

On Activism and Teaching

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Responses

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Abstract

Activism, because of its orientation toward collective motives, offers great opportunities for allowing children and students not only to learn science and technology but also to become lifelong learners concerned with their eco-social and political environment. However, activists may make the experience less enjoyable and rewarding when they teach in the school mode or when their teaching is subordinated to schooling. Traditional turn-taking patterns to elicit and test for knowledge are then employed to assure that production and reproduction of right answers. In this article I exemplify and theorize modes of teaching that are differently appreciated by the students who interact with activists. I conclude suggesting to activists to draw on the opportunities that their activism provides to engagement and collateral learning and to stay away from the reproduction of school knowledge, which coincidentally is a reproduction of the status quo and the inequitable societal structures that come with it.

Introduction

For more than a decade now, I have advocated the deinstitutionalization of science and technology education. Initially I was still thinking activism from the perspective of science education and using it as a way of situating and contextualizing the learning of science, technology, engineering, and mathematics—whatever the local curricula prescribed. But since then, I have come to realize that even the best situations and contexts cannot make provisions for the *learning paradox*, according to which it is impossible to aim at acquiring knowledge as yet unknown. How can we aim at learning something that we do not even know to exist? I also have come to know very well a particular theory that has arisen from the work of an influential Soviet psychologist, Lev S. Vygotsky, who has succeeded in founding a Marxist social-psychology that takes into account collective motives and their mediating role in shaping individual goals (e.g., Vygotsky, 1989). According to Marxist thought, learning itself is not a goal, it is a by-product of human activities that satisfy human needs, such as farming to grow food, construction to build shelters, or tool manufacturing to increase the control over the natural-societal environment. Learning is a collateral in the productive engagement in collective activity that inherently makes sense. Here the term *activity* is understood in terms of the German/Russian concepts of *Tätigkeit/deyatel'nost'*, which, in contrast to mere being busy (with the equivalent German/Russian concepts of *Aktivität/aktivnost'*), denotes collectively motivated productive endeavors (Roth & Lee, 2007). The theoretical notion of activity is aimed at bringing both the collective motive and the role of society into the analysis of knowing and learning in productive activity. This theoretical notion, as a recent review of the literature shows (Roth, Lee, & Hsu, 2009), has a lot of potential for re-orienting science education, especially for rationalizing how and why students learn differently when they participate in activism.

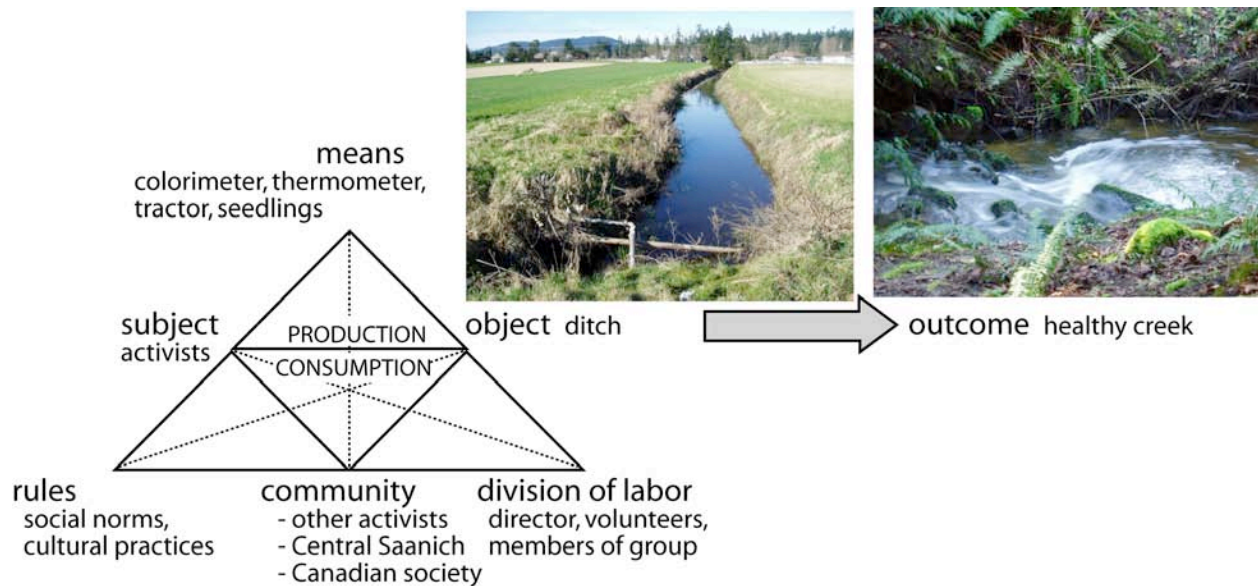


Figure 1. A cultural historical activity theoretic perspective on activism in the Hagan Creek watershed. The object/motive is the transformation of the creek from the ditch stage into a healthy creek that can carry a population of trout.

