Learning Science: A Deweyan Perspective

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In the 1916 inaugural issue of Science Education, the lead article was John Dewey’s (1916) “Method in science teaching.” Since then, the influence of Dewey’s ideas can be found in just about every facet of progressive science education in America. Champagne and Klopfer (1977) reviewed 60 years of Science Education and suggested that every theory or practice that emphasizes reflective thinking and problem solving owes a debt of gratitude to Dewey. Although their review was conducted over 20 years ago, its claims about Dewey’s legacy remain persuasive. In their summary, Champagne and Klopfer point to the general failure to realize Dewey’s vision in actual classroom practice. They offer several possible explanations: (a) It is generally difficult to translate abstract philosophy into specific pedagogy; (b) the kind of rare, sophisticated thinking advocated by Dewey is difficult to attain; and (c) the goal of having students reason like a scientist may not be valued by all.

Although Champagne and Klopfer’s analysis is to be taken seriously, we arrive at a slightly different conclusion. With regard to their concern that the translation from philosophy to practice and the Deweyan vision of the educated person are not easily attained, we agree that the challenge is difficult, but worth attempting. With regard to their concern that not everyone needs or wants to think like a scientist, we assert that this belief depends on one’s notion of what Dewey means by “thinking like a scientist.” In this article, we will discuss how Dewey’s vision of the scientific mind is rich in thought, emotion, and drama: in short, it is much more fully human than the aloof, strictly analytical stereotype of scientific thinking.

Dewey’s legacy remains unrealized for the additional reason that many of his ideas about learning are underappreciated at best, and misunderstood at worst. Reasons for this state of affairs are not hard to find. First, Dewey had predilection for bringing uncommon meaning to common words. Experience, ideas, interest, and habit are just a few terms that Dewey uses with sometimes arcane, often subtle, and always precise meaning. Because these are common,
everyday terms, they can be easily misunderstood. Second, Dewey’s ideas are subtle and complex. However, many of his widely read educational pieces (e.g., *Experience and education, Child and the curriculum, How we think*) are simplified versions of his more substantial philosophical pieces (e.g., *Experience and nature, Art as experience*). Furthermore, a strong case can be made that, in addition to the complexity of his ideas, Dewey also changed his position significantly over the course of his career (e.g., the differences between the 1933 and an earlier edition of *How we think*). Third, Dewey did not always do himself a favor in the way he chose to express his own ideas. His most faithful students acknowledge that, as a teacher, Dewey had a dense and unfamiliar way of teaching that rewarded only the most committed and patient (Hook, 1939).

In his lifetime, Dewey saw for himself how his ideas for progressive education were being misunderstood and used as the basis for teaching practices that were so student-centered that subject matter became a lesser, even minor, concern. This so bothered Dewey that he wrote *Experience and education* in an effort to restate his ideas concisely and clearly about students, subject matter, and education. After his death in 1952, Dewey’s philosophy continued to be interpreted and translated into educational practice but without the benefit of his reaction and clarification.

Dewey’s influence can be traced through the work other educational scholars such as Joseph Schwab, Donald Schön, and Lee Shulman. Major themes from Dewey’s vision of learning were also reinforced, although not directly cited, by Piagetian constructivists such as Jerome Bruner and Eleanor Duckworth. Even sociocultural and sociohistorical scholars have drawn connections between Vygotsky and Dewey’s emphasis on the social features of learning.

If he were alive today, Dewey might be pleased to see the widespread acceptance of his ideas by both theorists and practitioners. However, he would likely be disappointed with the superficial treatment of his philosophy and express much the same concerns as he did in *Experience and education*. Over 80 years after his first article in *Science Education*, Dewey’s work may have become more of a source of affirmation than inspiration. His name is often used as a comfortable touchpoint to justify theories and practice in science education, particularly those that involve active, student-centered learning. Dewey has become almost a mere symbol or figurehead for a broad spectrum of progressive ideals in science. (By contrast, in educational philosophy, scholars are engaging in deep analyses of Dewey’s pragmatism which is enjoying a renaissance of sorts.)

Therefore, our goal is to reexamine and clarify the meaning and implication of a few Deweyan ideas that relate to science education. We choose one of Dewey’s (1934) later works, *Art as experience*, as a major source for our discussion. This choice may puzzle some readers, as *Art as experience* was not written for educators—it is primarily a philosophical analysis of aesthetic experience—nor does it take science as its main subject. However, *Art as experience* is a most unusual book. Sidney Hook, one of Dewey’s most prominent students writes,

> Although it is primarily an analysis of the roots, structure, and interrelations of the aesthetic experience, “Art as Experience” clarifies all the leading ideas of Dewey’s philosophy... It is a singularly rare thing—a book on aesthetics which actually enables the reader to see what he had not seen before, to go to objects of art and come away with a quickened apprehension of their qualities. (Hook, 1939, p. 194)

We believe that *Art as experience* speaks directly and powerfully to issues of learning science. Central Deweyan ideas that have influenced science education, in particular his notion of “experience,” receive a deeper and clearer treatment here than in any other work. We hope to
not only help others avoid the danger of misinterpreting Dewey’s work, such as justifying inappropriate practice, but also to help others avoid the potential tragedy of underinterpretation. That is, it would be most unfortunate if the best part of Dewey’s work were to go unnoticed.

Overview

In this article, we begin with Dewey’s notion of experience. According to Dewey, the central goal of education is to help students lead lives rich in worthwhile experiences. Dewey’s emphasis on worthwhile experiences has broad appeal and has, unfortunately, become little more than a popular truism akin to saying that schools should produce students who are smart, productive, or good. However, a more careful reading of Dewey reveals how his use of “experience” is original, incisive, and compelling. We review Dewey’s construct of experience—central to his thoughts on philosophy and pedagogy—and how it is defined in an unorthodox yet powerful way. At the core of this discussion is the distinction between ordinary experience and an experience. Next, we move to consider the educational implications of Dewey’s construct of an experience and develop his construct of the “idea.” Ideas are closely related to experiences in that to be alive with an educative idea is to have a worthwhile experience. We distinguish ideas from concepts and argue that the goal of science education should be for students to go beyond the understanding of concepts to an experiencing of the world through ideas. Next, we discuss how ideas-based teaching might occur. We develop two metaphors for teaching designed to facilitate educative experiences with ideas. In addition, we introduce assessment criteria for evaluating the degree that learning is ideas-based. Finally, we examine how the feminist and sociocultural perspectives on science teaching compare with a Deweyan perspective.

