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## IDENTITY IN SCIENTIFIC LITERACY

### *Emotional-Volitional and Ethico-Moral Dimensions*

- Michelle: We went there last year to Goldstream [Park]–  
Jane: I go by there almost every weekend. Twice.  
Michelle: when you could actually see [salmon] spawning; and this guy pulled out a salmon and did a dissection on it. It was kind a gross. And then we went a couple of months later when all the salmon had died and they were just little. And you could see eagles. We missed the eagles. But it was smelling really bad. We've got pictures of us all covering our noses. It was like gross.  
Jane: You know at Centennial [Park], you know what you could probably do? But there's more fish coming in or something, you could, do something like they have at Goldstream?  
Environmentalist: Yea.  
Jane: Set up something like that.  
Michelle: Yeah.  
Environmentalist: That would be neat. Maybe one day.

As part of an interview, the eighth-graders Michelle and Jane and an environmentalist, who had been their chaperon during a field-based environmental unit one year earlier, are talking about a creek where they had seen salmon. Jane proposes that something could be done to increase the resident fish populations in the creek that they had studied for nearly five months and the results of which they had presented during an open-house event organized by an environmentalist group dedicated to the revitalization of the local watershed. Closer inspection of the account shows that it contains not *just* information but in fact gives clues about the emotional-volitional and ethico-moral dimensions of being generally and identity specifically. Thus, the two young women talk about something that could be done about a creek, the sorry state of which they had amply documented as part of their research. Their talk thereby embodies an ethical aim, namely caring for and thereby being stewards of the land that provides habitat not only for fish but the human inhabitants of the valley. Although the smell of decaying salmon is “gross,” signaling negative emotional valence, attaining the ethical aim of stewardship has positive emotional valence, for otherwise it would not be worth doing. More so, this brief conversation also provides glimpses of who these female students are, that is, about their identity. They are individuals who go to a specific park about twenty kilometers from their village to observe salmon spawning and who, as told

elsewhere in the interview, participated in an environmentalist open-house event where they exhibited the results of their research on the creek. Both during this open house and during the interview one year later, the young women provide ample evidence of their knowledgeable participation in activities, where scientific knowledge and practices came in handy, and quite frequently so. The scientific literacy exhibited while interacting with others and the natural world—elaborated and evidenced later in this chapter—contrasts the reluctance these young women had previously shown to science and science education. That is, although they had done research, which in part had little resemblance with the tasks most seventh-graders do in school science laboratory, the scientific literacy observable in their actions was integral to their identity; and these actions and their identity was characterized by emotional-volitional and ethico-moral dimensions not normally observable in science classrooms.

In schools, science, as other school subjects, is taught separately from everything else, during a particular block of school time and, especially in middle and even more so in high schools, in special places called laboratories. The underlying epistemology is clear. Scientific knowledge can be separated from everything else of everyday life, taught in special rooms at a particular time of the day: its theoretical aspect can be taught in and through lectures, whereas its technical part is taught through step-by-step exercises in specially designed laboratory tasks. Never ever does there appear to be a question of how all of this relates to whole persons asked to learn science, to how these persons experience themselves, their identities. In policy statements and curriculum design, even less thought is given to the emotional-volitional and ethico-moral dimension that are an integral aspect of all actions, including those related to the deployment of theoretical and practical knowledgeability in science. Scientists have participated in constructing the atomic bomb that victimized hundreds of thousands of Japanese civilians, have developed the birth-defect-producing thalidomide, and continue to develop scores of genetically modified crops that leave their indelible mark on the environment. Yet few scientists appear to be concerned with the effects that the outcomes of their work have on specific individuals, who are the victims of scientific and technological “progress,” and on society as a whole. All of this shows that many scientists divest themselves of what philosophers have come to discuss under the term *answerability* or *responsibility*, which is an integral element of any act, scientific or otherwise. One of the most flagrant statements concerning the question of scientists divesting themselves of answerability was told to me by a Monsanto scientist—he only ate organic food all the while developing genetically modified, herbicide resistant seed for his employer.

The move to divest science and scientists from the responsibility for their actions and to others is made easy in an epistemology that (a) considers only theoretical and technical knowledge and (b) considers these forms of knowledge only theoretically. Both moves are part of an abstraction that detaches identity and answerability from the richness of attested life: “I cannot include my actual self and my life (*qua* movement) in the world constituted by the constructions of theoretical consciousness in abstraction from the answerable and individual historical act”

(Bakhtin, 1993, p. 8–9). The obtained theoretical world of conceptual knowledge and technical skills thereby comes to exist separate from my unique being and from the ethico-moral sense of acting. As a result, people generally and science learners specifically become indifferent and fundamentally predetermined and determinate beings. That is, the ethico-moral dimensions of agency, answerability, and identity are integral aspects of agency that only exist in our practical engagement with the world. There is another component equally important but often overlooked in school science and in the discussions of scientific literacy: the emotional-volitional dimension of action.

There are two components to the term emotional-volitional. On the one hand, the volitional aspects generally are discussed in Western scholarship in terms of intentions and intentionality said to underlie and determine goals and actions. Yet cultural-historical activity theorists point out that individual goals are only one aspect of ongoing practical activity, that is, praxis. Each action in fact presupposes some societal activity in the aegis of, and for the realization of which, the action has been produced in the first place.<sup>1</sup> We do not just act to achieve some goal but always do something that gets partially realized through that goal; we always act *for the purpose of* and *in order to*. What Michelle and Jane are talking about and how they interact with the environmentalist and the interviewer is a function of the situation: The talk reproduces and produces a societal activity known as “interviewing about.” That is, we always act in the course of being engaged in some societal activity that contributes to its maintenance and survival, that is, to the satisfaction of needs generally. Although the two components, the general motive of an activity and the specific goals that realize it get us further in understanding human actions, a third component is necessary: the nonconscious serialized operations that concretely realize the goal into a completed act. This triad—motive, goals, and operations—constitute the unity of every moment of praxis and therefore are irreducible to one another or to some other moment of activity (A. A. Leont’ev, 1971).

Emotions, the second component of the emotional-volitional dimension of praxis, are integral to each of the three-part volitional component (Roth, 2007). In the long term, we engage in particular activities because they promise to satisfy certain needs, both in terms of the job itself as in the means that we receive in return for our work. In the short term, we set goals to be achieved and to increase the control over our life conditions, that is, our action possibilities. Achieving goals also is associated with increases in emotional valence and we generally avoid those situations that are associated with negative emotional valence and negative outcomes—though short-term costs are acceptable if there are payoffs in the long run. Finally, present emotional states, which are associated with the body and often nonconscious and even unconscious, mediate and provide context for the unfolding of operations.

The purpose of the present chapter is to articulate an empirically grounded framework for theorizing scientific literacy in a way that does not reduce the notion to theoretical and technical knowledge at the expense of other irreducible aspects of human praxis without which we cannot understand why people do what they do. These other aspects are of emotional-volitional and ethico-moral nature. My em-

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pirical materials derive from a three-year ethnographic effort in one village in the Pacific Northwest of Canada designed to study learning as individuals from different communities of practice come to interact with one another. These communities included environmentalists, citizens, high school students, First Nations elders, environmental stewards, and scientists.

#### BECOMING A CITIZEN THROUGH PARTICIPATION IN ENVIRONMENTALISM

The object/motive of our work was to document science both as a resource for action and a terrain to be negotiated, as various members and groups of the community engaged in issues about the embedding watershed and the water available to residents. We wanted to understand what it meant for people to participate in multiple activity systems and how these multiple forms of participation mediated their identities. As part of this effort, I also taught a unit about the environment at a local middle school (grades 6–8 [ages 11–13]) together with several resident science teachers. The curriculum was driven by the idea that science education ought to provide students with resources to develop into responsible and responsive citizens (Roth & Désautels, 2004). What I had not realized at the time of planning the study was the central role that emotional-volitional and ethico-moral aspects of being play in knowing and learning.

#### *Setting the Stage for Learning Science in and for the Community*

The science unit on water and the environment began with a series of newspaper articles, one of which in particular caught the attention of the students. Entitled “Group is a bridge over troubled waters” (Reimche, 1998), the article has as topic (a) the sorry state of the ocean waters surrounding the peninsula on which the community is located and (b) the efforts by some local environmentalists to revitalize and save the local creeks and watersheds that feed the ocean. The middle school students immediately understand the issues stake, as many of their parents commercially or recreationally (a) fish the ocean waters for salmon, halibut, and rockfish, (b) set traps for crab or prawns, or (c) collect a variety of shellfish including clams, mussels, and oysters. The students already know that some shellfish beds are either no longer operational or so heavily polluted that they can no longer be harvested; those students who know about this articulate their understandings in the whole-class discussion.

