of “transdiscipline” suggests that it is simply a methodological modification of traditional disciplinary practices (see also, Klein 2005). Finkenthal (2001), on the other hand, suggests that disciplinary thinking is ubiquitous in both the natural sciences and the humanities and structures the way we “objectively” see reality. He goes on to say that

moving from discipline to discipline is not such a great adventure...we are basically using the same tools, we apply the same types of reasoning, briefly we submit ourselves to the one and the same *mathesis universalis*. “Interdisciplinarity” is thus a limited enterprise, it is a “weak” interdisciplinarity. (p. 71. italics in the original)

Disciplines (and multi-disciplines and interdisciplines) are understood as part of one large enterprise that necessarily excludes the affective situated realm of direct experience. The critique of disciplinarity is that it is not sufficiently inclusive to capture the totality of that which is studied (which always includes the observer). Nicolescu (2008) critiques the inability of disciplinary knowledge to accommodate context and the paradox of subjectivity in its methods. Describing the distinction as between an *In Vitro* and an *In Vivo* knowledge (p. 3) he articulates transdisciplinarity as including both context and subjectivity encompassing an understanding over and against knowledge; a wholeness of embodiment as opposed to analytic intelligence; and the inclusion of values as opposed to their exclusion. He also describes the necessary logic of a transdisciplinary methodology as incorporating the “included middle” as opposed to the “excluded middle” of a disciplinary Aristotelian logic. This non-Aristotelian logic requires that paradox be dissolved by somehow incorporating the problem within a larger framework arising from a new perspective or way of seeing the world that includes the observer. Nicolescu (2008) suggests that the included middle exists at a level of reality different than the Aristotelian binary opposition indicated by the law of the excluded middle - where for every A there is a not-A and a “thing” can never be more or less than itself.

Brenner (2008) describes the included middle from the perspective of physics and the creation of the “quanton” as the third element making whole the “particle/wave” paradox of quantum physics (p. 158). He says, “The logic of the included middle does not abolish that of the excluded middle, which remains valid for simple, consistent situations. However, the former is the privileged logic of complexity, of the real mental, social, and political world and of an approach to resolution of its antagonisms” (p. 158). This notion of the “real mental” is significant when one reflects on the ordinary experience of an “object”. An object is, by virtue of how it is named and “normally” perceived, an “other” and this other is “not-the observer” or Not-A. I am not you – I am not that which I perceive. It appears that ordinary consciousness and perception operate on the strength of Aristotle’s law of the excluded middle. Theoretical physics and the Deweyan idea of the “life-process” suggest a different order of perception and consciousness. This is what is at stake in the discussion of a transdisciplinary methodology. How does one achieve this? Is there some “thing” to be achieved? It is my view that education is the ideal practice for developing this different perception.

Transdisciplinary methodology as I am interpreting it here (and following Nicolescu 2008) suggests that this transformation can be effected via three key strategies.

- First, we must develop in ourselves an active recognition that context and subjectivity are foundational to our identities. How we inhabit contexts with our subjective phenomenological selves determines the quality of our lives. The quality of experience and the care for each other in being able to fully experience the world are psychological, political and cultural issues that require attention. We need

ongoing critical inquiry into what systems and practices exist that deny or erase the effects of subjectivity and embodied local action.

- Second, that we understand and appreciate the difference between understanding and knowing – where understanding is emergent, relational, and dynamic and knowledge is historical, univocal, and fixed. Broadly conceived as the difference between education and instruction - a conscious recognition of these two modes of rational cognition will result in a wholesale transformation of educational practices. As in Freire's (2000) work the imperative is that the development of *understanding* precede and condition the development of *knowledge* – that education should drive instruction and not the other way around. This distinction also adheres to the difference between embodied and lived experience and understanding and the more abstract disembodied and “thought about” world of abstract knowledge. Clearly both are necessary but the emphasis is first on the foundation and then the superstructure.
- Third, that there is a keen and broadly practiced appreciation and inclusion of values in the work of science, economics, and social order. The wholesale retreat from consideration of values and ethics in industrial production and war technologies is at the heart of global crises. I argue that a central reason for this paralysis in understanding values and ethical behavior is the inability to listen and respond to one another openly and creatively. That is, we don't know how to engage in transformative dialogue.

Mitigation of these harms is an urgent global task. However there is little traction for these sentiments absent a compelling argument demonstrating a biological and “scientific” interpretation of transdisciplinary thinking. Before my analysis of these three key features of a transdisciplinary methodology related to education it is first necessary to describe in more detail a response to Nicolescu's (and others) interpretation of the “included third” or the mechanism through which we “transcend” the limitations of the binary logic of A and Not-A. It is my position that Humberto Maturana and his colleague Francisco Varela achieved in a number of works a coherent framework for understanding how our physical embodiment both generates and reflects this overall transdisciplinary insight.