Experience

One of the most frequently misunderstood part of Dewey’s work is his notion of experience. Before describing a more general vision of learning and teaching, we first clarify what this term meant to Dewey. Teachers and researchers in education have often used Dewey’s “experience” as the pedagogical antidote to rote learning; for example, students should learn through experience rather than just sit there and memorize. Dewey’s name has been used to justify hands-on activities, out-of-school learning activities, project-based learning, apprenticeships, and so on because they all purportedly involve learning through experience. This expansive definition of experience is not what Dewey intended. He felt that there were different types of experience—some of which are more significant. What distinguishes the kind of experience worth having in science class? In “Art as experience” there is a chapter entitled, “Having an experience.” The important word in this title is “an” for Dewey draws a critical distinction between ordinary experience and an experience (this is a typical example of how Dewey relies on common words to denote uncommon meaning). Dewey begins by describing how ordinary experiences arise:

Experience occurs continuously, because the interaction of live creature and environing conditions is involved in the very process of living. Under conditions of resistance and conflict, aspects and elements of the self and the world that are implicated in this interaction qualify experience with emotions and ideas so that conscious intent emerges. Oftentimes, however, the experience had is inchoate. Things are experienced but not in such a way that they are composed into an experience. There is distraction and dispersion; what we observe and what we think, what we desire and what we get, are at odds with each
other. We put our hands to the plow and turn back; we start and then we stop, not because the experience has reached the end for the sake of which it has initiated but because of extraneous interruptions or of inner lethargy. (Dewey, 1934, p. 35)

As Dewey notes, although the potential for having an educative experience often arises in the course of living, the experience frequently ends without ever developing. The inchoate experience remains embryonic and never comes to mean anything because we are distracted, tired, or lazy. Thus, although there is activity—that is, things happening over time—there is no coherence, development, or flow to these things. Such is the nature of ordinary experience. Dewey, then describes how an experience arises:

In contrast with such experience, we have an experience when the material experienced runs its course to fulfillment. Then and then only is it integrated within and demarcated in the general stream of experience from other experiences. A piece of work is finished in a way that is satisfactory; a problem receives its solution; a game is played through; a situation, whether that of eating a meal, playing a game of chess, carrying on a conversation, writing a book, or taking part in a political campaign, is so rounded out that its close is a consummation and not a cessation. Such an experience is a whole and carries with it its own individualizing quality and self-sufficiency. It is an experience. (Dewey, 1934, p. 35)

When material experienced “runs its course to fulfillment,” Dewey emphasizes that educative experiences become more than things that merely happen. Instead, the forward movement of an experience has a unity among its constituent elements: “every successive part flows freely, without seam and without unfilled blanks, into what ensues” (Dewey, 1934, p. 36). Furthermore, in these experiences there is a sense of the possible, an anticipation of how things might come together. As an experience becomes imbued with anticipation, development, and unity, it also becomes an act of thinking and meaning.

As cited earlier, Dewey describes educative experiences as having a plot or history, and elsewhere he adds that these experiences have a dramatic quality. Given how Dewey has characterized the structure, flow, and energy of an experience, we propose that educative experiences can be thought of, indeed they are, dramatic events. Consider the following description of an experience. One might easily think that Dewey was describing the energy of a powerful play:

Because of continuous merging, there are no holes, mechanical junctions, and dead centers when we have an experience. There are pauses, places of rest, but they punctuate and define the quality of movement. They sum up what has been undergone and prevent its dissipation and idle evaporation. Continued acceleration is breathless and prevents parts from gaining distinction. In a work of art, different acts, episodes, occurrences melt and fuse into unity, and yet do not disappear and lose their own character as they do so—just as in a genial conversation there is a continuous interchange and blending, and yet each speaker not only retains his own character but manifests it more clearly than is his wont. (Dewey, 1934, pp. 36–37)

Central to the dramatic and aesthetic essence of educative experience is its push to completion or consummation. Although all events come to an end—this is a truism—how it ends and how the end relates to what preceded it distinguishes mere cessation of activity from consummation and ordinary experience from an experience. Dewey writes,
The experience is of material fraught with suspense and moving toward its own consummation through a connected series of varied incidents. (Dewey, 1934, p. 43)

Thus, the consummation—the coming together of the various parts and incidents, the completion of development—not only marks the end point of an experience, but is a quality that pervades the entire event. This idea may seem somewhat counterintuitive: how can an end point be anything more than something that happens at the end of an event? How can an end point pervade what comes before it? This is where Dewey relies on the notion of anticipation—an idea at the core of his philosophical pragmatism and one that will be critical in our discussion of the implications of Dewey’s ideas for science education. Anticipation is the intellectual and emotional energy that both drives and holds together the development of an experience. Because the consummation of an experience is the object of anticipation, it colors the entire activity. The individual looks forward to, imagines what may or may not be, and is surprised, disappointed, or fulfilled when consummation occurs.

Thus, anticipation is a key idea in understanding how an experience is a compelling drama (Dewey, 1934; Jackson, 1998; Prawat, 1993). Consider this example: A person walks down a hallway, approaches a door, and opens the door. This is a mundane description of an ordinary occurrence. There is no drama and no educative meaning. By contrast, consider: A person walks down a hallway to open one of two doors, to encounter immediate pain or pleasure, to make an irreversible choice that will forever change the course of his life. This example (a loosely borrowed version of Stockton’s short story, “The lady or the tiger”) is a dramatic event rather than a simple occurrence. What transforms the experience of this event for either the person opening the door or the person reading the story from an ordinary experience to an experience is the powerful feeling of anticipation evoked. The various elements of the event develop and cohere as individual pushes forward and as the event pulls the individual with it.

Consider also students for whom science lab is little more than a series of activities to complete. Granted, they are active and there is experience. However, one would be hard-pressed to characterize the lab as an unfolding drama of inquiry where one part leads to the next, where the activity is compelled by the anticipation of what might be. In both “The lady or the tiger” and genuine science inquiry, the event not only happens, but has an energy that connects its parts and moves it forward.

One might be wondering why Dewey uses the arts as a basis for explicating the nature of experience. Jackson (1998) summarized the connection between the arts and an experience in this way:

> The arts, above all, teach us something about what it means to undergo an experience. Successful encounters with art objects and performances offer a set of standards by which to judge ordinary experiences. (p. 124)

Although the arts represent the realm of idealized, optimal experience, the compelling qualities of aesthetic experiences—progress towards consummation, emergence of a whole from varied parts, and so on—can be found in any domain, including the sciences. Here, Dewey describes how experiences from a wide range of domains can be deeply aesthetic:

> The most elaborate philosophic or scientific inquiry and the most ambitious industrial or political enterprise has, when its different ingredients constitute an integral experience, aesthetic quality. For then its varied parts are linked to one another, and do not merely succeed one another. And the parts through their experienced linkage move toward a
consummation and close, not merely to cessation in time. This consummation, moreover, does not wait in consciousness for the whole undertaking to be finished. It is anticipated throughout and is recurrently savored with special intensity. (Dewey, 1934, p. 55)

From this discussion of experience it should also be clear that Dewey’s philosophy does not translate into a simple recommendation for more labs, field trips, projects, groupwork, or hands-on activities. Dewey’s philosophy helps us appreciate that neither student activity (i.e., having them do something) nor particular kinds of environments (having stimulating or novel materials or equipment) are sufficient for producing educative experiences. Similarly, educative experiences can neither be choreographed (e.g., as set of instructions) nor presented to students (e.g., as a demonstration, exhibit). Instead, the educative experience is evoked, it emerges from the participation of students with the environment as they create and become involved in the drama of its plot.