In the newspaper article that we read together, the feeder creeks are presented as having been damaged: dredging turned them entirely or partially into ditches, increased water flow rates through ditches and culverts eroded the habitats not only of fish but also of birds and other animals. There is talk about sewage, high coliform counts, and the damage these have done, among others, to animal life in the creek and ocean. An environmentalist is quoted to feel that “the success of the revitalization process would only come through the *involvement of the people who live in the community*” (p. 9, my emphasis). This statement in particular gets the students going. Although they, as most people in the village community, do not know



*Figure 8.1. The creeks feeding the surrounding ocean waters, where commercial and hobby fishery harvest a variety of fish, crab, prawns, and shellfish, not only are denatured—straightening, shade-tree removal—but also subject to (a) industrial—effluents from local industries shown in the background—and (b) agricultural pollution—through runoff from heavily fertilized fields and livestock.*

the creek they immediately feel called upon—they exhibit the ability to respond, responsibility, and therefore their ethico-moral character—wanting to clean up the creek, find out more about it, document its pollution, and so forth. More so, the students are excited not only about doing research outside the classroom and school, which constitutes a break in the often dull routines of their everyday school life but also about being enabled to contribute to their village as a whole.

The teachers, with the help of parents, environmentalists, and graduate students take the class of students every other week for an entire afternoon outdoors to get to know the creek in its various reaches (e.g., Figure 8.1), define interesting research questions and projects, collect data, and document the creek in any way they want to. After this first visit, the teachers engage the students in another whole-class discussion during which it becomes evident that it is precisely the sorry state of the creek as documented in Figure 8.1 that involves the students in ways that their normal science classes does not. Students are empathetic and concerned. The photographs I use here are just like those Michelle shoots for her exhibit at the subsequent environmentalist open house; these photos are integral elements of the emotional aspect of the creek as the object of research and care. (Some journal

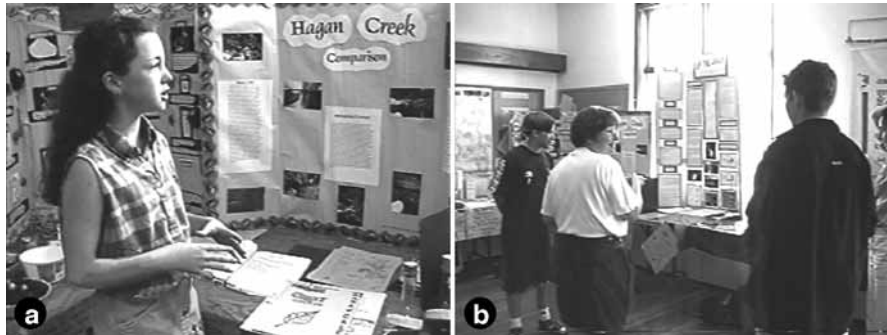


*Figure 8.2. Middle school students collect a variety of data in the creek and its contributors. a. A group of students collects microorganisms just below a riffle designed to increase the dissolved oxygen levels of the water. Another group of students receives an introduction to scientific instruments (calorimeter, dissolved-oxygen meter), which they subsequently use to monitor the creek.*

editors in science education categorically ask authors to remove all images, and therefore make authors remove all those aspect that spoke to and called upon the participants in identifying with their objects both emotional-volitionally and ethico-morally.) A visit by the leader of the environmentalist group that has been featured in the newspaper article further deepens the commitment that students have toward the environment generally and toward the environmental health of their community and watershed specifically. Their intention is to help clean up the local creeks and to construct a better understanding of the creeks by researching it in both healthier and less healthy reaches, including different aspects of the flora and fauna within and alongside them.

Every time the class leaves the school for the creek, the student groups disperse along several kilometers of its length together with their chaperones (parents, graduate students, scientists, environmentalists, teachers), to collect the data they need to respond to their research questions and foci. For example, one group collects a variety of micro-organisms in different parts of the creek that are distinguished by the rate of flow and the presence or absence of a riffle, a rock structure designed by the environmentalists to increase the oxygenation of the creek (Figure 8.2.a). They intend, among others, to correlate stream speed with the distribution of the different types of microorganisms (e.g., arthropods). A biologist, who also works with and for the environmentalists, introduces students to a variety of instruments (Figure 8.2.b) also used by others to collect reliable data that can all be assembled into a database and independent of the institutional position of the data-collecting agent—including school and university (college) students, stream stewards, and the environmentalists themselves.

Data and specimen are brought back to the classrooms, where students have more time to interact with others, interpret the quantitative—e.g., physical measures—and qualitative data (e.g., classification of animal and plant specimen). Once



*Figure 8.3. At the environmentalist open-house event, Michelle and Graeme exhibit the result of their work, produced in response to the call by the environmentalist for community participation in the preservation and revitalization of the local creeks. a. Michelle has done a qualitative study, featuring photographs and classification of environmental quality. b. Graeme talks to visitors about his quantitative study of faecal coliform in different parts of the creek as a function of land use.*

the students are working at and in the creek, and seeing the sorry state of some of its section, they are even more eager to contribute to the common, collective cause in their own ways. The ultimate purpose of the science lesson is to enable willing students to contribute to an open-house event organized by an environmental group, whose members also participate in the teaching. In this way, students are provided with resources for engaging with environmentalists in a common cause.

Michelle and Graeme have chosen to document an aspect of the sorry state of the creek. Though working independently of one another—Michelle with three other girls—both closely work with the same environmentalist who also is a trained microbiologist. Although they work with this same facilitator, they realize their participation in environmentalism in very different ways. Michelle and her team mates do not want to engage in the measurement and correlation of physical variables but instead have in mind documenting the creek and its states in a variety of ways, including tape-recorded descriptions and reportages, photographs, audio-recordings of bird songs, leaf pressings, and so on. She does effect some qualitative determinations of the presence of fecal coliform bacteria. Later, during the open-house event and responding to a visitor's questions about the (source of the) differences between healthy creek and ditches, Michelle, standing next to her poster (Figure 8.3.a) suggests:

And the animals, you would find at the creek deer, squirrels, and more animals from the forest. But in the ditch you would find things like bugs and birds more; not the bigger animals, because they cannot live in those habitats. And there is no fish in the ditches. There's like little bugs and no fish. . . there is fish in Centennial [Park], there is cutthroat trout and stickleback. And the creek is cleaner, because it is not beside the road. And people are not dumping garbage into the creek, they dump it into the ditch, out of their cars and as

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they are walking by. We found much more garbage: we found pop cans, drinking things from McDonalds, French fry cases, things like that.

Graeme has enacted a very different series of projects, having enacted his participation more in the way of scientific “high culture.” Thus, after reading that fecal coliform is a major polluting agent, he decides to correlate the incidence of this bacteria in different parts of one creek with his the usage of the adjacent land. Speaking while standing next to his poster, which names a number of farms below which the creek features fecal coliform counts above the provincial and national norms, Graeme says, among others:

I found at the headlands: the at the very headland farm, there was basically no coliform um right below the chicken farm, there is a three-sixty-five coliforms for a hundred mills, that’s about a hundred and f– sixty above um agricultural standards.

In the context provided by our structural organization of the science lesson, students engage with a real community issue, and therefore, in evolving forms of identity very different from normal participation in school. For example, Davie, an eleven-year old, has been diagnosed, labeled, and “received treatment” as “learning disabled” within the school; there is evidence from other courses observed that he behaves in ways that were consistent with the label. Yet in the environmental unit, he not only exhibits enthusiasm and knowledgeability with respect to scientific processes and mathematics, but also teaches other teachers in the school how to conduct research, participates in the teaching of other science classes, and is a fervent exhibitor at the open-house event.

The various regular teachers with whom I teach the unit in the school note that even students traditionally not doing well become interested and engaged. I am told stories about this or that student who “is just so keen . . . I mean he wasn’t a tremendously good student and yet he was the one who just put his heart and soul into every time we went out there. . . . He just kept the whole group a hundred percent motivated.” That is, resident teachers observe their students to be different than in normal classroom settings; the students *are* different, which means, they exhibit different forms of identity. Michelle and Graeme also participate in this school-based environmentalism, mediated by the interactions with others from the community who agree to become involved—parents, citizens, politicians, First Nations elders, scientists, and environmentalists. Although neither Michelle nor Graeme have liked science before, their participation leads to the production and reproduction of enthusiasm. Thus, Graeme’s involvement goes beyond the school as he enlists some university scientists to get access to a microbiology laboratory for conducting the tests for bacteria in the creek water samples he collects.

### *Concretizing Responsibility*

The term responsibility literally means the ability to respond. The middle school students exhibit such ability, as shown by their immediate responses to come to the

rescue of the ocean surrounding their village by contributing to the revitalization of the local creeks. In the course of their work of documenting the creek and its surroundings and collecting quantitative data to support their construction of relationships, the students find out a lot about their community and its history. Part of Central Saanich is located in the Hagan Creek watershed. In Central Saanich and the watershed as a whole, water has been a problem for many years. Despite being located on the West Coast, Central Saanich has a relatively dry climate (about 850 millimeters of precipitation per year) with hot dry summers and moderately wet winters. Concomitant with the climate, recent developments have exacerbated the water problem. Farmers have straightened the local creeks (Figure 8.1) thereby decreasing the amount of water retained in the soil available for filtering into and supplying the aquifer.