Autopoiesis

Essentially my argument is that the impulse toward inhabiting the “included third” originates in the biology of living systems and culminates in the biology/psychology/culture of human systems. Piaget (1971) established the precedent of extending biological models to the realm of cognitive development and helped develop the structures for arguing biological questions in relation to epistemological and ontological assumptions. Mead (1938) also made similar strides in making sense of our biological and social nature . Maturana and Varela (1980; 1987) extend that tradition and argued that all living organism share a fundamental organization which appears to both isolate them as individuals and through various membranes and boundaries connect them to their environment. Their work helps clarify the dilemmas and paradoxes of consciousness, cognition, and culture and offers a conceptual and practical bridge between the vexing polarities of the body/mind distinction and the seemingly intractable paradox of Aristotle's excluded middle.

Maturana and Varela (1987) call the underlying organization of all living organisms autopoiesis and define it (initially) as the “mechanism that makes living beings autonomous systems” (p. 48). Their work, however, does not suggest that these autonomous systems be ontologically separate from their environment. Where the concept of autopoiesis is important and useful is in offering both a criteria for discerning what is and what isn't an individual (in their

terms - a unity) as well as an analytic framework for understanding the “border” phenomena associated with questions of exactly where and how this unity exists and operates (Urrestarazu 2011). However it is already obvious that we are on the horns of a dilemma as we begin to theorize mechanisms and/or processes for understanding organisms as essentially non-dual or through a transdisciplinary lens. Maturana (1988) recognized this and offered that

observing is both the ultimate starting point and the most fundamental question in any attempt to understand reality and reason as phenomena of the human domain. Indeed, everything said is said by an observer to another observer that could be him - or herself. (p. 27)

What has to remain clear is that we are always “in language” and this phenomenon of language is fundamentally associated with our consciousness (see for example, Gadamer 1976; 2013, Mead 1934;1938; 1932) and as such locked into a binary pattern of subject and object that necessarily brings the logic of A and not-A into stark relief – that is we naturally see and interpret the world as subjects or observers². It is precisely in transcending this type of reflexivity that the transdisciplinary project is interested in. However, prior to discussing the change in perspective necessary for a transdisciplinary set of perceptions it is important to address key philosophical issues related to autopoiesis.

Consistent with the Maturana quote above is Maturana and Varela’s (1987) observation that “every act of knowing brings forth a world” (p. 26). This statement, suggestive of a radical constructivist epistemology, implies that there is no world independent of the observer's perception (or knowing) of it. Other theorists (Bhaskar 2008; 1978; Mingers 2014; Searle 1995) have explicated the fundamental objections to this extreme form of constructivism. They make the distinction between what Bhaskar (1978) calls “intransitive” objects of knowledge and Searle (1995) calls “brute facts” and the (in Searle’s terms) “observer relative features of the world” that are clearly constructed by and through human agency. Minger’s (1995), in line with this realist approach, suggests “that the fact that our descriptions are always subject-dependent does not preclude the existence of a world independent of such descriptions” (p. 116). Mead (1938) also holds to the paradoxical notion that there is a “world that is there” (p. 96) independent of human reflective consciousness. What this topic opens up is the very complicated philosophical debate between realism, anti-realism, and idealism. While not gone into in depth here it is important to understand that one’s view of the “reality” of the world of “being” that Aristotle’s excluded middle suggests is central to the transdisciplinary conversation. As noted above there is a very common-sense interpretation of the world as being separate from me and that every object (excluding myself as an object of course³) in the world is by virtue of being an object not me! What Nicolescu (2008) suggests is a group of nested realities each with a corresponding perceptual/observer generated view of that reality (p. 5) where the “included third” reflects a transcendence of the “excluded middle”. What seems clear to me is that reflective consciousness is an example of an “included third” in Nicolescu’s perceptual realm that corresponds with the “both/and” paradox of (for example) physics in trying to come to grips with the particle/wave phenomenon. That we can observe and analyze path dependent behaviors (i.e., causal chains) in (for example) animals and other organisms is a “transcendence” itself from our own nature as animals interpreted as operating in an apparently deterministic milieu. Consequently, we experience ourselves (and others) as individuals and so we tend to concretize and separate ourselves and others. In terms of Maturana and Varela’s initial statement that “every act of knowing brings forth a world” we need to understand that our way of knowing the world specifies and delimits the world we know. It is in this sense that we ‘create’ the world through

² Of course this is a huge topic that encompasses multiple disciplines and is quite complicated. Evolutionary theory has also made this issue increasingly problematic. See Rosen (2004) for an excellent discussion.

³ This expresses well the paradox of reflexivity!

knowing it and need to be mindful of interpreting what we know as an absolute or invariant feature of an independently existing reality. However, not being able to 'know' the world as it is is not the same as there being no way that it is. But again this brings into stark relief the very problematic notion of what "is" actually means to an observer.