Anticipation, Ideas, and Experience

In our interpretation of Dewey, anticipation distinguishes an experience from mere experience by bringing both coherence and energy. Anticipation is a dynamic state of being that both organizes and transforms. How do anticipation and experience figure into our views of science learning and instruction? Before going into detail, here is a synopsis of our argument: The central goal of a Deweyan view of education is to help students lead lives rich in worthwhile experiences. The task of the school is to provide students with transformative experiences: experiences that are valuable in themselves and valuable in their potential to lead to other worthwhile experiences. We assert that anticipation is at the heart of dramatic educative experiences. It follows, then, that effective teaching should be about creating anticipation in students. We introduce another Deweyan construct, the idea, as the subject-matter entity which can create anticipation. The goal of effective teaching is, thus, to create worthwhile experiences by creating anticipation, such as engaging students with ideas.

The notion of ideas as that which creates anticipation, as the forward-moving energy of an experience, may be unusual to some readers. We tend to be more accustomed to thinking of ideas as the culmination or endpoint of activity. Ideas, in this view, are the end product of scientific inquiry. However, for Dewey, “ideas” refer to every part of experience except that which is static or diminishing. Thus, when students interrupt the routine of the class to exclaim “We have an idea!” they are at the beginning of an experience—perhaps, an educative experience. We next outline a few central features of ideas and discuss how they relate to cognition, affect, and behavior in Dewey’s perspective on learning.

First, ideas are anticipation having subject matter substance. Many kinds of anticipation exist in schools; many of them are not connected to the substance of any discipline. Students can look forward to taking a test, the end of class, and interacting with friends but this is not the anticipation of educative experiences. Similarly, when students attend primarily to the novel antics of the teacher, to the smoke and flash of a demonstration, or to the pleasant interactions with friends during groupwork, they may appear interested and engaged. However, although this kind of engagement is laden with positive affect and activity, this cannot be an educative experience because the action and affect are disconnected from subject matter. By contrast, when students are seized by the idea that plant seeds can be spread about by animals and begin to think about birds, dogs, and cats differently, there is educative anticipation. There is an idea.

Second, ideas inspire action; only in action do ideas have meaning and value. Dewey (1933) explained that ideas are possibilities, conditionally held meanings. As such, they generate
anticipation about what may be discovered, explained, revealed, or brought to pass. Each idea, according to Dewey, “is anticipatory of some possible future experience” (p. 17). This anticipation—what Deweyan scholar Sidney Hook (1939) called a plan—leads to action. Dewey (1933) wrote, “the idea after it is formed is tested by acting upon it, overtly if possible, otherwise in imagination” (pp. 104–105). By “tested,” Dewey meant the idea is used “to guide new observations of, and reflections upon, actual situations, past, present, or future” (p. 106).

Dewey’s view about ideas, consequence in action, meaning, and value is an area of potential misinterpretation. In progressive student-centered education, learners are often encouraged to create and develop their own explanations for scientific phenomena. This approach seems enlightened especially as an alternative to approaches that expect students to understand and value ideas because they came from a book or a teacher. Progressive educators often cite Dewey as justification for this practice. Although Dewey would no doubt agree that students’ ideas should be taken seriously, he would likely disagree that ideas are valuable or meaningful only because they were student generated. In Dewey’s pragmatic philosophy, the value of an idea is based in its consequences—the actions it inspires—not its source. “Ideas are worthless except as they pass into actions which rearrange and reconstruct in some way, be it little or large, the world in which we live” (Dewey, 1929, p. 111). As a broad philosophical position, pragmatism takes a stand against the argument that the meaning of a belief is determined a priori, that is, by its logical coherence, the empirical methods that produced it, or the rational analysis by which it was deduced. Similarly, others may argue that meaning or value of a theory is associated with the status or power of the source from which it came (e.g., church king, famous scientist). In all these cases, the meaning and value of the idea is claimed by virtue of its origins. Pragmatism takes the opposite stance and situates meaning in the idea’s consequences, in its possibilities. Therefore, to think that Dewey would value an idea simply because it was student generated would be a serious misreading of his philosophy. An idea has value not because it came from a student: This assertion only repeats the historical error of associating meaning and value with its source. Instead, the worth of an idea lies in the possibilities that it yields in the world of the student. This is what Dewey meant by student-centered learning. This is why ideas are educative only to the degree that they inspire action.

Third, not only are educative ideas inextricably connected to subject matter and action, they also have a distinct emotional quality. The important emotions of educative ideas are feelings associated with anticipation and can be distinguished from feelings that have more to do with a general like or dislike for science. The emotion of anticipation is the feelings emerging from participating in the experience of a particular idea. It differs from both the standard “glad, sad, and mad” and from the kind of reactive emotion that comes and goes with little lasting impact. The affect of anticipation unifies and propels the developing experience and, therefore, is associated with the development of unity, with the progression toward the drama’s consummation. For example, movies can evoke a variety of different emotional responses. On the one hand, there can be a rush of excitement in response to a tightly edited chase in an action film, or there can be shock at a sudden outburst of violence or laughter at a character’s pratfall. However, film critics are quick to point out that these emotions are often gratuitous—that is, disconnected, unnecessary, and even distracting to the flow and development of the main idea of the movie. Just as in a powerful movie, the critical emotional responses from students in educative science experiences are integral, not ancillary, to the central ideas. When observing a class of engaged, interested students, one merely has to ask, “What is it, exactly, that is engaging them?” Are they enlivened by the possibilities and anticipations created by the ideas, or is their emotion associated with something ancillary to the substance of the lesson?
In summary, anticipation distinguishes simple experience from an experience and is the engine that gives an experience life and direction. The tension between where one is and where one might be energizes feelings of excitement and fear, of disappointment and hope—the very qualities that give vitality to life. These are the emotions that matter in science learning and are a sophisticated complement to “liking and disliking” and “being interested or not interested”—the common taxonomy used to describe students’ feelings about science. “Experience, in the degree in which it is experience, is heightened vitality” (Dewey, 1934). To anticipate, then, is to feel fully human, fully alive.

Ideas and Concepts

To arrive at a discussion of how teaching might occur, it is first necessary to define what is taught. It has been widely accepted that good teaching emphasizes concepts. Often contrasted with facts, concepts are more integrative and, therefore, more powerful for remembering, understanding, and using science knowledge. As an alternative, we propose that science teaching should be organized around ideas rather than concepts. Because ideas and concepts are typically synonymous in the common language of science education, some definitions and distinctions are in order.