At the same time, the farmers draw on the creek and groundwater during the dry summer months, further increasing the pressure on the valuable resource. Other residents in the watershed have individual wells that draw on the aquifers. Their water is biologically and chemically contaminated during the dry period of the year so that they drive five kilometers to the next gas stations to get useable water, a situation that, among others, has led to a long and acrimonious public debate, where science became both tool and contested terrain. Urbanization and the related increase in impervious surfaces (pavement), losses of forest cover throughout the watershed and along the stream banks (e.g., Figure 8.1), losses of wetlands and recharge areas (the areas near Figures 8.1.a, b were wetlands prior to the arrival of the White settlers), and the loss of natural stream conditions further worsened the water problem.

In addition to finding out about the decreasing amounts of water available, students also find out that the water has been affected by human activity in qualitative ways as well. Storm drains and ditches conduct rainwater into Hagan Creek and its tributaries and away from these newly developed areas—along with the pollutants of suburbia, lawn chemicals and car leakage. The community of Central Saanich previously has introduced an industrial park to the watershed, which is carefully contained within a four-block boundary (at the top end of Figure 8.1.a). The drains of its machine shops and biotechnology laboratories empty into “stinky ditch” (Figure 8.1.a), which in turn, empties into the main creek of the watershed. To increase its potential to carry away water in a rapid manner, the creek itself has been straightened and deepened in some areas (e.g., Figure 8.1.b), and much of the covering vegetation has been removed, thereby increasing erosion and pollution from the surrounding farmers’ fields. These physical changes have led to increased erosion and silt load in the wet winter months, and are responsible for low water levels and high water temperatures during the dry summer months when (legal and illegal) pumping for irrigation purposes taxes the creek. These water woes of the community are periodic and repeated features in the local news papers, community pamphlets, and fliers.

The Hagan Creek-Kennes Watershed Project, an environmental group, arose from the concerns about water quality and was “fishing for community support. The actions of the group include monitoring water quantity and quality or contrib-

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uting the rewriting of community policies related to Hagan Creek, the watershed, and the quality and quantity of water. The group has created and actively promotes a stewardship program, builds riffle structures in the stream to increase cutthroat trout habitat, builds fences designed to protect the riparian areas, and monitors the number of cutthroat trout in different parts of the creek. Other activities include replanting riparian areas for increased shading to result in a lowering of water temperature more suitable for fish. The environmentalists engage in educational activities, which includes giving presentations throughout the community or assisting me teach middle school students as part of their Hagan Creek-related investigations (e.g., Figure 8.2.b).

This description shows that these environmental concerns have existed in the community for quite some time. These concerns are publicly available, both through the newspaper articles and the participation of the environmentalists in a variety of activities including town hall meetings, signs that sprout up in the watershed marking the creeks and their fish habitat, through the public talks, and so on. This situation, therefore, constitutes environmentalism as a societal activity—the director of the group receives a salary and therefore makes her living. Environmentalism exists in the community, continuously produced and reproduced in and through every action of the environmentalists and others who did something about the sorry state of the watershed. The ethical aspect of the motive of the activity transcends collective intentionality, for it embodies the stewardship principle and is concerned with the long-term health of watershed and the people inhabiting it. Participating in such an activity, students not only contribute to the community but also the reproduction and production of environmentalism as a legitimate form of societal activity, and thereby change their own forms of participation—i.e., students learn.

#### EMOTIONAL-VOLITIONAL AND ETHICO-MORAL DIMENSIONS OF AGENCY

All approaches to the emotional-volitional and ethico-moral dimensions of the human life form hinge on actions as the crucial theoretical notion. This, as the following exposition shows, reflects the fact that actions lie at the boundary between the singularity of the individual subject and its constitutive role in the plurality of the human lifeform: actions mediate between individual and the collective. In addition, understanding actions and their relation to other moments of praxis is important because all (dialectical) theories of identity take them as the point of departure: we *are* what we *do*. In the present section, I begin my elaboration of a theory of identity in scientific literacy by establishing the emotional-volitional and ethico-moral dimensions of praxis and then articulate the relationship between agency and identity in the section that follows.

#### *Actions in Cultural-Historical Activity Theory*

In dialectical social theories, agency is the dialectical complement to structure, because there cannot be agency without structure—body, environment, mind—but

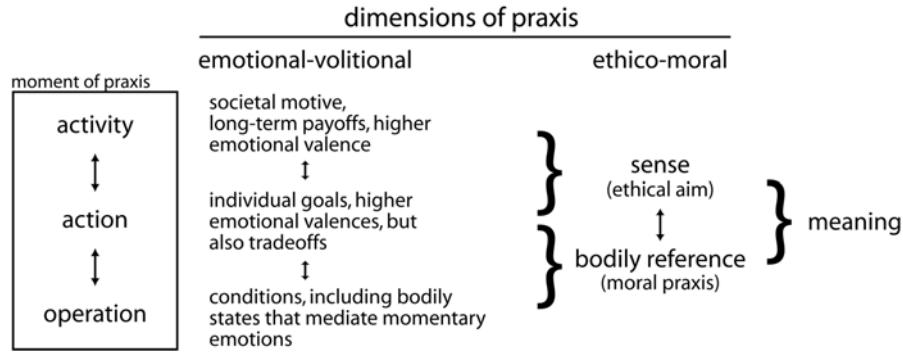


Figure 8.4. Each moment of concrete praxis realizes motive-oriented societal activity, goal-directed actions, and condition-driven operations. The different levels are associated with different aspects of the emotional-volitional and ethico-moral dimensions of knowledgeable praxis. Meaning is not an attribute but a process of sharing the common nature of being.

without agency, it makes little sense to talk about any specific structure. The concept of structure itself is dialectical in the sense that the structural aspects of an agent—animal or human—are the results of interactions with environmental structures, which are resources in and for action, but what is relevant environmental structure depends on the structure of the agent. Thus, already at the beginning of the previous century, biologists noted that a tree trunk constitutes very different structures for an insect, a bird, or a human being (Uexküll, 1928/1973).

For human beings, too, there are differences in the way individuals perceive particular settings and the things and processes that can be found therein and that constitute them. At the outset of the environmental unit, for example, dissolved oxygen and dissolved-oxygen meter do not exist as resources for Jamie, one of the middle school students engaged in environmentalism, or as object toward which his consciousness is oriented. More so, the creek and its surrounding also initially are fairly undifferentiated; during the unit, they increasingly become articulated as something having a variety of properties that initially did not exist. These properties, such as flow rate, prevalence of microorganisms by species, water quality, and so on come to exist in and through the students' participation in environmentalism. But thinking in terms of agency, which some authors also articulate in terms of *power to act*, is somewhat abstract. In fact, by its very abstract nature—it does not refer to any specific action—the notion of agency may in fact block the recognition and theorization of a particular feature that are my main concern in this chapter: the emotional and ethico-moral dimensions of agency. These are available only in the deployment of concrete action, that is, in the lived experience of praxis (Bakhtin, 1993). But considering actions in and of themselves is fraught with problems, as these are always subordinated to some larger objective—or, to express it in terms of the theory that I develop here, some object/motive (Figure 8.4).

In cultural-historical activity theory, actions are subordinated to cultural-historically developed societal forms of contributing to the maintenance and con-

tinuation of collective life (A. N. Leont'ev, 1978).<sup>2</sup> The students in the environmental unit do not just do something the whole purpose of which is to be graded but in fact contribute to environmentalism, which is a cultural-historical form of collective activity. Students, their teachers, and everyone else participating in the teaching of the unit also participate in another societal form of activity, schooling, designed to contribute to the maintenance and survival of the species at the collective level. That is, societally mediated activities are organized forms of going about meeting basic needs of the collectivity. Farming, schooling, producing machines, and doing research are activities that have emerged in the course of our cultural history. On the teachers' part, for participating in schooling and thereby concretely realizing this form of activity, they receive in exchange resources (salary) that they can trade in, as part of subsequent exchange processes, for the basic necessities of their individual lives. That is, by contributing to any one of the existing activity systems, individuals take control over their own life conditions by exchanging whatever they produce (goods, labor) for their personal basic necessities. Activities therefore are oriented toward objects/motives that have emerged at the collective level.

While recognizing the subordination of action to some collective object/motive, we also need to be aware that they do not exist other than in bodily human performances. *Environmentalism* is but an abstract term that denotes a form of activity that embodies a range of action possibilities. It takes concrete actions such as measuring stream speed, taking photographs of the ditch and health creek, recording audiotapes to capture the spoken description of different places along the creek, and constructing and exhibiting displays at the open-house event for environmentalism to concretize the activity. The individual acts—the product of actions, existing in the seriation of nonconscious performatives—make history, as they are irrefragable, once-occurrent events and therefore leave their mark on the material totality of this world. This articulation leads to a perspective in which each moment of human praxis is understood in terms of three mutually presupposing levels or orientations to be found in any performance: *activity*, *action*, and *operation* (Figure 8.4). Or rather, there is a hierarchy of societal motives, individual goals, and non-conscious operations that characterize each moment of praxis. The societal motives and individual goals constitute the *volitional* moments of agency; the operations, which are conditioned by the context, are not consciously chosen and therefore constitute a moment of passivity in the face of the power to act that they express.

