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Studying Learners and Assessing Learning: A Process-Relational Perspective on the Learning Sciences

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The field of the learning sciences appears to favor cognitive and social approaches to the study of human learning. In this article, the author proposes that a deep cognizance of cultural influences on learning is vital if formal and informal learning are to make vital connections to learners' lives and their personal need for meaning making in life. Drawing upon process philosophy, the author identifies and discusses three issues for the consideration of learning sciences researchers, namely, (1) the importance of relational thinking, (2) the centrality of approaching learning in terms of experience and *becoming*, and (3) the need to reframe causal analysis in assessing learning.

Introduction

Sawyer (2006a,b) characterizes the learning sciences as an interdisciplinary field that studies teaching and learning in a variety of settings that include formal learning in the classroom and informal settings outside of school. He states that the goal of the learning sciences is "to better understand the cognitive and social processes that result in *effective* learning...so that people learn more deeply and more *effectively*" (p. xi, italics added). It is unclear *what* standards and *whose* standards of effectiveness are being implied in this characterization. It is also unclear why cultural processes, so vital to both formal as well as informal learning, are excluded. The implied notion of effectiveness might perhaps be inferred from how Sawyer (2006a) characterizes "better learning" in terms of (1) scaffolding, (2) externalization and articulation, (3) reflection, and (4) building from concrete to abstract knowledge. While these characteristics are all desirable, the central question related to purpose remains unanswered: externalization and articulation to what end? Is the implicit goal students' attainment of higher scores on standardized tests? Are the identified characteristics so desirable in and of themselves that the question of *purpose* need not be addressed? I do not believe that this is the case.

Whitehead (1929) opens his seminal book, *The Aims of Education*, thus: "Culture is activity of thought, and receptiveness to beauty and humane feeling. Scraps of information have nothing to do with it. A merely well-informed man is the most useless bore on God's earth. What we should aim at producing is men who possess both culture and expert knowledge in some direction. Their expert knowledge will give them the ground to start from, and their culture will lead them as deep as philosophy and as high as art" (p. 1). He further adds: "There is only one subject-matter for education, and that is Life in all its manifestations. Instead of this single entity, we offer children—Algebra, from which nothing follows; Geometry, from which nothing follows; Science, from which nothing follows; History, from which nothing follows..." (pp. 6–7).

Engaging in learning, from which nothing follows, must be distressing at best for any learner. In this article, I offer some direction for Sawyer's four characteristics of "better learning" in the hope that something meaningful might follow from students' investment of effort in learning. It is recognized that "meaningfulness" is an inherently value-laden term. I propose that a turn to process philosophy can be productive for framing "meaningfulness" of outcome in both formal and informal learning as well as the assessment of that learning.

The remaining parts of this article proceed in the following manner. In the next section, I provide a brief background to the origins of process philosophy. I then articulate the main tenets of this philosophy. Next, I identify and highlight three issues, arising from process philosophy, for the consideration of learning sciences researchers. These issues are: (1) the importance of relational thinking, (2) the centrality of approaching learning in terms of experience and *becoming*, and (3) the need to reframe causal analysis in assessing learning. I then conclude the article. It should be noted that the three chosen issues are highly selective. Hence, they provide only a partial savoring of what process philosophy might mean for the learning sciences in particular and for education in general.

Background to Process Philosophy

Process philosophy traces its roots back to the early Greek philosopher Heraclitus of Ephesus (b. ca. 540 B. C.).

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For him, the fundamental nature of reality is not constituted by a constellation of *things* but by one of *processes*. This thinking stands in direct opposition to that of Parmenides, a contemporary of Heraclitus, who upheld the unity of nature and argued that grasping this unity is the object of knowledge. For Heraclitus, however, the world is a manifold of opposing forces joined in mutual rivalry and interlocked in constant strife and conflict. Eternal motion and the negation of all persistence are the hallmarks of Heraclitus's cosmology. For him, "all things flow" (Nietzsche, 2001). Process is thus fundamental. Everything in nature entails process, activity, and change. Consequently, a river is not an *object* but an ever changing flow, and the sun is not a *thing* but a flaming fire. We must therefore avoid the temptation to materialize nature into enduring things or substances because they are not stable things but rather fundamental forces at work that produce and constitute the world in which we live (Rescher, 1996).