How do we conceptualize the difference and relationship between ideas and concepts? To begin, concepts are typically associated with ways of representing or thinking about the world. In the cognitive tradition, sense making is a core activity: individuals make sense of the world and act according to the sense they make. Cognitive activity is the business of sense making and its office is the mind. In this portrait of human activity, concepts (or its relatives: schema, mental models, representations, etc.) are the “sense” that is constructed and then acted upon (Gardner, 1985; Greeno et al., 1996). In the cognitive tradition, the mind and its constructions mediate between a person and the world.

By contrast, Dewey’s aforementioned emphasis on experience focuses attention on not only what is occurring in the head, but on the active, temporal connection between the individual and the world. Jackson notes,

One of [Dewey’s] main points is that experience is not a psychological phenomenon. It is not something that happens exclusively “within” us, though it may certainly have components that we commonly describe in psychological terms. Rather, experience takes place in the world itself. It is made up of our continuous interaction and participation with objects, situations, and events that constitute our environment. (Jackson, 1995, p. 194)

This “continuous participation” connotes not only the transaction between person and world, but also an amalgamation of action, feeling, and thought. That is, to participate fully in an experience means not only to think, but to engage all of one’s faculties.

To fully appreciate the difference between ideas and concepts, a brief excursion into Dewey’s philosophy of knowledge is necessary. Although cognitive perspectives emphasize thinking, Dewey emphasized something else—something we call “being.” One’s being is constituted not only by cognition, but also in action. Dewey’s emphasis on being, rather than cognition, reveals an epistemological stance that locates meaning neither in the mind of the learner nor in the surrounding environment. Instead, meaning is a transactive phenomenon: it exists only in the situation created in interaction between person and world.

In Dewey’s use of the term “transaction,” he was attempting to connote two important epistemological assumptions. First, as the person acts on the world, the world also acts on the
person. Thus, learning is not only doing, but also undergoing: Dewey’s term for the nonrational, receptive process of being acted upon by the world. Many educators inspired by Dewey appreciate the process of doing, but either neglect or are unaware of doing’s necessary complement, undergoing. Second, in transaction, both the person and world are necessarily transformed. This view of an environment, similar to Bandura’s later notion of reciprocal determinism, is essential to understanding why Dewey could only identify meaning as in the interaction between person and world. Neither the person nor the world is a stable, inert entity; both change in the others’ presence. Thus, for Dewey meaning is in our being: that is, in the transactive phenomenon of our being in the world. Existentialists such as Heidegger or Sartre went so far as to claim that the meaning of our existence is created in what we do, in contrast to having intrinsic meaning or meaning bestowed by a higher authority. Only in action do we create meaning. Thus, our “human being” is our active relation to the world. To learn is to change one’s being or relation to the world. We can now better understand Dewey’s emphasis on action when he asserted, “Action is at the heart of ideas” (Dewey, 1929). The notion of “learning by doing”—often attributed to Dewey—is an incomplete representation of his philosophy. “Knowing is doing” is the often forgotten, but broader idea.

Returning to ideas and concepts, just as concepts are the core object of thinking in the cognitive perspective, we propose that ideas are the core construct in a Deweyan perspective on learning. Whereas concepts are representations and are the basis for thinking, ideas are anticipations and are the basis for action and being. To some readers, ideas and concepts may seem synonymous and we admit that Dewey’s use of the term idea (along with other terms), although precise, is often confusing. To begin, concepts are something that students learn: To understand is to have an accurate representation of it and to be able to apply it appropriately. The goal of conceptually oriented teaching is the construction of accurate, meaningful representations. By contrast, ideas are something that seizes students and transforms them. The goal of ideas-based teaching is to help students to be taken by an idea and to live with it, to be with it in their world.

Consider an example: In the midst of a rather uninspired high school science lesson on photosynthesis, a student suddenly sits bolt upright and exclaims, “I have an idea. You say that variation is important in Darwin’s theory of evolution. Does that mean, then, that variation or diversity among people is also important for adaptation in the human species?” In this example, the having of an idea is an event that moves forward with dramatic energy; it is an experience. The student is filled with thought, has feelings associated with where the idea may lead, and is energized to act either physically or in imagination. Thus, in an experience, thought, feeling, and action are unified, there is “heightened vitality,” and the individual experiences what it is like to be fully alive. The goal of effective teaching is not merely to foster new understanding, but to foster more vital ways of being. In short, the goal of education is inspiration (the word inspiration has the Latin root inspirare, which means “to breathe life into”). The degree to which teaching facilitates inspiration, rather than just conceptual understanding, is the degree it is organized around Deweyan ideas rather than just concepts.

In summary, concepts are typically characterized as a cognitive phenomenon, rather than as a behavioral, affective, and cognitive phenomenon. In addition, concepts are usually described as static representations, rather than as events and ways of being or participating in the world. We fully realize that some readers may take issue with our characterization of the concepts and cognitive perspective. Our intent is not to set up a straw man argument, and we acknowledge that readers may vary in the degree that they see their own perspective of concepts coinciding with our notion of ideas.
From Concepts to Ideas

Although we distinguish ideas from concepts, and although the goal of science teaching is to have students experience ideas rather than simply construct accurate representations of concepts, concepts nonetheless have a vital role in instruction. Concepts provide a valuable starting point for instruction, for they mark potentially important sites to visit in the terrain of the curriculum (Lampert, 1988). It is important to realize that most scientific concepts originated as ideas. At some point in history, textbook concepts represented a valuable way of seeing or being in the world for scientists. For example, most students in earth science encounter the concept that the sun is the center of our solar system. To what degree does earth science instruction about this topic evoke inspiration; to what degree are they made more fully alive having learned this idea? To contemporaries of Copernicus, to conceive of the sun—rather than the Earth or Rome—as the center of the solar system was a life-transforming idea. This way of seeing the world (literally) was profoundly engaging and affected how people viewed the Church, God’s plan, and man’s place in the grand order of the universe. In addition, it inspired action as astronomers pointed their telescopes in different directions, to look for new patterns in their observations, to make new connections. The idea was shocking, threatening, exciting, and beautiful. To be with this idea was to be part of an experience where the world seemed unfamiliar again and there to be rediscovered.