While autopoiesis describes the dynamics and organization of a unity or individual the structure of the organism affords its interaction with the environment. By organization they mean the pattern of relationships that make up the autopoietic process. This organization is not concrete or manifested as a physical system until we look at the 'structure' of the system. The structure is the embodiment of the 'organization' and exists (in terms of the theory) independent of it. A simple example would be the difference and similarity between the organization of a chair and the structure of a specific chair. The organization of a chair is realized through an idealized 'chair' concept where the distinctive components of the chair are not physical artifacts but a system of relationships that, when embodied, become a specific particular chair that has a specific and particular structure.

The structures of living beings vary widely (hence their habitation in different niches) but their essential organization (or autopoietic function) is invariant. The relationship between the organization and structure of an organism as well as the organism's negotiation of relationship with the environment is of considerable interest to both biologists and educators. Learning, adaptation, and the process of change are associated both with this "boundary" behavior of an organism's relationship with the environment as well as the 'intraorganism' phenomena that brings forth the border behavior. The 'intraorganism' behavior can be described as the operation of an autopoietic organization, the interactions that the organism conducts with the environment Maturana and Varela describe as "structural coupling".

Individuals interact with the global environment or with other individuals through the coupling of appropriate organs or processes all the while conserving both their organizational unity (autopoiesis) as well as their ability to adapt to the global environment. The conservation of these two functions (autopoiesis and adaptation) drive the activity of the organism. Since the inception of the theory of autopoiesis there have been many attempts to apply the theory to human activity and human social systems (Mingers, 1995). The most well-known is Luhman's (1984) effort to conceive of social systems as autopoietic absent individual human participation. One of the pitfalls of this early theorizing was the necessity to apply the theory to human beings and to social systems analogically. The initial theory was (and is) very specific to molecules and biological processes – that is, it is "scientific". Maturana and Varela's (1980) contribution was in developing a theoretical framework explaining physical systems and their transition and operations as biological systems. While there is controversy over this "social" aspect of the theory (Urrestarazu 2014; 2011) I am more interested here in the theory's resonance with transdisciplinary methodology. It is in an earlier observation by Maturana and Varela (1987) that I want to direct attention. They observed that

the formation of a unity always determines a number of phenomena associated with the features that define it; we may thus say that each class of unities specifies a particular phenomenology. (p. 51)

This statement suggests that from an observer's perspective the "reality" that is experienced is a function of the "phenomenology" of the observer which is function of its physical and biological properties. "Observer" as I am using the term here is not meant to suggest only reflective human consciousness but also the positionality and haptic "thrownness" of any organism that is more or less autonomously navigating space/time. This "phenomenology" resonates with Nicolescu (2008) and others as they investigate different orders of "reality" that

correspond to different orders of “perception”⁴. When we include reflective consciousness into the analysis (which was always implicit of course) we can begin to see how our ordinary perspective of the excluded middle – of the intransigence of paradox may, in fact, be transcended. Perspectives are phenomenological concomitants of physical systems and as we better understand the complexity of physical, biological, and social systems we ourselves continue to transcend (or retreat) along the infinite regress suggested by Nicolescu’s notion of an infinite set of nested realities. What I think is quite compelling is the suggestion that we will transcend our binary thinking by paying closer attention to the phenomenology of our bodies independent of reflective consciousness. This does, however, fly in the face of generations of theorizing that has marginalized our bodies as primitive and flawed vehicles in need of constant improvement by the “civilizing” and regulating processes of reflective consciousness and scientific intervention. A kind of global “hubris” has occurred that counts our way of thinking as superior to the wholeness of the universe. That perspective is not going unchallenged.

Transdisciplinary Pedagogy

Post-modern and post-structural critique of colonial and enlightenment ideology and control can be understood as response to a global structural situation that commodifies subjects and their bodies, undervalues local situated action, inverts and subverts the ontogenesis of learning, and silences claims for social justice. As noted above there are three key strategies suggested here. First is taking into account our situated, local, and embodied emotional selves. What this means for schools and learning is a framework that values the voice of learners throughout the learning experience. This valuing is not to be achieved by an ideological or prescriptive application of theory but through a direct experience supported by a gradual and growing awareness and responsibility.