Classical Western philosophy, tracing its roots to the thinking of Plato and Aristotle, adopts an onto-epistemological bias in favor of *things*. Aristotle, for example, insisted on the metaphysical centrality of indicatable objects. This thinking, and its ramifications, has had a far-reaching and enduring impact on dominant traditions of science making and the search for universal laws of nature to this day. However, such an object-centric worldview, which assumes the existence of an objectively knowable world, is fraught with philosophical difficulties (Rorty, 1979). One key pertinent difficulty relates to the construction of the human self as a psychological *entity*, an issue that must be addressed in the domain of learning. A turn to process philosophy, focusing on processes, events, and occurrences, encourages the foregrounding of verbs (processes) rather than nouns (entities) thereby providing a means for dealing with entrenched philosophical conundrums such as the mind–body problem.

The Tenets of Process Philosophy

Rescher (2000) positions process philosophy as a doctrine committed to the following basic propositions:

1. Time and change are among the principal categories of metaphysical understanding.
2. Process is a principal category of ontological description.
3. Processes are more fundamental than things for the purposes of ontological theory.
4. Several, if not all, of the major elements of the ontological repertoire (e.g., nature, persons, material substances) are best understood in process terms.
5. Contingency, emergence, novelty, and creativity are among the fundamental categories of metaphysical understanding.

Based on the above, we see that process philosophy makes a fundamental commitment to the process-oriented nature of what is real. Storms and heatwaves are as real as dogs and oranges.

Process takes priority over product, both ontologically and epistemologically. Furthermore, what exists in nature is not merely originated and sustained by processes; rather, processes ongoingly and inexorably characterize nature. A process is a complex that gives rise to a unity of distinct stages or phases. This complex has temporal coherence as a sequentially structured sequence of successive stages. A process also has an emergent structure, emerging probabilistically, that provides the process with a distinctive "shape" or "format" (Rescher, 2008).

The rise of quantum theory has strengthened the position of the process worldview. Modern physics envisions very small processes, or quantum phenomena, combining in their *modus operandi* to produce standard "things," or ordinary macro-objects, in an inherently probabilistic manner. From a quantum perspective, matter-in-the-small is a collection of fluctuating processes organized into relatively stable structures by statistical regularities: regularities of comportment at the level of aggregate phenomena. Macro-objects, usually deemed a physical *thing*, are nothing more than a stable statistical pattern. Consequently, processes are not the machinations of things; instead, things are the stability patterns of variable processes (Rescher, 2008).

Issues for Learning Sciences Researchers

The modern worldview, upon which the learning sciences is founded, dominates the current context of education in all modern societies. It may be characterized by two distinctive features: (1) the dominance of science, the scientific method, and technology, and (2) a mechanistic paradigm. While modern science has advanced the welfare of humankind in numerous pervasive ways, its success, in materials terms, has also had certain ideological side-effects. Insistence that the scientific method is the right and only way to engage in research of professional standing is a pervasive aspect of modernity. In this mode of work, objectification and quantification reign supreme (Evans, 1998). However, Whitehead, a key process philosopher, took strenuous exception to the application of classical methods of science, drawn from the natural sciences, to describe and understand human beings, their behavior, and societies at large. He argued that the methods of science, so successfully applied to material objects, have been erroneously applied to human beings and human societies. He proposed, instead, a philosophy of organism (Whitehead, 1978) to counter the invasive effects of scientism. This philosophy advances the process view based on organisms, technically called "actual entities," that grow, mature, and perish (Sherburne, 1981).

The advent of modernity, triggered by the success of Newtonian physics, has led to a deeply entrenched mechanistic paradigm: a worldview that treats animate and inanimate objects alike as functioning like machines.

Mechanistic thinking is reflected in preference shown for abstraction, simple location, cause and effect, individualism, differentiation, mechanization, and materialism: traits that are evident in school systems today. Whitehead's worldview, however, is one that is based on processes associated with living things. Thus, organism replaces mechanism, and the metaphor of the machine is replaced by the metaphor of the tree of life (Evans, 1998).

In light of the short critique above, I put forward three issues for the consideration of learning sciences researchers and identify some pertinent implications.

Relational Thinking

In today's global society and interconnected world, we recognize that people and ideas are highly connected. However, the phenomenon of connectedness applies equally to nature. A local rainstorm that we are experiencing may be part of a regional low pressure system, the trajectory of which is shaped by the jet stream which has been pushed from its normal location by El Niño in the Pacific Ocean. Similarly, trying to understand the reasons for global warming is difficult and controversial because the reasons are too complex and *interdependent* to be captured by formulations such as, given conditions *a, b,* and *c,* then consequences *x, y,* and *z* necessarily follow. Not only are we unsure of all the relevant conditions, but we are also unable to predict all the consequences to which these conditions are likely to give rise. Consequently, linear thinking based on simple if–then rules and implicit cause–effect relations are no longer sufficient. What is needed is a form of relational thinking that emphasizes the patterns of connection and interaction at work. This kind of thinking recognizes that outcomes may arise from no single change, no single causal intrusion, nor even the aggregation of several of them. Instead, networks of interaction and system ecologies become the focus of relational thinking. Such thinking, in terms of systems of interconnectedness, recognizes that the whole is greater than the sum of its parts. Systems have features that their components do not have. Focusing on the system and its web of interconnectivity requires paying attention to the wider contexts in which problems and possible solutions are embedded (Allan & Evans, 2006).