Today, in most science classes the heliocentric model of the solar system is no longer an idea, but a concept to be learned. Its power to inspire action, thought, and feeling is largely absent as it is presented as something merely to be understood rather than something to be inspired by. The science teacher’s challenge is to “reanimate” such concepts so that students can become more alive with the idea. According to Dewey, (1902) subject matter

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\ldots \text{must be restored to the experience from which it has been abstracted. It needs to be psychologized: turned over, translated into the immediate and individual experiencing within which it has its origin and significance. (p. 285)}
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“Psychologizing” an idea might be interpreted as connecting an idea to students’ interests or prior knowledge. However, given Dewey’s analysis of experience, to restore subject matter “to the experience from which it has been abstracted” is to have students experience the drama that comes when one’s being is transformed by a powerful idea. (Note: An interesting case may be made that some concepts may be impossible to resuscitate, even by the most skilled teacher, owing to changes in what is taken for granted in a society. For example, the notion that the world is round used to be a wildly provocative idea. It is a fair question to wonder whether this idea still holds the power to inspire in an age where photographs and images of our round Earth are commonplace.)

Metaphors for Ideas-Based Teaching

If effective instruction is organized around ideas and its goal is for students to undergo educative experiences, what metaphors of teaching might we draw on? When translating Dewey’s philosophical and psychological ideas into specifics of practices, we want to be careful in several ways. First, to be too prescriptive is not productive. It is a risky proposition to argue that a particular set of practices can be deduced from a philosophical perspective. Instead, we shall propose several metaphors for ideas-based teaching grounded in the Dewey’s notions of ideas and experience. Second, these examples are not necessarily posed as radical alternatives to existing practice. Much teaching already inspires students’ thought, feeling, and action about
worthwhile science and is therefore ideas-based. We find it unnecessary and counterproductive to draw caricatures of existing practice or to disparage it as traditional so that we may argue the value of our ideas. Instead, we discuss the degree that existing practice is more or less ideas-based and then consider how it might be transformed.

**Ideas as Powerful Stories: Emphasis on Anticipation**

We find the arts—visual arts, music, literature, and especially drama—to be particularly rich sources of metaphors for teaching. In the arts, much like ideas-based teaching, the goal is to have the audience experience the world in a particular way. Powerful drama prompts the audience to think, feel, and, although they are unable to take physical action, at least imagine or anticipate action. Dramatists understand the interplay between action, thought, and emotion on stage and in the audience. In essence, they understand how to evoke worthwhile experiences in their audience.

The story metaphor is useful because it highlights the central role of anticipation. Without a sense of anticipation, a story becomes a flat telling of events rather than a continuously unfolding experience. This forward-moving quality of experience is a critical part of the story. Granted, stories tend to have a chronological structure and progress in the sense that one thing happens after another. To an outside observer the happening of events against time is obvious. However, there is another perspective that which comes when one moves inside the story, to live rather than observe the story. The difference is analogous to an observer’s perspective watching a car move down the road versus the driver’s perspective in control of the car, looking down the road, anticipating, controlling, and responding to what is happening.

Think about the experience of a good book, movie, or play. Think about how the skillful telling of a powerful story pulls you in, beyond the words and the action, until you are within the story rather than simply watching it take place. In the classroom, the teacher is the storyteller, the students are the readers, and the development of the plot is the drama of experiencing the world with an idea. It is the teacher’s job to conjure up characters, actions, setting, and, finally, a plot that brings the idea alive.

Effective teaching is dramatic. We say this with trepidation because this characterization lends itself to easy misinterpretation. One is quickly reminded of many science classes where drama comes by way of flash, smoke, humor, surprise, shock, repulsion, and so on. Granted, in these classes students are attentive but this kind of teaching is not truly dramatic. Sensational words, actions, props, or settings are only the surface qualities of drama. Truly powerful drama is inextricably connected to its substance. The movie version of *Jurassic Park* is an example of how a good idea can become disengaged from the dramatic elements of the story. One might argue that the central idea of the movie (certainly in the original novel) is that nature can never be controlled, even by the logic, knowledge, and technology. This provocative idea about the limits of science is unfortunately unconnected to the events of the movie. Granted, the movie is still engaging, but in a less powerful way. Although there is still a certain level of anticipation, it is anticipation associated more with the threat of being eaten alive by dinosaurs than with any larger scientific idea. Because the central idea is underdeveloped and not convincingly integrated with the dialogue and action, the movie is ultimately less powerful, less important. It entertains in an immediate escapist sense but fails to move in an enduring way.

To teach dramatically is to have an unwavering sense of the central idea and to realize that the characters, action, dialogue, and props of drama all must function to evoke an audience’s experience of the idea. The drama of biology should not come from fiddling with lab equipment or materials. Instead, the good teacher finds the drama that comes with exploring a powerful idea
such as the possibility that plants are the only organisms in the universe that can convert the sun’s energy to food energy—food that ultimately sustains every other life form. Outside of biology class, the idea moves us to experience our everyday lives a bit differently. Perhaps we will become more concerned about deforestation, have a more connected view of the local ecosystems, or be inspired to water that dried-up African violet on the windowsill. Similarly, the drama in a physics class should not come from colliding balls, flashy demonstrations, or playing with springs, air tracks, and pendulums. Granted, these are all important activities. The real drama of physics, however, lies in its ideas. For example the teacher may introduce students to the drama of Newton’s laws in the following way:

For much of history, people had not been very successful at predicting and explaining motion. But Newton, with his three simple laws, figured out how to explain the motion of all observable objects. His laws gave him a vision into the very nature of the universe—which in his day was like seeing into the very nature of God. And with that vision came a magnificent, but terrifying power—the power to explain, predict, and control the world. Since that day, the world has never been the same. Let’s take a look at these ideas and see how they might also change our selves, our world.

The teacher is attempting to foreshadow the significance of Newton’s laws and create anticipation what power is connected to Newton’s laws and how they have forever changed the world. The drama unfolds as the teacher helps students act on these anticipations.

One of us once attended a gathering of a professional poetry group in San Francisco and was surprised to hear carefully crafted work read in a flat, almost lifeless voice. Not being a poet, he asked his poet friends about the reason behind this kind of reading. He learned that it is not that the authors do not want to move the listeners, for they do indeed. Instead, both the poet and the audience typically understand that the power of the poem should lie in its substance, not its delivery. Although this anecdote is rather severe and unlikely to lead directly to successful teaching practice, it highlights a commitment to place ideas at the heart of educative experiences. This notion that compelling ideas, with minimal superfluous drama, can carry the day may be difficult to accept. Dewey, however, is clear on this issue:

There is no mistake more common in schools than ignoring the self-propelling power of an idea. Once it is aroused, an alert mind fairly races along with it. Of itself it carries the student into new fields; it branches out into new ideas as a plant sends forth new shoots. (Dewey, 1933, p. 335)

The task of getting students to the point where the “alert mind fairly races along with” ideas is not easy. The teacher must identify the “big ideas” in a domain. These ideas are not necessarily found in the bulleted list at the beginning of each textbook chapter, nor in curriculum frameworks assembled by panels of experts. The central criterion when searching is, “In what ways does a particular idea have the potential to transform students’ experience of the world?” Before instruction can begin, teachers must understand in their minds and believe in their hearts how an idea has the power to inspire.