Freire’s (2000) work on coming to terms with oppression, the banking model of schooling, and the general alienation of people from their power and freedom is fundamentally transdisciplinary. However, he does not suggest that the paradox of the oppressed and the oppressor will be turned over via a dialectical synthesis but rather through the development of critical consciousness, or “conscientization”, where individuals take up the task of learning to perceive the world around them beyond the paradox and contradictions generated by “ordinary consciousness”. His suggestion is that we learn how to dialogue with others who become along with “me” - not separate others, but a We where we are all “Subjects who meet to *name* the world in order to transform it” (p. 167, italics in the original). A substantial difficulty in seeing Freire’s work manifest in large scale change is, I argue, based on fundamental properties of how our social selves experience and live in the world. Normativity, habit, prejudice, and a belief that our perceptions and conceptions are accurate interpretation of a singular “reality” continue to hide from us the emergent and creative force of natural systems and of each other. The historical work of culture (particularly western cultures) to tame the vagaries of nature has come at some cost. Freire’s understanding of the nature of dialogue and its underlying phenomenology in the face of this historical and anthropological evidence is consistent with many strands of thinking concerning the difficulties we face in communication and transformation through dialogue (Anderson, Baxter, & Cissna 2004).

Consequently, achieving functional communication or dialogue is difficult if not completely understood (Hawes 2004). One method, suggested here, is through the regular practice of a group “Bohmian” dialogue (Bohm 1980; 1992; 1996; Francovich 2013; Gunnlaugson 2014; Isaacs

⁴ However I am compelled to note that Nicolescu (2008) interprets the “laws” that exist at one level of reality as not necessarily being at all commensurate with the “laws” of another level (see pp. 5-6). This is a central part of the primary argument for not violating laws when going from one level to another. Maturana and Varela suggest that the laws related to “objective science” can remain invariant but that as the structure changes the phenomenology of the unity changes and, as I am arguing here, the perspective changes.

1999). This type of dialogue is based on the simple premise of suspending one's automatic and habitual response to the speech and action of others. Its rationale is based on Bohm's fundamental insight into the neurological and behavioral antecedents to habitual social behaviors and their/our sensitivity to proprioceptive feedback beginning with one's feelings and sensations and progressing to insight around one's thoughts. Bohm (1996) termed this notion "proprioceptive thought" (pp. 24-26) and it is at the heart of his theory and practice of dialogue. This practice may serve as a foundational technique for the learning of responsibility and the practice of a "Freirean" freedom (i.e., democracy) and is, in my experience as a teacher, ideal for educational contexts and is easily incorporated as a leading group activity. I currently use this technique for practicing responsibility in virtually all of my doctoral seminars.

The second major foci is the epistemological distinction between understanding and knowledge (Taylor 2002) where the former is implicated in the contingency of direct experience and the latter in the certainty of positive knowledge. Taylor was keenly aware of the difficulty from a phenomenological perspective of our ability to engage in direct experience noting that "Experience is that wherein our previous sense of reality is undone, refuted, and shows itself as needing to be reconstituted" (pp. 281-282). This "undoing" is precisely what a Bohmian dialogue is meant to facilitate. We want to be able to experience the "other" directly and with as few filters, habits, and prejudices as possible. In Taylor's (2002) Gadamerian inspired scheme the distinction between knowing and understanding is predicted on three key differences.

- First we must distinguish between "knowing an object" and "coming to an understanding with an interlocutor" in a bilateral interaction.
- Second, we should recognize that when knowing objects we may often ignore context, however, in relation to another the situation is "party dependent" and both we and our interlocutor(s) change.
- Finally we must recognize while objective inquiry often requires fixed goals - when dealing with an interlocutor there is always a shifting and adapting of goal directed behavior (pp. 280-281).

Knowledge, as interpreted here has become for elites the *sine qua non* for creating robust social identities. Understanding, on the other hand takes time, is messy, and always fraught with uncertainty.

Finally is the necessity of including values and ethics in our various efforts at education and a civil society. If we are serious about our embodiment and contingent situated nature and if we make the effort to understand prior to knowing we may expect that a "natural" ethical response will be developed. Noddings (1984; 2006) and Mead (1932) suggest that ethical behavior is an ontological property of the world – that organisms "care" in their continual and reciprocal transactions with the world. It is my position that these are linked propositions whose unity is found in the biological and social roots of reflective consciousness and that this general topic can be addressed in language using a scientifically oriented transdisciplinary methodology.

Conclusion

The task of a transdisciplinary methodology, as argued here, is to contextualize, shape, and guide inquiry and the utilization of methods toward achieving a shift and transformation in perspective – to provide a meaningful theoretical basis for living with and transcending paradox such that the integrative nature of our experience is manifest in all of our practices. This perspective is also implicated in the epistemological and pedagogical work of making explicit distinction between understanding and knowledge. The relationship between science, belief, and doubt (the domain of reflective consciousness) should not be conflated with the body's certain faith in the vital and needed emotional and relational connection with one another and with the earth.

Transdisciplinary thinking may also serve as a theoretical basis for practicing a Bohmian dialogue and including it in our pedagogies and curricula. The cognitive construction of reflective consciousness is a demonstrated fact – its relationship to the autopoietic emergence of awareness, however, needs more work. of only the first author and the headers on even pages will include the name of the journal.

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ISSN 2327-011X