#### *Praxis: Dialectic Unit of Motives, Goals, and Operations*

Activities, or rather, societally mediated motives do not get themselves realized; concrete goals are required for directing individual human subjects to realize the activities in which they participate and of which they are constitutive moments. There are many different actions that possibly realize the same form of activity—environmental monitoring, such as Michelle, Graeme, and Jamie have done, may be achieved through observing birds (Michelle), measuring water quality (Jamie), operating a water monitoring stations (water technicians), or doing regular coliform

counts and measurements (Graeme). My ethnographic work shows that the same actions may realize very different activities—operating some water-monitoring station may be used to support claims that the environment is in a bad state or to highlight the existing collaboration between environmentalists and their local community. The water monitoring stations also may be used by farmers to control their water usage or by an engineer asked to evaluate water quantity and quality in a particular part of the village, where residents are not connected to the water grid but have to draw water from their own wells.

A specific action presupposes the activity that it is intended to realize; but the activity presupposes particular actions to be completed. The relationship therefore is dialectic (Figure 8.4). This dialectical relation I denote by the term *sense*. It is not that any action could *have* sense, because in a different activity, the same action would have a different sense. Actions therefore are “free floating” because many of them are possible even within one and the same activity but their sense change with the activity that they realize. The same measurement action, for example, taking dissolved-oxygen readings, realizes very different activities: in the hands of field ecologists, the instrument may lead to the construction of theoretical knowledge whereas in the hands of environmentalists, it serves to generate data in support of new demands for new community bylaws. Goals therefore constitute possibilities that need to be realized in a concrete way by concrete individuals in concrete *praxis*. Here I understand *praxis* in terms of once-occurrent practical action and thinking that only can be attested but never captured through however careful accounting and interpretation after the fact.

This concrete realization of a goal (plan) in and through human bodies and the tools they employ occurs through the enchainment of nonconscious operations (Figure 8.4). Operations therefore constitute sedimented, embodied, and nonconscious *ethos*: they are formed as a concrete individual interacts with others and, in the process, acquires them through explicit teaching or through unconscious mimesis. Thus, the children in Figure 8.2.b are taught in an explicit manner about how to use a colorimeter, where and when to push a button and how to read the display. In the course of employing the instrument for his own purposes, Jamie in particular becomes so knowledgeable that he not only uses it without consciously thinking about it but also teaches the use of the instruments to various visitors at the open-house event where he exhibited the results of his research (Figure 8.5).

Operations, therefore, simultaneously are singular, in their one-occurrent nature, and plural, in that they are concretizations of collective possibilities. Thus, when Jamie knowledgeably measures water quality in terms of the amount of suspended particles using a colorimeter, inserting a test tube and pushing buttons, he can simultaneously explain what he is using it for. But although his operations come forth without being consciously controlled, they do not occur in a willy-nilly fashion. Rather, they are occasioned by the current context, including the current state in the realization of a goal and the material structure of the instrument, which affords and constrains what it can be used for. And, of course, the dialectical relation to action and activity constrains their nonconscious performance.



Figure 8.5. At the open-house event, Jamie shows an adult visitor how to measure the density of suspended particles in water using a colorimeter and how to interpret its display.

From this exposition it is evident that goals (actions) and operations presuppose each other: Operations concretely realize and therefore presuppose actions (goals); but actions are free-floating possibilities as long as operations have not realized them. Jamie uses the colorimeter in specific ways *in order to* measure the density of suspended particles in the creek water (goal); but the goal is realized through his adding water to the test tube, zeroing the instrument, entering the test tube into its place, and pushing the appropriate button to take the reading. Jamie does not have to consciously think about his performance, all of these moments of the measurement actions come forth, constituting the embodied form of his knowledgeable. This, of course, has consequences for his identity, which, if the trope “I am what I do” is correct, has nonconscious aspects to it because of the nonconscious nature of operations.

An action, such as measuring the suspended particle concentration, and the operations that realize it—taking zero reading, pushing buttons, filling a test-tube with a water sample, entering a sample into the instrument, taking readings—therefore also stand in a dialectical relationship. This relationship I denote by the term *reference*: the goal is the referent that frames the range of operations called upon. This term, reference, connotes the fact that some actual individual *concretely* realizes what simultaneously is but a possibility; and possibilities are, because of the collective nature of activity, inherently possibilities for others.

This shows that goals (actions) are suspended between the collective motive (activity) that mediate their sense and the concrete operations that realize them in and through a bodily performance. Each goal (action), therefore, has a double significance in the sense that it is directed not only toward the self but also toward the other. It is intelligible not only to person acting but also to others in the culture who recognize in the action something they could have done themselves: in action others “*recognize themselves as mutually recognizing one another*” (Hegel, 1807/1977, p.112 [¶184]). Actions therefore mediate between individual and collective, and therefore, between possible identities and those that are concretely realized.

The relation between sense and reference also is dialectical because of the mediating function goals (actions) have between societal activity and concrete human praxis that concrete individuals realize with their material bodies. This relation I denote by the term *meaning*. Meaning therefore is not something individuals can “make” in a strict sense, as the activities in which they participate have cultural-historical origins embodying collective motives and experiences. Meaning also is not something that is merely determined collectively, to be appropriated by newcomers to a certain culture—newborns or immigrants—because it is grounded in concrete operations. That is, meaning exists in concrete, embodied human praxis, which itself is organized by cultural-historically evolved patterned activities. Rather than receiving meaning—through construction or otherwise—new tools or words *accrue* to meaning when they find their place in concrete praxis, which reproduces and produces collectively recognizable forms of activity. In collective praxis, *meaning* is the sharing of the “with” that founds what is characteristically human in being (Nancy, 2000).

From this perspective, neither the ensemble of observable actions nor the ensemble of artifacts and tools, nor a combination of these, yields culture. Culture exceeds what can be observed at any one moment, for otherwise we are unable to understand cultural change. For culture to change, new and therefore unobserved forms of actions already have to be possibilities. Because each practical (once-occurrent) action not only reproduces existing practices and resources but also and inherently produces them in new form, I am at each instance not only reproducing culture but also producing it in the form of possibilities that have not existed previously.

#### *Emotional-Volitional Dimensions of Action*

The previous subsection shows that human beings do not just perform but that there are societal motives and individual goals that orient, mediate, and condition what I do. Jamie does not just push buttons on the colorimeter for no reason at all, but, out in the field, to take concrete measurements of suspended particle density in different parts of the creek (goal), which realizes his participation in and to environmentalism. During the open-house event, too, he pushes buttons (Figure 8.5) but now with the express purpose of teaching others in the community how the instrument is used. Michelle and Graeme do not just produce words during the open-house event (Figure 8.3), but produce words—most or all of which they do not select consciously—but produce words to make a statement, ask a question, give an explanation (goal). Each of their speech actions contributes to realize environmentalism generally and, here, the open-house event specifically and concretely.

In this account, however, there is something missing. Even though goals and motives express the volitional dimensions of acting, they do not express why someone acts in the first place. Even intentions are not sufficient to explain why someone acts unless there is some regulating mechanism that directs or evaluates intentions. Only an emotional (emotive) dimension can explain why we do what

we do: we generally act to increase emotional valence, often associated with the satisfaction of (more or less fundamental) needs. This emotional-volitional dimension of action—already can be found in single-celled organisms that orient themselves within some gradient (light, concentration) when it is correlated with a gradient of food—is an integral feature of our individual and collective makeup (Holzkamp, 1983).

The emotional dimension of performance is both driver and context for what we do. It is therefore integral to performance, to every moment of praxis, rather than being an external variable that can be added from the outside and after the fact. By noting its integrality I mean to highlight that it is a constitutive moment without which actual performances (and therefore cognition and consciousness) cannot be understood.

Whereas need satisfaction in animals occurs at the level of the individual, the emergence of society and its culture change the locus of need to the collective level. The paradigmatic example for articulating this shift is that of hunting at the moment of anthropogenesis. The hunting posse divides itself into two groups, hunters and bush-beaters; by doing their part in this division of labor, bush-beaters assure the satisfaction of their food needs by contributing to success of the collective hunt although they do not do the killing themselves. A little later in the division of labor of a hominid group, some individuals no longer participate in the hunt but fashion tools that hunters use to do the killing. Again, by providing hunters with well-fashioned and well-made tools, in exchange of which they receive a part of the kill, toolmakers can meet their basic needs without being involved in hunting altogether. Progressive division of labor leads to the cultural-historical evolution of forms of activity, all of which contributes to the maintenance and reproduction of the collective human lifeform. Teaching, growing food for thousands, capturing several tons of fish are not necessary for the individual but are activities that contribute to the survival of the collective. That is, the collective motives embody the satisfaction of collective needs, and therefore, successful activities are associated with higher emotional valence. By participating in one or the other form of activity, individuals guarantee their need satisfaction achieved through a variety of exchange relations that convert labor into food, clothing, a home, and so on. There therefore are emotional dimensions embodied in collective activity, which therefore both transcend and are constitutive of an individual's emotions.