Relational thinking is also vital in a world of burgeoning diversity and pluralism. The sense of relationality appropriate to a diverse world is one that recognizes that commonality is something to be achieved, an outcome to be wrought rather than simply found. Relationality in this sense can only be achieved if members of a community develop the skills required for reconciling differences and weaving them together in creatively useful ways (Allan & Evans, 2006).

The descriptions above do not portray the curriculum and information-centric approaches to the teaching and learning of algebra, geometry, science, and history, referred to earlier by Whitehead, from which nothing of personal significance to the learner follows. Despite interest in complex systems on the part of a small segment of learning sciences researchers, the kind of science education studied by members of the research community remains largely traditional in its orientation. The foregoing discussion implies that education in general, and not just science education, would benefit from being imbued with relational and systems thinking that emphasizes connectedness and interdependence in contextual settings rather than simple linear cause–effect thinking. As Evans (2006) argues: "Seeking the patterns which connect, and endeavouring to understand them, is a strong part of a process perspective for teaching and learning" (p. 20). Nurturing relational thinking will also facilitate the development of multicultural and pluralistic approaches to education that can lead to improved community and civic society.

Experience and Becoming

Traditional approaches to teaching regard the psychological self as a cognitive entity upon which the treatment of instruction should be applied to yield the effect of learning. Socio-cognitive approaches grant recognition to the value of collaborative learning and the work of Vygotsky (1978) but retain an essentially cognitivist focus by viewing learning and its assessment in terms of mind-related phenomena. In so doing, students are essentialized as entities with attributes such as intelligence (e.g., high IQ, low EQ), knowledge (e.g., knows this but not that), and skills (can do this but not that). Students end up being objectified and labelled. In contrast, a process perspective conceptualizes a person as a unified manifold of actual and potential processes comprising actions, capacities, tendencies, and dispositions to action, both physical and psychical. In this manner, a concept of personhood is secured that renders the self experientially accessible (Rescher, 2000, 2008). The unit of analysis, for the purpose of learning, is therefore the person, not the person's mind. In this manner, no mind–body duality arises (Mesle, 2008). Neither is there a challenge of "knowledge transfer" because history is always in-person: that is, one *always* brings one's entire history and projective future into the present moment of being (Holland & Lave, 2001).

Based on a philosophy of organism, education that is framed by process philosophy places a high premium on the organism's search for personal meaning. This search for meaning must inherently be rooted in experience with and activity in the world. Based on Whitehead's process philosophy, the basis of experience is emotional; that is, affective in nature. The relevance of what an individual does and thinks gives rise to an "affective tone," and all knowledge is conscious discrimination of objects experienced (Whitehead, 1932/1998).

Some care is warranted as to how we understand the construct of *experience* in the present discussion. Traditional notions of experience view it as knowledge,

as subjective, oriented to the past, located in isolated experiences, and related to action. However, Dewey, another key process philosopher and also a pragmatist, positions experience somewhat differently. For Dewey, (1) knowledge is a *subset* of experience, (2) experience is both subjective and objective, (3) experience is future oriented toward a consequence, (4) experience is united and integrative, and (5) experience encompasses theories and concepts and hence is a *foundation* for knowledge (Elkjaer, 2009). The primacy of experience over knowledge should be self-evident from the foregoing characterization. Furthermore, experience directed toward knowing is always transactional in nature, entailing an intervention "into" nature. Experiential learning in this sense is always enactive. It is part of a process of inquiry directed toward a search for meaning (Biesta & Burbules, 2003; Dewey & Bentley, 1949).

A key meta-concept arising from a process-oriented philosophy of education is the notion of *becoming*. Becoming is inherently a process shaped by events and occasions from which a learner makes choices and decisions. This process of becoming is one of acquiring definition as a person by consciously or unconsciously choosing among alternatives that a learner experiences. Actualization of a learner's potential is a complex, multi-faceted process by which any person becomes a novel human being through a trajectory of learning experiences (Evans, 2006).