Ideas as Art to Appreciate: Emphasis on Perception

For many, art is the highest form of representation, the truest medium of communication. Deweyan scholar Philip Jackson (1995) wrote,
the arts provide us, either as artists or as consumers, with experience that are exemplary in their unity, in their educative potency, and in the type of consummatory pleasures they yield. What accounts for this exemplary status is the way in which the arts refine, concentrate and intensify those same traits and qualities that we find in every “normally complete” experience. In so doing, they lead us to an enriched understanding of the experience object and, ultimately, to a deepened understanding of the self. The arts reveal, in other words, what more of life could be like and, concomitantly, what we ourselves could be like if we really worked at it. (p. 194)

Not surprisingly, *Art as experience* is considered Dewey’s most coherent, powerful writing, the culmination of his 4 decades of philosophical work. It seems almost inevitable, then, that the production and appreciation of art should provide us with another metaphor for ideas-based teaching.

Scientific concepts are like works of art. Just as a Shakespearean play may transform our understanding and experiencing of love or a Monet painting may forever transform the way we see shadows and light, so may ideas also transform the way we experience and perceive the world. Concepts are intended to enable the beholder to live in and experience the world in new and worthwhile ways (i.e., they are intended to function as ideas). The arts do this by causing us to fully perceive (as opposed to recognize) ordinary objects, events, or experiences in our lives. The distinction between perception and recognition is critical to this discussion and needs to be elaborated on. Dewey (1934) explained:

Recognition is perception arrested before it has a chance to develop freely…In recognition we fall back, as upon a stereotype, upon some previously formed scheme. …Recognition is too easy to arouse vivid consciousness. (pp. 52–53)

In contrast, in perception although we may be looking at something very familiar, “there is an act of reconstructive doing: and consciousness becomes fresh and alive” (p. 53). Furthermore, perception like any aesthetic knowing has a pervading emotional quality. Jackson (1998) commented on Dewey’s views of perception:

Dewey’s first point is that only as we come to care about objects (feel solicitous about them) do we begin to perceive them. Perception, in other words, is more than noticing or sensing something. It involves feeling as well as sense. (p. 149)

He went on to explain Dewey’s second point about full perception:

I think what Dewey means is that during those moments of full perception, when we become totally absorbed in what this event or idea is like, that the various components of our psychological being—our ability to think, to feel, to appreciate, to experience through all of our senses—come into play at once. At such moments our various capacities not only are realized (i.e., become real) but are also momentarily fused and unified. Only then do we experience what it is like to be fully human. (p. 149)

To perceive is to view the world with fresh eyes and to be fully alive in an experience. Ideally, art fosters perception. For instance, a Monet painting may cause us to move beyond mere recognition of shadows. It may cause to look deeper and perceive that shadows are not dull, dark, and gray as we may have previously thought. Instead, they are full of light and color. This discovery may then fill us with sense of wonder, appreciation, excitement, puzzlement, or simply
satisfaction. In the same way, concepts should also foster perception. Just about every scientific concept is potentially an idea, and every idea, according to Dewey, is a powerful lens. Ideas, Dewey (1933) explained, are like lenses in that they are used to guide new observations of and reflections upon actual situations, past, present, or future.

For instance, a magnifying lens may focus your attention on the grains of a granite rock and allow you to perceive things you never saw or noticed before. Likewise, ideas highlight certain aspects of objects, events, and experiences and allow us to see these things anew. For example, Newton’s laws have the potential to become ideas which transform our perception of ordinary events. We describe a middle school student from one of our studies who demonstrated this potentiality (Pugh, 1999a, 1999b). This student, Ed, not only gained a cognitive understanding of Newton’s laws, but came to perceive and experience the world differently. Ed commented that Newton’s laws were worth learning, “not just because I want to get a passing grade and go into eighth grade, but because it’s telling me that I can look at . . . when two cars crash into each other. I can look at that in a different way. When I watch a movie I can look at that in a different way. Now I’m going to see things that I’m used to seeing in a different way.” Indeed, Ed did give a number of examples of how he saw and experienced the world differently. He saw the movement of a bicycle in terms of force pairs. He saw the event of riding in a car in terms of inertia and even explained this to his grandmother. Perhaps the best example was about his 2-year-old cousin, who went running across the wood kitchen floor in her socks and then tried to stop. As may be predicted, she could not stop and slid into the door. Ed immediately thought about this event in terms of Newton’s first law: A child in motion (on a wood floor with socks on) will continue in motion until acted upon by another object. For Ed, this new way of perceiving events in his life was thrilling and he thought Newton’s laws were fascinating because of the way they changed his perception. He commented, “I think [Newton’s laws] kind of fascinating. . . . [They] made me think about things I hadn’t thought about before, like why you slide when the car takes a turn. And why water stays in the bottom of the bucket when you spin it around. . . . Made me think about stuff that I’m not used to thinking about in that way.” This example further demonstrates the connection between perception and emotion and between knowing and doing.

From the ideas-as-art metaphor, we might say that the role of the teacher is analogous to the role of museum docent or field guide on a nature walk. The goal is to teach the students to more fully perceive the world by teaching them how to see it through the lenses of powerful ideas. One potential way to do is for the teachers to address the hand of the “creator.” Docents augment our ability to appreciate art by giving us an understanding of the artists—what they experienced in creating the piece. Likewise, science teachers can help students appreciate concepts and have transformative experiences by giving them a sense for the origin of the concept and how the concept was a full-blown idea for the creators. For example, the teacher could help students appreciate what Darwin experienced as he was developing his theory of how animals become adapted to their environment. The class could discuss the sense of excitement and anticipation he felt, struggles he had to overcome, the inner tensions he faced, and so on.

A second strategy would be for teachers to emphasize the perceptual aspects of ideas and to model their own experience how ideas helped them to more fully perceive the world. Sister Wendy Beckett, featured in the BBC production, *The story of painting*, is a beautiful example of someone modeling her experience of appreciation. When she describes particular paintings, the great joy brought by these works of art is clearly obvious. She is obviously made fully alive in her love of art. Moreover, she is alive with the ideas in the discipline of art. Likewise, teachers can demonstrate what it is like to be alive with the science ideas that make our world more meaningful and consequently they can foster anticipation of what it might be like to be alive with these ideas. For instance, teachers may emphasize ways that the idea of evolution profoundly
transforms the way we perceive living things and share their own exciting, thrilling, or disturbing experiences of seeing the world through the lens of evolution. Finally, when teaching an idea, teachers should leave room for the students to have their own personal experience. They must attend to, facilitate, and support appropriate affective responses in addition to cognitive responses. If experience is like a rushing stream, as William James described it, teachers need to bring students to the banks, show them the thrill of being carried away, and then encourage them to leap in and “yawp” with all their heart.