At the level of the individual, there also are conscious emotional dimensions. Thus, human beings generally chose their goals such that what they do leads to a higher emotional valence (Turner, 2002). Sometimes intermediate goals are associated with a lowering of emotional valence—e.g., having to train hard and for an extended amount of time before garnering an award in a sports competition. But this generally is taken happens when there are longer-term payoffs in sight.

With respect to knowledge, learners generally choose goals so that their action possibilities increase; and this increase in agency and control over one's environment has a higher emotional valence than some current situation. Expansive learning occurs precisely when individuals know that their labor leads to an expanded agency. It is not surprising, then, that the students in the environmental units I

teach feel very positive about their experiences, which not only grants them control over their goals and production means for reaching them but also over the assessment of the extent to which they achieve their goal. Thus, Michelle and her peers (including Jane) are not required doing the same measurements others have done or following the official curriculum objectives:

- Jane: No we wanted to go around and look at different sites instead of just—  
 Michelle: Like 'cause there was this one group—  
 Jane: instead of just stay at one site like cause they like alternated like after two weeks or something like that, then they went to a different site, [but we got to go—]  
 Michelle: [but we like got to] like six different sites instead of just the two—  
 Jane: to different sites all the time.

Their account—produced one year later during a conversation with an environmentalist—shows that how they have been able to go about participation has had a higher emotional valence than what they have seen others doing. Thus, “instead of just stay at one site” doing as others have done, collecting samples in one or two places along the creek, they “got to like six different sites.” In the end, it has not been surprising that they characterize this science unit generally and their participation particularly by saying, “It was cool” and “It was lots of fun just to do the whole Hagan Creek project, and the whole class had a lot of fun.” Not only has it been fun what she has done but also it has been apparent—in her poster, in her talk about what she had learned—that she has tremendously developed her knowledgeability concerning environmental issues generally and those that concern Hagan Creek specifically.

Goals, the volitional dimension of actions, are associated with emotions such that anticipated increases in emotional valence, associated with expansion of control and positive outcomes, are preferred over undesirable outcomes. There is, however, another emotional dimension not directly accessible to consciousness, because it is grounded in the current organic state of the body, levels of hormones, in all its parts, and in the connected psychophysical body systems (Damasio, 1994/2000). How I feel, even if I cannot articulate my emotional state, mediates what I do and how I do it. On anyone day, what the students do and what they say, for example, during the open-house event, is mediated by the kind of day they have: a good, bad, or average day. These unconscious and nonconscious emotional states constitute an aspect of the conditions that determine the type and quality of the operations that our bodies bring forth. Much like on the volitional level, where my intentions are given rather than intended, the emotional dimensions of operations are largely inaccessible to consciousness. In this respect, we are passive, hosts and hostages to our intentions and emotions, which mediate the operations that we nonconsciously bring forth. (This passivity is the neglected dialectical sibling of agency; and any truly dialectical theory therefore has to take it into account [e.g., Roth, in press].)

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This exposition shows that actions cannot be understood independent of emotional-volitional dimensions. We do not just learn and become scientifically literate for no or some unstated reason—theoretical and practical knowledge in and for themselves, if they are not linked to some emotional valuation that comes with the enhancement of one's power to act, are not worth being learned. But the emotional dimension not only is integral to the volitional dimension but also in the ethical aims embodied in activities and the moral dimensions of each concrete performance.

### *Ethico-Moral Dimensions of Actions*

So far I have established that we do not just act for the fun of acting—not unless the actions themselves lead to some form of positive emotional valence, such as is the case of games. We do not just set and achieve goals independent of the societal motives particular forms of activities embody. Thus, each goal-directed action not only produces some result but also produces and reproduces a form of activity. That is, what I do has repercussions for the collective: the results of my actions are resources that enable or constrain the actions of others and myself; therefore, my actions contribute to the action possibilities available collectively. In and with the facticity of my doing, I contribute to the constitution of society generally and to all its individuals, including myself, specifically. In doing what they have done, Michelle, Graeme, and Jamie realize environmentalism, which, in and through their action, is both reproduced and produced in a new form. In participating, they contribute to maintaining a form of activity that shapes the landscape, policies, and local conditions in the village community. Their exhibits at the open-house event highlight and therefore make salient aspects of the physical environment that constitutes the concrete habitat for the people of their village. In this, environmentalism embodies a particular concern, which is of ethical nature. Each act, because it affects the operations and mediates the goals of others also has a moral dimension.

Ethical aims, such as the principle of (environmental) stewardship, lie at the interface between actions and activity, with which they share a volitional aspect. Michelle, Graeme, and Jamie participate in environmentalism with the aim of contributing to a larger good—understanding pollution and contributing to diminishing it. This ethical aim concerns both the environment and the human beings inhabiting it. This aim is embodied both in the motive that drives environmentalist activity and in the goals individuals frame to realize the activity (Figure 8.4). Each action that realizes environmentalism embodies this ethical principle of stewardship; its sense derives in part from the ethical aims that it seeks to achieve.

Although ethics and morality sometimes are treated indistinguishably, I follow others in reserving “the term ethics for the *aim* of an accomplished life and that of morality for the articulation of this aim in *norms* characterized at once by a claim to universality and by an effect of constraint” (Ricoeur, 1990, p. 200, my translation). In this way, morality constitutes a more limited, though legitimate and indispensable *realization* of the ethical aim in concrete praxis; ethics thereby stands in a dialectical relation to morality. Articulated in this way, ethical aims and moral ob-

ligations map onto the dialectical framework characterizing each moment of praxis (Figure 8.4).

Moral norms constrain actions in the service of realizing the ethical aims toward the true life in and for just institutions. When Michelle and Graeme report on the pollution of Hagan Creek through fecal coliform bacteria that apparently have their origin in particular farms or farming practices (as Graeme's exhibit showed), they also mark particular farms in an implicitly negative way. Given that environmentalism in the Hagan Creek valley generally and students' own concretizations of environmentalism specifically embodies the steward principle. The term *pollution* not only means dirt and physical or biological impurities but also connotes moral impurity. Being identified as a source of pollution therefore marks the farmers and industries as acting in a morally abject way. The identification itself embodies morality in the sense that there are possible consequences, because the actions have definitive effects within the community as a whole. This is not the least evident from the fact that Graeme has not been allowed back onto a chicken farm, associated with coliform levels that are more than double the national and provincial norms—his mother called it the “political . . . and social reality of doing some science.” Michelle and her group mates, too, were accused of trespassing while attempting to gather data from a farm property.

To ascertain the credibility of his claims, Graeme negotiates access to and help from a university laboratory, where, under the auspices of an experienced microbiologist, he conducts the determination of the amount of fecal coliform bacteria in the samples he collected. There is therefore a considerable level of certainty that the measurements would hold up to scrutiny if they were checked by another test. At the same time, adhering to the scientific norm gave credibility and gravity to the claims gives weight to his decision to report the results, though it does not abrogate Graeme from his responsibility to users of the facts he reports and to those (implicitly) accused as polluters. In such situations, where the moral norm that prohibits hurting others (here through accusation) and the duty of reporting pollution come into conflict, the ethical aims (here stewardship) serve as mediating devices. In the framework articulated, it is legitimate to seek recourse in the ethical aim whenever contradictory norms lead to impasses in practice. Practical wisdom consists precisely in inventing forms of conduct that best satisfy the exceptions required by solicitude while betraying any relevant norms to the least possible extent.

Morality generally and the answerability for one's actions specifically have their origin in concrete praxis rather than in any private cogitation and pondering of action possibilities. Therefore, abstract considerations of patterned actions (practices) and theoretical knowledge inherently do not allow us access to the ethico-moral aspects of human life generally and those of human actions specifically. Only practical action, concrete human praxis—organized in and mediated by societally, culturally, and historically determined motives—constitutes the appropriate unit of analysis. This unit cannot be broken further into elements that would serve as building blocks of the unit (Vygotsky, 1986). At best, analysts may identify ways in which the unit exhibits itself in one-sided form in any one identifiable aspect (e.g., subject, tools, norms, division of labor, community of practice). In being

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concretely realized in and through a material human body, the embodied action (enchained operations) not only materializes (becomes real) general possibilities but also becomes a singular historical act—it occurs only once and cannot ever be taken back. Human beings can argue about its sense and reinterpret it repeatedly, but its historical facticity cannot be undone. It is exactly out of this nature of action as a once-current event that agents are subject to responsibility and answerability, that is, the ethico-moral dimension of action.

#### SCIENCE AND IDENTITY

This chapter presupposes that the notion of *identity* and the aspects of our everyday experience it denotes is in part grounded in what we do. That is, the material human body and its relative (structural) constancy in time in itself do not constitute sufficient ground for theorizing identity. In this section, I theorize identity before linking identity to the emotional-volitional and ethico-moral dimensions of action outlined in the previous section.