In Whitehead's thought, *becoming* is a more basic category than *being* because *how* an entity *becomes* constitutes *what* that actual entity *is*. Thus, its *being* is constituted by its *becoming* (Hosinski, 1993). Consequently, a process perspective on education positions the study of learning on a very different foundation: one that is person-centric rather than mind–centric. It proposes that the currency of learning is to be found in transactional learning experiences grounded in inquiry-directed actions in the world. It encourages educators and learning sciences researchers to pay greater attention to learning conceived in terms of *becoming* (Semetsky, 2006) in order that a philosophy of organism might be realized. Such an approach offers rich opportunities for reframing education with a view to enhancing its quality. Most importantly, the approach opens up a pathway for allowing learners the space for personal agency and the exercise of creativity that they now demand.

Causal Analysis

In the section on *Relational Thinking*, I made reference to how process philosophy points to the need for systems thinking so that we can be freed from the constraints of linear and sequential thinking. This re-orientation has significant ramifications for how research in the learning sciences might be conducted.

Design research has been upheld as a key contribution of the learning sciences. It is positioned as a research approach suited to application in "messy classroom settings." A careful reading of the literature suggests that many learning sciences researchers adopt the analytic mindset of positivist and rationalist science: an approach that assumes the possibility of widespread generalization of causal effects arising from an (assumed) underlying stable and objective world of teaching–learning phenomena. Systematic variation is assumed to be present, thus rendering the testing of hypotheses plausible (Collins, 1992). An excerpt drawn from the Design-based Research Collective helps to make this apparent: "Claiming success for an educational intervention is a tricky business. If success means *being certain* that an intervention *caused* learning, then we need to look carefully at the intervention in a particular setting" (Design-based Research Collective, 2003, p. 5, italics added). Several questions immediately arise. What kind of causation is implied here? Is an intervention a unitary "thing" whose effect can be non-controversially determined? Is a design research intervention a suitable theoretical unit to which causal attribution of an effect can be meaningfully measured? Is it possible to be *certain* of the intervention being the cause of whatever outcomes are observed?

According to Morrison (2009), educational research contemplates two basic types of causation: deterministic and probabilistic. The layperson's understanding of cause leading to effect is a case of deterministic causation. Hume, in his classic *Treatise of Human Nature* (the Abstract of which is also published in Hume (2007)), reasoned that in this type of causation, such as when one billiard ball strikes another, there is (1) contiguity in time and place, (2) priority in time of one event over the other, (3) a constant conjunction between the cause and the effect, and (4) a necessary connection between the putative cause and the putative effect. Hume's careful analysis of this event led him to conclude that human reasoning cannot provide a justifiable basis for causal attribution. His critique of causality led him to the conclusion that causal attribution is a matter of "custom"; that is, a habit of thinking that is learned from *experience* rather than deductive, logical, and necessary proof (Morrison, 2009). Based on Hume's critique, deterministic causation is "unprovable."

What of probabilistic causation? Morrison (2009) asserts that probabilistic causation is a more realistic approach to educational research than determinisi causation. This is so because causal knowledge is always *inductive* and *inferential* rather than deductive (Salmon, 1988). In this form of causal knowledge, statistical generalization and probability replace certainty. Statistics alone do not prove causation; to believe that they do is to engage in circular thinking. Instead, it is the theoretical underpinnings and assumptions made by a researcher that embody causation: by imputation. The role of statistics is to support, challenge, extend, and refine these underpinnings and assumptions. Thus, it is in the construct validity underlying the proposed theories and

models that causality lies (Morrison, 2009), and such constructs are the outcome of creative human imagination.

How then might the learning sciences proceed? I suggest that, in keeping with process philosophy, we begin to think more in terms of webs of interdependencies from a systems point of view rather than in terms of simple causal effects. Consequently, we ought to adopt approaches to assessment that shift from causation to emergence. This approach is consistent with complexity theory, where linear causation is replaced by webs and networks of connections, multi-causality, multiple effects, and multivalency (Haggis, 2008). Therefore, it is no longer appropriate to consider a single cause and a single effect, because causes and effects in educational interventions are always plural, multiply connected, and multidirectional (Morrison, 2009). Moving away from reductionism, atomism, and essentialism, systems thinking seeks holistic "causal" understanding. Complexity theory does not negate causation; it just renders it more challenging to understand. Quantum theory and Heisenberg's uncertainty principle raise major challenges to the domain of "normal causality" (Salmon, 1988). Regression is part of yesterday's linear world.

Conclusion

In this article, I have attempted to make a case for a more humanistic and person-centric approach to the study of human learning in both formal and informal settings. In doing so, I have drawn from process philosophy and considered three pertinent issues that it raises for the learning sciences and for education. In particular, I have highlighted the importance and relevance of relational thinking, the centrality of approaching learning in terms of experience and becoming, and the need to reframe causal analysis in assessing learning. It is my hope that other researchers will find these ideas intellectually provocative and that, working together, a process philosophy-based education can be more fully defined and then realized. □

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