A Comparison with Other Perspectives on Learning

We now turn to comparing and contrasting Dewey’s perspective with Lemke’s sociocultural and Brickhouse’s feminist perspectives on learning. We organize our discussion around two issues: the role of the real world in learning and the interplay between ideas, subject matter, and motivation.

Epistemology: The Role of a Real World

With roots in critical theory, literary criticism, anthropology, and postmodern epistemology, sociocultural and feminist perspectives have educated our sensitivity to the contextualized qualities of learning and knowledge. A shared mission of these perspectives has been to debunk conceptions of meaning as:

- something in the object,
- something that can be rationally derived from a general system of rules, or
- something in the individual mind,

and, instead, to recognize meaning as

- something situated in a social (i.e., gendered, cultural, historical, political) context.

(Note: “Situated” can imply that meaning is embedded in either physical (Brown et al., 1989; Gibson, 1966) or the social setting. Lemke’s sociocultural and Brickhouse’s feminist perspectives draw on the social aspects of situatedness. Most perspectives are hybrids of these assumptions)

With the development of theories about the socially situated nature of meaning, language plays an increasingly important role as both the process and product of meaning-construction. Two reasons may be cited: First, as an entity, language is neither in the head nor in the object—it is between people. Thus, the Rortian “linguistic turn” presents a solution to the age-old problem about the “location” of knowledge and the mind (cf. Cobb, 1994). Thus, meaning resides neither in the head nor in the world, but in the language we develop. In this view, to learn science is to learn its language (e.g., Roseberry et al., 1992; Gregory, 1990; Lemke, 1990). Second, because language and communication are inherently social phenomena, they are well-suited to reflect how meaning is shaped by gendered, cultural, historical, and political forces.

The sociocultural and feminist emphasis on social context and language has inspired classroom practices that help students share various viewpoints, value others’ ideas, develop well-formed arguments, and become proficient and comfortable with the genres of science discourse. Advocates for student-centered pedagogy support this move away from the more
didactic models of teaching as students were more able to have ideas, to voice them, to feel like legitimate participants in a community of discourse, and to gain ownership of what they learned.

Dewey would undoubtedly support many, if not all, teaching practices sensitive to the influence of social context on meaning and to the importance of language. He would, however, sound a cautionary note. As we become more focused on language and the socially contextualized nature of knowledge, Dewey would warn against the tendency to diminish the role of the real world. As a realist, Dewey did not view knowledge as a purely social (or individual) construction. Instead, legitimate knowledge and meaning always has a basis in our interactions with the world. Put differently, experience is not a purely psychological phenomenon. Dewey wrote,

Instead of signifying being shut up within one’s own private feelings and sensations, . . . experience signifies active and alert commerce with the world; at its height it signifies complete interpenetration of self and the world of objects and events. (1934, p. 25)

Jackson elaborated on this idea,

Experience, in other words, is transactional. It is not just what registers on our consciousness as we make our way through the world but includes the objects and events that compose that world. The objects and events are as much a part of experience as we are ourselves. (1998, p. 3)

One of his main points is that experience is not a psychological phenomenon. It is not something that happens exclusively “within” us, though it may certainly have components that we commonly describe in psychological terms. Rather, experience takes place in the world itself. It is made up of our continuous interaction and participation with objects, situations, and events that constitute our environment. (p. 194, 1995)

Although Dewey and Jackson warned against construing experience as an internalized individual phenomenon, an analogous point can be made that knowledge should not be portrayed as something completely internal to the social processes of group activity.

Thus, Dewey’s epistemology contributes to sociocultural and feminist perspectives by giving equal time to the social-contextual, the individual psychological, and the natural world. All three entities function as both generators and arbiters of knowledge. The notion that meaning is negotiated is expanded to include negotiation not only in interaction with others, but also in interaction with the world. Similarly, the value of an idea lies not simply in its rational basis, nor in the sway of the social influences associated with it, but also in what it yields for individuals as they act in the world.

Motivation: An Emphasis on Subject Matter Ideas

When comparing different perspectives on learning, it is important to consider the question of what motivates learning. Why would students want to engage in science? In science education, the negative question is more common: Why do students not want to engage with science? In the past 40 years, there have been many important perspectives on the problem of engagement. Piaget’s theory of learning and development was influential through Bruner’s seminal Process of education and more recently in the work of Duckworth. To the behaviorist’s external and observable reality of action and environment, Piaget proposed another reality—an internal one—of knowledge, representation, and intention. Although infamous for his
provocative stage theory, Piaget’s more important and lasting legacy is his constructivist position that emphasizes the interconnection between knowledge and activity.

In science education, the elements of knowledge and activity were reinforced by Joseph Schwab’s distinction between the substantive (concepts, principles, and facts) and syntactic (procedures and practices) structures of science. The gradual separation between content and process, between knowledge and activity, has had an unfortunate legacy in science education. Educators have subsequently struggled with issues such as whether content or process is more important, and how to combine the two. Dewey opposed such dualism or bifurcation for they inevitably led to either–or dilemmas or the problem of integrating that which was never in need of integrating in the first place. Before we discuss Dewey’s solution, we continue in our description of perspectives on the problem of engagement.

In the separation of content and process, reform movements lined on either side. On the content side, blue ribbon panels of famous scientists were formed to determine the most important content for students to learn. Echoing both Piaget’s and Bruner’s call for structure, instructional psychologists, most notably Ausubel, proposed teaching methods by which this content could be most effectively organized and presented. By contrast, process-oriented approaches, such as Science A Process Approach or Elementary Science Study, strove to teach the students the basic rational activities of science such as observation, inference, analysis, and synthesis (DeBoer, 1991). The absence of recognizable science content was justified either as a necessary tradeoff for more important methods or because greater transfer of skills was thought to come only when learned with less domain-specific content.

The problems associated with emphasizing either content or process are familiar: Learning is either too passive or so lacking in substance that it can hardly be called science. In this light, the emergence of conceptual change teaching in the early 1980s presented a compelling alternative. As in Piaget’s theory, conceptual change learning is motivated by a desire to reduce perturbations in one’s various representations of the world. The underlying assumption is that humans, by their nature, are curious, sensemaking creatures. Learning is therefore prompted by disequilibrium or dissonance in our ways of thinking and acting in the world. Put succinctly, we are motivated by problems (Posner et al., 1982). Conceptual change instruction encouraged learners to find problems in their current understanding and then to adopt more fruitful alternatives. Compared with many activity-oriented perspectives, conceptual change teaching was more directly concerned with working with the content of science; compared with content-oriented perspectives, conceptual change offered a more active role for students. Content and activity were finally reunited. Unfortunately, students neither changed their conceptions as anticipated nor sought to reduce logical inconsistencies as expected.