Over the past decade and a half, the concept of *identity* especially in its relation to the notion of *community of practice* has gained purchasing power in theoretical approaches to knowing and learning (Holland, Lachicotte, Skinner, & Cain, 1998). Although the notion is often approached as if it were unproblematic—for example, it is equated with the life history narrative of a person—there is more to it as gauged from the fact that philosophers, after elaborating attendant issues for an entire book, do not come to definite conclusions but are left with numerous aporia (e.g., Ricœur, 1990). The self continues to be a riddle. In this section, I articulate a dialectical approach to identity, which, because it is framed dialectically, continues to be a notion based on inner contradictions. Let us return to Michelle and her participation in the environmentalist open-house event. Her participation in *this* event constitutes her as an individual who does *this* rather than some other thing and therefore constitutes an aspect of who she is. Because communication not only articulate topics but also constitutes forms of actions, studying conversations enables us to understand who someone is. We return to the open-house event.

In this episode, a visitor to the open-house event asked Michelle to talk about her findings. Michelle, standing next to her exhibit, compares the healthy sections of the creek with some of the parts that had been straightened and dredged and thereby rendered into ditches. As she talks, she points to some of the pictures.

Michelle: And then there is another ditch ((points to a photograph similar to the ones in Figure 8.1)) and this one over here ((points to another photograph)) but it some more of Centennial and over there ((points)) and then the ditches have a lot more culverts, which are dirty, and they are long and dark in the ditch

Visitor: Uh um

Michelle: but if they do have them in the creek they are usually shorter and not so dirty because there is still much water running through them. And we found out a lot of differences.

- Visitor: Yea, I was going to ask you what you were finding there.
- Michelle: Yea, we found so many differences that– I could not even put them all on my poster because you can't really state them all. Um there is animal differences, plant differences, everything there really and–
- Visitor: And you know why? You found these differences in the–
- Michelle: Yea, some of them is the water itself and the habitat around like for um for example, the water movement is rapid in the Centennial thing . . .

In this conversation, Michelle and the visitor talk about the specific findings of her research. The visitor's request reifies Michelle as the producer of the exhibit, which itself is an expression of Michelle. In this exhibit, Michelle has objectified herself. Her actions in the creek have taken the form of objects: They are objectified in the material records, photographs, and text she produced. In the conversation, Michelle is asked to account for what she has done, actions that have led to the ultimate production of the exhibit. By accounting for what she has done and found, agency is attributed to Michelle, who thereby also articulates an aspect of her Self. These are her actions and not those of another person that have produced the photographs; she accounts for the differences between the different parts of the creek, and in this, exhibits her accountability or rather answerability for what she has done. Michelle turns out to be what that person has done that can self-referentially point to herself saying "I" and "Michelle." This framing, however, does not get us out of the aporia, as actions partially are free floating, belonging, as Figure 8.4 shows, to the intersection of individual and collective. There is therefore the question about how actions come to be attributed to particular agents, especially given the fact that praxis in its entirety constitutes a unit and the individual subject is but a one-sided expression of it.

In the present episode, more is happening than the collective construction of an account of some research results that Michelle, Jane, and two other girls have produced. Michelle and the visitor are currently talking at an open-house event. In fact, the event is an environmentalist open-house event because of the particular kinds of exhibits that are found there and the kinds of interactions and conversation that occur. That is, the open house is not a thing or box into which participants are placed; rather, it is an event, and as event, it is constituted by the transactions of participants over and about exhibits.<sup>3</sup> These transactions constitute Michelle as an exhibiting participant, therefore an environmentalist, and the other person as a visitor, interested, as indicated by her questions, in the findings of the various exhibitors. But the visitor and Michelle act and talk in the way they do because they know themselves to be at an environmentalist open-house event. That is, the visitor and Michelle participate *in* the event, which only exists because of their (and others') participation. That is, together, Michelle and the visitor constitute one of the many moments that make this an environmentalist open-house event. They draw on their different institutional position as resources to reproduce and produce the event as that which it is—Michelle *is* a member of the environmentalist movement (as seen from the objective fact that she exhibits), the visitor *is* a person interested in environmentalism (as seen from the objective fact of her attendance). In doing

what they do the visitor and Michelle produce differential identities. Let me focus here on Michelle, though the argument is reciprocally valid for the visitor.

It is often assumed that our institutional positions are the causes for our actions. But this approach is problematic because it accounts for identity only when things work out in the way they are intended. Thus, in the present situation, Michelle is reified as an exhibitor, an expert on the question of the health of Hagan Creek, whose expertise is available in part through the inscriptions she has mustered in her exhibit (Figure 8.3.a). That is, in such approaches, the fact that Michelle has studied the creek, produced a poster, and now exhibits it and accounts for the work that has produced it may be taken as cause for who she is in the conversation. But such an explanation only works because the transaction reifies her special expertise and the attribution of the exhibit to Michelle's actions. We can easily imagine conversations that would not reify Michelle as an expert concerning the creek and its environmental health. We all know science educators who treat graduate students as if they were children, philosophically unsophisticated, and unworthy of any consideration. We also know of situations where the presence of a teacher in one class leads to tremendous learning and exemplary science classes and the presence of the same teacher in another class is associated with a "bad lesson." In each case, despite evidence that a graduate student or teacher may be associated with considerable expertise in one situation, he or she comes out of other situations as less than expert. Thus, it is better to think of Michelle's expertise and identity as an expert with respect to Hagan Creek as being produced in this episode as much as it is being reproduced. Her previous experiences, including data collection, production of the poster, and the traces these actions have left in her body-mind serve as resources in the present situation. So does the institutional position of being an exhibitor and the expertise that might be attributed to it.

In this perspective, therefore, identity—the question of who someone is—is the consequence of a transaction then and there, in the thickets of the open-house event. This aspect is fleeting in the sense that Michelle, after the open-house event, returns home where she may be reified as a teenager and child. Her identity during transactions with the parents is different than that during the transactions in the open-house event, which are different again from that with her peers, on the hockey squad, or in the school. This fleeting aspect has led some to theorize identity in terms of a fractured Self (cf. Giddens, 1991).

The idea of a fractured Self, produced and reproduced differently as a function of the activities in which we participate—environmentalism, schooling, family—contradicts our everyday experience. Despite all the changes we have undergone, psychologically, socially, or biographically, we can point to a picture and say, "This is me when I was five years old." That is, in our everyday world we experience and presuppose some stable, core Self that survives all the different embodiments our Selves take as we move from activity to activity. This stability is necessary for making societal life into what it is, for if we cannot presuppose a stable referent "I" in statements such as "I promise" or "I swear," then promising and talking under oath has no meaning whatsoever. If the "I" were unstable, as the notion of a fractured Self suggests, then there would be nothing or nobody who could

be held accountable and answerable for having promised or said something under oath. The stable moments of everyday praxis on which the constancy of identity is built can be discerned in the following episode.

In the following conversation one year after their science experience and the open house, Michelle and Jane are talking to a graduate student interviewing them about their engagement in environmentalism in the presence of the same environmentalist, who had been their and Graeme's chaperon during the science unit.

Interviewer: What kind of samples did you look at?

Jane: Um. Water and if we found any bugs or anything.

Michelle: And like the dirt samples and sand and figured out how moist it was, and the plants around it . . . and the tree fell on us— just about ((laughs)).

Environmentalist: Yea ((laughs)), just about. I had forgotten about that . . .

Michelle: ((Laughing)) You remember that . . . it scared me.

Environmentalist: I was— What's going to happen here? ((Laughs.)) No . . .

Michelle: I was hiding behind big, a big tree. If it falls on me, it's falling on the tree first.

In this episode, the participants reconstruct an event that had occurred while they investigated the creek and the surrounding land. Michelle begins the account of the falling tree, and subsequently retells how she was hiding behind some other tree so that she would not be hit. She talks about being scared, while at the same time laughing while recalling the event. The environmentalist contributes and thereby elaborates the event. He has been a witness and in this capacity, reifies and stabilizes the account. Later on during the same interview, Michelle returns to the episode: After they had walked away from this dangerous moment, they attempted to jump over a barbed wire, which toppled so that she “just about fell into a pot-hole.” Here, “Michelle” *is* the result of a collective account, someone who in the middle of her (serious) investigation of the creek is imperiled by a falling tree. It provides a context to the scientific results that she has reported, something that to her and the environmentalist is an integral aspect of their experience. They have done this science in and despite of the dangers that they have been exposed to. The episode is quite singular, yet defining for Michelle and what she has done, how she has done it, and, therefore, a defining moment in her auto/biography (e.g., Roth, 2005).

This episode shows that auto/biography, as history generally, requires memory, here individual and collective. Without memory, the story about the falling tree and the roles of the different participants in the event would not exist. Nor would identity exist, because it requires accounts of a person in situation and what he or she has done. Auto/biographies are narrative forms that tell who someone is in terms of strings of events that together constitute a singular life—Michelle in the episode with the falling tree, making the decision to research the creek in six rather than in one or two locations, or presenting at the open-house event. The moment that holds all these different instantiations of Michelle and different situations together is the narrative anchored in the physical body that is constant across the situations—in

contrast to the fleeting nature of Michelle as subject and Self. Not really her body is the anchor, for it, too, is changing, physically, biochemically, or hormonally. Yet there is a structural constancy that allows others to recognize Michelle in the female student during the lessons, in the environmentalist during the open-house event occurring several months later, and in the person participating in the interview one year later. Despite all the changes Michelle has undergone in the course of the sixteen months from the start to the end of her participation in my research project, including the psychological, sociological, and bodily changes, there is something that allows us to speak of the same Michelle. One way in which this constancy is achieved—in addition to the body to which the experiences are ascribed and who is the locus of memory—the narrative form contributes to the constitution of the constant aspect of identity, the aspect on which the very concept of identity, sameness, is grounded.

There is a double dimension underlying narratives that allow them to take their central role in the constitution of identity. First, narratives are told in terms of characters and plots. In the account of the falling tree, Michelle and her chaperon, the environmentalist, have their different parts, play different characters. The account is part of the plot, Michelle, Jane, and the environmentalist reconstructing aspects of the environmental unit and the subsequent open-house event. Here, Michelle is the person of interest, who is threatened by a falling tree. She says that she was scared, and asks the environmentalist whether he remembers her being scared. Later on during the same interview, she comes back to recount aspects of the event again, increasing its salience: “I said, I said “you know a tree is going to fall down.” It was like five minutes later CRCRAASHSH!! I like jumped out of my pants. I was like so scared and I hid behind a tree.” In addition to being scared and nearly having “jumped out of [her] pants,” Michelle now also is a person who has nearly predicted the possibility of a tree falling. That is, part of her (literary and literal) character is the dimension of being and feeling scared; other persons might have provided very different accounts, and therefore articulated very different identities—for example, that of a person who is not scared despite the obvious danger. Here, the character developed is that of a scared person who nevertheless knows what to do, namely hide behind another tree or trees, which would prevent the falling tree from hitting Michelle.

Second, because this is a narrative with a clear plot and a character, whose properties—e.g., being scared in such situations—are developed in the process, it is intelligible. That is, in its very singularity, the event, involving a particular character in a particular plot, transcends itself in becoming a kind of person in a kind of event. The narrative, in its very form, exposes a possibility of being that is available to others as well. It is plural although tied to the singularity of the event experienced together by *these* individuals in *this* situation. More so, because of the plural nature of the character–plot configuration—plural because it constitutes a narrative possibility for the entire collective (community, culture)—and because of the inherent intelligibility of language as such, the auto/biographical account constructed during the interview is intelligible to others, that is, is a general possibility of being. The collective nature of the conversation points us to the simultaneous

autobiographical and biographical nature of the account and to the singular plural nature of all auto/biographical narratives.

The memory of specific measurement actions—the “real” science and scientific literacy as some science educators and scientists might say—intimately is tied to the situations in their entirety, thereby giving body to what would have been a de-contextualized account. It also gives shape to the “who” of the actions and, therefore, to the identity of the participants. In the following episode, Jane and Michelle together with the environmentalist reconstruct one of their fieldwork studies.

- Jane: Well we did, um, one measuring thing at like Centennial or something like that
- Michelle: Oh, yea.
- Jane: where we like
- Michelle: measured the depth of the water.
- Jane: measured it from a like a tree or something like that. I can't remember.
- Environmentalist: What was that about?
- Michelle: The moisture and also the depth of the water.
- Environmentalist: Oh yea, yea.
- Jane: Oh yea, and we were seeing
- Michelle: I remember the depth part.
- Jane: how much plant life or whatever was like in a certain amount of area.
- Environmentalist: Yea, I remember that. It's all coming back to me now.
- Interviewer: Yea. You guys have a good memory for this. It's last year that you did that, right?
- Michelle: Well, I remember that part though because I just about fell in . . .
- Jane: Laura fell in.
- Michelle: Yea, Laura fell in and that was bad.
- Jane: She was funny.

It is immediately evident that the account is constructed collectively, as different individuals contribute to constituting just what has happened and the roles individuals have played. More so, as Michelle articulates in response to the interviewer's question, she remembers having measured moisture levels (near the creek) and the depth of the water “because [she] just about fell in.” Again, it is part of the plot, which constitutes her as a character, that she “just about fell in.” Falling into the creek as part of conducting their scientific research is a constitutive aspect of her identity: she has done it despite the apparent dangers involved. The fact that it is a general possibility of constituting the identity of a person is evident at the very end of this excerpt, in which Jane tells the interviewer that another student actually has fallen into the creek—a situation Michelle characterized as “bad,” whereas Jane described Laura to have been “funny.”

Such experiences, which here are narratively reconstructed, actually happen to someone in flesh and body, during a once-occurrent event. This aspect of life as constituted by events that occur only once, events that in their original form are lived and attested to, allows us to anchor narratives with general characters and

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plots to concrete individuals. The concrete human body, its flesh, mediates between the collective and the individual, *ethos* and *pathos*, and collective action possibilities and concrete operations. The endangered flesh during the once-occurrent event, because it is structurally perpetuated, becomes the anchoring point of auto/biographical narratives. These therefore simultaneously are singular, pertaining to *this* individual (Michelle, Jane, Laura), and plural, pertaining to human beings in general. Because they constitute general possibilities, characters, plots, events, and identities thereby are intelligible to others, who may well have been or will find themselves to be in a similar position—Jane fell in, Michelle just about fell in.

#### EMOTIONAL-VOLITIONAL AND ETHICO-MORAL DIMENSIONS OF IDENTITY

In the previous sections I show (a) how emotional-volitional and ethico-moral dimensions are constitutive moments of actions and (b) how actions centrally figure in the constitution of identity. That is, identity inherently has emotional-volitional and ethico-moral character, because of its anchorage in actions and agency. Even without being directly addressed as topics of conversation, emotional volitional and ethico-moral dimensions of agency appear in accounts of what people have done, and therefore, in the constitution of their character in life history plots recounted in auto/biographical form. Throughout the interviews held one year later, the participants in the environmental unit talk about how much fun they have had in direct association with accounts of what they had learned. Similarly, the volitional and ethico-moral dimensions of actions are all over the retrospective accounts of what students have done and how they have done it.

In the following excerpt, Michelle and Jane respond to the interviewer's question concerning their learning. Contrasting her account of not knowing anything about the creek, its presence, the ocean, pollution, and so on, Michelle responds extensively, assisted by Jane and confirmed by the environmentalist, articulating the sorry state in which she has found the creek to be in.

Interviewer: So now what do you think is going to be like that information that you learned, what do you think people need to know?

Michelle: How dirty the creeks are, and how much they— 'cause they run into the ocean and stuff, and all that dirt is going to get swept into the ocean and it's on people's property and it's nice to go for a walk along the creek and to see it all filmy, it's gross, and how dirty it is. And people need to know how dirty it is and how really it affects all of us at some time.

Jane: It was kind a hard to fix that though.

Environmentalist: Yea.

Michelle: It's kind a like, well you can't live here though. It's like you've been living here for fifteen years. Okay, now you've got to pack up and move. Bye-bye.

Michelle not merely articulates the dirt in and film on the water, but also uses a term that expresses the emotional aspect of pollution: “It’s gross.” The term clearly has negative emotional valence, pointing to the abject quality and even moral indecency of those who cause it. As a consequence of pollution, Michelle cites the possibility to have to move, leaving a place where one has taken root. Being uprooted is not a value-free determination of an event, but laden with all the connotation of having to—as contrasted to wanting to—cut one’s ties to a familiar place. Pollution, the result of the actions of others, “affects all of us at some time.” Being affected negatively also is laden with negative emotional valence. Their own power to act is limited in the case, as Jane points out, with specifying the particular actions she might have been able to enact.

The ethico-moral dimensions also are available in this excerpt, as afflicting others (through pollution) occurs against the ethical principle of stewardship. This principle requires us to appreciate and guard two gifts to humanity: the environment with all its natural resources and our own human nature. Affecting others negatively through environmental pollution is morally abject and inconsistent with the principle of environmental justice, according to which the costs and impact of pollutive actions and activity cannot be redistributed to and covered by others—the patients of the agency of others. The (ethical) stewardship principle has led Michelle and Jane to articulate their finding—how dirty the creeks are—at the environmentalist open-house event; their actions that have realized this aim were therefore morally justifiable.

Being in the position of contributing to realizing the ethical aims of stewardship for the Hagan Creek watershed also requires consideration of particular norms. Thus, students have found themselves in situations where they have had to weigh the need to collect data along the creeks to support their claim of the varied nature of pollution against the norm (embodied in law) of trespassing and therefore of asking whether they could access the creek by crossing farm property. This issue of the need to access a creek at many places to construct reliable knowledge and the constraint posed by restricted access to private property is salient in the following episode. It begins with Jane’s explication why their results are limited: they have not been allowed to sample Hagan Creek at its lower reaches, which would have required to cross either private property or an aboriginal reservation.

Jane: Well, we never actually got to really see where the creek ends up because we weren’t allowed to go down there. ((General laughter.))

Environmentalist: No that’s private property.

Jane: Well, we did go to that one lady’s property.

Environmentalist: Which one?

Jane: Um, it was . . .

Michelle: Oh, yea.

Jane: It was like near the first site, I think, err—

Michelle: And we just kind a wandered on, oops.

Environmentalist: Yea.