The feminist and sociocultural perspectives applied a different analytic lens to the problem of motivation. Although their postmodern origins resonated with the Piagetian notion of knowledge-as-constructed, they were less willing to see science as primarily an individual phenomenon. The child was not, in their view, a lone scientist exploring his or her world. Instead, feminist and sociocultural perspectives saw the importance of portraying science as a social phenomenon. They operated from different assumptions about humans than did cognitive approaches. Humans were seen as fundamentally social creatures whose sense of the world and themselves was inextricably embedded in their interactions with one another. To learn science was to participate in science activities with others.

Sociocultural and feminist approaches form a broad class of practice ranging from cooperative groups working on a common task (Cohen, 1994) to whole-class discourse communities where students conjecture, share, and evaluate scientific ideas (e.g., Roseberry et al., 1990; Michaels & O’Connor, 1990; Lemke, 1990; Anderson et al., 1997). Within these
approaches, engagement is associated with a desire to participate with others in shared activities. To participate appropriately in this “community of practice,” individuals must understand the symbols and practices of that community. For example, it can be argued that the idea that “plants transform radiant energy into food” is made meaningful and engaging to students as it enables them to participate more fully in a community to which they desire to belong.

In this light, the problem of engagement was that students did not identify or feel comfortable with the nature of the activity and their role in the activity. Feminism and sociocultural perspectives often feature explicit ideological commitments to justice, equality, freedom from oppression, and empowering those with less power. A superordinate goal of instruction, then, is to facilitate classroom interaction that correspond to certain standards of participation—for examples, working cooperatively, taking the role of legitimate contributor, respecting each others’ contributions. Even when the science subject matter is somewhat inaccurate or insubstantial, instruction may be judged as worthwhile because process matters more than substance. In this contemporary vision of science, we see an interesting recapitulation of the 1960s tension between the relative merit of learning the process and content of science.

How might Dewey respond to the problem of motivation and the approaches taken by the conceptual change, feminist, and sociocultural perspectives? To the conceptual change approach, Dewey would suggest that change in understanding is compelled by more than just the mechanics of logic or the need to develop a coherent system of understanding. Scholars and teachers frustrated with the robustness of students conceptions have long appreciated this to be the case. Although Dewey would agree that conceptions may be deeply rooted and that students may indeed have logical difficulty accommodating disconfirmatory evidence (Kuhn, 1989), he would suggest that there are other reasons why conceptual change teaching often fails to move students. First, learning is seen as more than just a rational, cognitive activity. As discussed earlier, in ideas-based teaching the basic units of learning are ideas rather than concepts. Action and affect, in addition to thought, are emphasized such that the goal of teaching is inspiration, not just understanding. Finally, to really engage with an idea, to live with it for a while, is a complex process that cannot be adequately characterized as cognitive. We describe this complexity as having paradoxical relationships between the rational and nonrational. For example, in the process of meaning making students must be skeptical and open to new ideas and experiences, rational and willing to suspend disbelief, and metacognitive and unselfconscious. On the one hand, students must be logical, careful, and conservative. On the other, like a work of art, a science idea cannot be fully experienced unless students can let go and allow themselves to be swept away by its power. Managing these relations is difficult but essential to educative experience. In summary, as humans we are inspired by more than just the need to resolve rational inconsistencies. Instead, learning is compelled by the possibility of living a life more vibrant with thought, feeling, and action. Dewey might argue that conceptual change science falls short because to portray students as rational and cognitive beings does not fully characterize what it means to be human.

To the feminist and sociocultural approaches, Dewey would agree that we are motivated in both a positive and negative way by how we relate with others. The prospect of pleasant or unpleasant interactions with others has a powerful influence on the nature of our subsequent action. We believe Dewey would expand on two constructs central to sociocultural and feminist accounts of engagement: participation and identity.

Dewey would also find great value in the sociocultural and feminist emphasis on participation, for he similarly saw meaning as situated in action rather than as a strictly psychological entity. He would, however, want to expand on what is meant by participation. As
should be evident by now, Dewey’s notion of participation refers not only to interactions with others, but also to participation more broadly in the drama of inquiry. As cited earlier, transformative experience is “active and alert commerce” with the world—“commerce” being the forward-moving energy created by the transaction between testing ideas and undergoing the consequences. It is in this kind of participation that we are fully alive, fully human: To be motivated is to seek and participate in these kinds of experiences. Next to the conceptual change perspective, Dewey’s account of engagement highlighted the role of other noncognitive human faculties; to sociocultural and feminist perspectives, Dewey highlighted our participation in the natural, in addition to the social, world. For example, Diane Ackerman’s *A natural history of the senses* is a compelling example of how understanding of science and history can enrich our lives by affecting how we literally sense the world through touch, smell, sight, and taste. (Note: it may be interesting to consider why we equate knowing with making “sense.” We welcome any insights.) Thus, the power and value of ideas are their ability to enrich participation not only with others, but with life as a whole. In every waking moment—with others, with nature, or by ourselves—there is opportunity to participate with our surroundings. Science teachers should help students see how powerful ideas help them to see, hear, touch, do, and feel in ways that they never thought possible. Meaningful learning engages not only language, but all faculties and senses.

When participation is broadened in this way, the construct of identity is similarly enhanced. Powerful subject matter ideas create anticipations about a way of being in the world, and that way of being includes not only an image of the world, but also an image of the student in that world. Ideas motivate when students find both the image of world and the image themselves in that world compelling. For example, to fully grasp the meaning of the idea that all rocks have fascinating stories, students must not only be able to tell the geologic story of some rocks, but also look forward to being the kind of person who cares enough to tell those stories. Thus, identity is defined not only as a social phenomenon; it is not only one’s relationship to others. For Dewey, we believe, identity also included one’s) relationship to or participation with the world (natural and social) as made possible by ideas. As many biographies and autobiographies reveal, an important part of scientists’ identity is that ideas hold special sway on them. They are motivated to continue to be the kind of people who experience the beauty and drama of science ideas. The social quality identity and engagement are associated with the great pleasure gained from sharing the experience of ideas with others.

**Conclusion**

What is most worth teaching in schools? Some may argue for the importance of accumulating knowledge or developing thinking skills. Others may contend that schools should help students achieve success in the workplace, thereby ensuring economic prosperity. However, for Dewey (1938), the work of educators is to “select the kind of present experiences that live fruitfully and creatively in subsequent experiences” (p. 28). We suggest that knowledge, skills, and prosperity (beyond mere subsistence) are not ends in themselves, but means to more satisfying experiences. The good life, and all that it connotes, is a life of worthwhile experiences. Life is about worthwhile experience; education should be, too. Dewey’s notion of ideas and the anticipation they create is a compelling way of thinking about how present educative experiences can develop into future worthwhile experiences. Through powerful ideas, students can begin to envision possible actions, thoughts, feelings, and identities. In our view, education, above all else, is about that which might be—the essence of ideas.
References