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- Jane: Well she knew we were there— Oh that was with [teacher] 'cause she knew we were there. She came out. She thought we were like—  
Michelle: She was like, what are you doing there? We were like, uh, you gave us permission. Oh yea, go ahead.

The environmentalist provides the reason why Jane, Michelle, and others have not been allowed to go to the mouth of the creek: it means crossing private property. But Michelle relativizes this explanation by reminding him that they have entered private property at least in one instance. Here, the need to sample for realizing the ethical aim overrode the norm related to the right of a landowner to limit access to her property. This account does not allow us to recover exactly why the landowner finally allows students and their chaperon to sample from her property, but there may have been some earlier communication with the teacher. In Michelle's account, there is evidence that some permission has been given, which, from her position, has legitimized their presence on the property.

The emotional-volitional and ethico-moral dimensions of identity always are distributed across all aspects of praxis, and therefore, all aspects of events that only occur once. In the students' narrative accounts, acting all the while running potential risk—and therefore, being characterized as risk takers—are present everywhere. Thus, Michelle talks about wanting to sample in culverts and meeting the resistance on the part of the environmentalist chaperon, who finally accedes and gives the girls permission to sample in these places. (The environmentalist *is* the chaperon *precisely* because he says that the young women are not allowed to do this or that.) One girl in the group has not wanted to enter the culverts, leading Michelle to characterize her as “too much of a chicken.” Here, the refusal to enter and not going into the culvert becomes evidence for a trait of character. As exhibited also in the following account, the chaperon's (initial) interdiction itself constitutes an enactment of morality, as he was responsible and accountable for what happens. Although he adheres to the stewardship principle and to the curriculum generally, he also has to act such that what he will have done is according to the relevant norms. In the following, Michelle and the environmentalist articulate the legal dimensions of being on a fieldtrip during school time and the norms that such events are subject to.

- Jane: We went on the other side of the bridge than the other people.  
Michelle: Yea, um, but we, he wouldn't let us walk across the logs and stuff like that, for insurance.  
Environmentalist: Yeah, well we don't like people falling. Well you know why, you know these days you're not even allowed to take people in these creeks. You need a certified lifeguard. That's a new rule that they had, like—  
Michelle: Well that just sucks.  
Environmentalist: I know. You guys wouldn't have been able to do what you did last year, this year, unless I was a certified lifeguard.  
Michelle: Really?

Jane: Oh well, we all wore lifejackets.

Environmentalist: Yea, that's right.

Michelle: Oh like, help me I'm in ankle-deep water and I'm drowning.

Jane initiates the account by saying that they crossed a bridge to work on side of the creek where others did not do their research. Michelle chimes in to explain that they have taken the bridge because "he," the environmentalist, has not allowed them to cross the creek via some fallen logs. Again, he articulates the reigning norms that constrain what they collectively can do: a lifeguard certificate is required before students can go through or over a creek. Michelle in turn articulates in emotionally laden way the arrival of the new rules: The expression "it sucks" clearly expresses negative emotional valence. In fact, the environmentalist says that the girls *actually* have acted in ways that during the present year he would no longer have been able to permit them. The girls then relativize the norms with respect to the actual situation in which they have found themselves: First, they have worn lifejackets—a fact that the environmentalist confirms—and second, the creek only has been ankle deep, so that there has not been an imminent danger in the first place that would have mediated their action. Their actions of crossing the creek to realize the ethical aim of stewardship through the construction of knowledge would still have been defensible on moral (normative) grounds, as the context has been such that the danger the norms are intended to limit did not exist. Here, the girls have acted in morally defensible ways, acting according to the interdictions that their chaperon has stated, all the while recognizing that the current condition (ankle-deep water, lifejacket) would not have made immoral crossing the creek via the fallen logs despite the interdiction.

#### CONSEQUENCES FOR A THEORY AND PRAXIS OF SCIENTIFIC LITERACY

Thinking about scientific knowledge, skills, and literacy inherently involves a "fundamental split between the content or sense of a given act/activity and the historical actuality of its being" (Bakhtin, 1993, p. 2). Because the emotional-volitional and ethico-moral dimensions of action are constitutive of concrete practical action, theoretical statements of scientific knowledge, skills, and literacy inherently omit these dimensions. These have to be brought in from the outside in the form of rational (legal) norms said to guide behavior.

Theoretical and practical knowledge as stated on paper on the one hand and practical wisdom exhibited in once-occurring everyday praxis constitute "two worlds that have absolutely no communication with each other and are mutually impervious" (p. 2). School science, which focuses on the inculcation of concepts, theories, and skills articulated in policy documents, therefore inherently is blind to all those dimensions that are constitutive of everyday knowledgeability, both theoretical and practical. What science students learn in schools therefore is inherently useless—if I may express it in such a hyperbole—because it lacks the emotional-volitional and ethico-moral dimensions that characterize everyday knowledge. For this reason students in regular classroom science cannot evolve science-related

identities, because their actions do not have emotional-volitional and ethico-moral dimensions other than avoiding punishment (low grades, suspension, expulsion) and expanding their action possibilities through increased symbolic capital (grades). Emotional-volitional and ethico-moral dimensions pervade and are constitutive of everyday activity, and therefore, everything we do—and this pervasiveness is evident throughout this chapter. As a consequence of the particular experiences that the students featured in this chapter had was the constitution identities through the particular actions that they had taken. Identity therefore has to be *in scientific literacy* rather than something that can be added to it from the outside.

The upshot of this is that students cannot develop science-related dimensions of identity unless they participate in forms of activity that embody emotional-volitional and ethico-moral dimensions. Not unless students intend to do something for the greater and *common* good, they do not enact the volitional and ethical dimensions characteristic of everyday life; and unless they have the opportunity to evaluate action alternatives in terms of the differential emotional valence associated with outcomes and constrained by (moral) norms, they are not in a position to evolve identities characterized by morality. Practical wisdom, a central dimension of identity (Ricoeur, 1990), is tied to concrete praxis in the same way that the emotional-volitional and ethico-moral dimensions are. Practical wisdom consists in inventing just behavior suited to the case: “the man of wise judgment determines at the same time the rule and the case, by grasping the situation in its full singularity” (p. 206, my translation). Unless students participate in concrete, once-occurrent practical life, where each action has consequences for others and for themselves, they cannot develop the form of judicious application of scientific concepts, theories, and literacy that the situation requires. It does not surprise me then that scientists disavow of the ethical nature of their work, because they attempt to divest themselves of having to answer for their actions, which they have held to be outside of all ethics and morality. How else can we understand why scientists develop atomic bombs, thalidomide, and genetic monster plants and animals? How else can we explain the behavior of scientists, who work for companies that lay proprietary claims to the genes and seeds of naturally occurring species or produce seeds that yield sterile grain so that third-world farmers cannot replant parts of their harvests?

My personal hunch is that students, who are provided with opportunities to learn in situations similar to the one presented here, where their work contributes to a greater good and therefore realizes ethical aims, develop scientifically literate identities very different from those that we observe today. More so, as shown throughout this chapter, there are emotional dimensions integral to the practical wisdom exhibited in, and developed by means of, the participation in environmental activity. These students do not have to be motivated, as the motive itself embodies ethical aims and as setting and achieving goals is related to higher emotional valence. In everyday educational praxis, I would expect such an approach to lead to individuals who, if not pursue scientific careers, will appreciate science much more so than past and current generations of students and citizens. Inherently, such an approach to educational praxis means that we have to radically rethink the activity system(s) in which we, educators and educational researchers, are part of. At the

moment, there are no provisions—practical or theoretical—other than those articulated here to understand scientific literacy in terms of the actions people take and the emotional-volitional and ethico-moral dimensions that are *constitutive* rather than additive features.

## NOTES

- The preparation of this article was made possible in part by grants from the Canadian Natural Sciences and Engineering Council and Social Sciences and Humanities Council.
- 1 I explicitly use the adjective *societal* (“gesellschaftlich”), which is the one traditionally used in the German and Russian texts that draw on cultural-historical activity theory. For what I believe to be political reasons, English translations historically use the adjective *social*, although Marx uses its German equivalent “sozial” in very different ways than he uses the equivalent of *societal*. The latter term clearly is political, as it thematizes the mediating role of society rather than simply of the social situation.
  - 2 In the languages of the cultures where activity theory has been developed, *Activity* translates the special German and Russian terms *Tätigkeit* and *dejatel’nost’* (activity), which contrast mere *Aktivität* (activity), which denotes any form of doing something. Activity as used here therefore has the special sense of being a societally specific form of engagement that contributes to the maintenance and survival of the human species.
  - 3 I use the term transaction, because it better characterizes the irreducibility of the situation than the term interaction. The latter notion can be thought of what happens when two independent entities come to act taking each other into account: action lies between (Lat. *inter*) the agents. The former notion implies the irreducibility of action to an agent, because the action goes across (Lat. *trans*), linking agent and patient. This makes it possible to theorize actions in terms of the subject|object dialectic—as this is done in cultural-historical activity theory—where the object can be another person. A transitive verb is a good paradigm for this perspective.

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