Productive activity, though irreducible because it constitutes the minimal intelligible unit, can be analyzed in terms constituent structures that stand in mediating relations and include the *subject*, *object*, *production means*, *division of labor*, *community* (both of the subject and for which it produces), *rules*, and *outcomes* (Figure 1). Importantly, the activity is motivated by the anticipated transformation of the given object into the anticipated or envisioned outcome. That is, the object/outcome combination forms a motive that orients the activity: the motive constitutes the very *raison d'être* of the activity system. This transformation makes only sense when the acting subject knows the outcome to be achieved, because only when you aim at the outcome can you transform the object in an intentional way. Thus, the activists who work in my community concerned with the eco-social environment of the Hagan Creek-Kennes watershed envision a transformation of the creek from a ditch into a healthy habitat for trout (Figure 1). Everything the activists do is organized by this motive, which in turn shapes the goals for the individual actions by means of which *these* activists realize *this* particular activity. Science students, on the other hand, are asked to engage with some materials (object) to learn. The explicit goal of science, technology, and mathematics education is for students to transform (abdicate) their current knowledge and to construct new knowledge. We can depict the process in this way:

$$S \xrightarrow{\text{acts upon}} \{O (K_{n1}) \rightarrow K_{n2}\}$$

But because the students do not know the resultant knowledge at the end of a task (K_2), they cannot aim at it. That is, the student may engage with the object and in so doing mobilize her knowledge (K_{n1}), but cannot intentionally do such that K_{n2} will result. There is no object/motive that the student can realize, because part of what orients activity and action is missing. We can only cook something from the ingredients we have in the kitchen if we have some idea or plan (recipe) that we concretize in and through our actions. If we do not have a plan or idea, anything can result. We cook as we might doodle with a pen on paper, where the end result is inherently unforeseeable and unforeseen. But the goal of the curriculum is not to teach just anything. It therefore does not come as a surprise that teachers are confronted so often with the question, "Teacher, is this the right answer?"

In cultural-historical activity theory—as for Karl Marx (especially 1973) who was its inspiration throughout its development from Vygotsky via Leont’ev to Yrjö Engeström and Michael Cole, who have made available this theory more widely to Western scholars in a variety of writings—learning is a collateral of productive activity. This is so because, first, during engagement in any form of activity, the human body expends and thereby transforms itself. Engagement leaves traces in and transforms the human body. This is why we can say, “participation *is* learning.” With these transformations come, for example, greater skill and honed performance. A second way in which human beings learn in collective activity comes from the fact of cooperation with others. When people work together, opportunities are created for doing things that an individual cannot (initially) do on her own. An example familiar to readers from everyday is the way in which children learn to ride a bicycle, when parents first (pretend to) hold and stabilize the child until she balances the bicycle on her own. Adult activities are of the same nature, seen, for example, in the way navy officers learn to navigate a ship by participating in a team and by moving from job to job as part of the career trajectory (Hutchins, 1995). Working in a team, individuals do part of the overall work until it is so familiar, so much routine, that they could do it on their own; it also creates opportunities for practices that only exist on the team—like the one of the beater in collective hunting, a job that does not even exist in individual hunting. In the activity theoretic framework, this aspect of working and learning in the collective is depicted in the mediated relation subject–object–division of labor. Some members of the collective subject mediate the access of others to the object, which allows these others to participate in ways they could not yet on their own; this participation transforms them (materially, ideally): they learn. In these examples, we clearly see how people learn by participating with others. They first act together with others until they are so familiar with the ways of doing things that they can do it without others present. This is a concretization of the dictum that any higher-order cognitive function first appears in soci(et)al interaction before it can be observed in the individual working on her own (Vygotsky, 1978). It is not, however, that the skill moves from the inter-psychological to the intra-psychological plane, for to participate at all, the skill has to exist intra-psychologically at the very moment that it is practiced as part of a team (i.e., inter-psychologically). That is, contrary to the way in which Vygotsky’s theory is frequently employed, the practice exists even *while* students act in the presence of a more knowledgeable adult.

The activity theoretic way of looking at teaching and learning in the context of activism brings an important dimension into the analysis that learning scientists and subject matter educators of all brands tend (like) to omit and perhaps even repress. This dimension is the reproduction of iniquitous society. Schooling is society’s way of reproducing itself and its cultural-historical knowledge, allowing future generation to take off where society currently is in its development rather than having to learn every bit of knowledge and skill that has marked previous generations. This is so because “the body has the capacity to be outside of itself thanks to its senses and mind” so that “the world is comprehensible, immediately endowed with sense” (Bourdieu, 1997, p. 163, my translation). The body and mind are shaped by interactions in a culturally and historically contingent society that are different today than it was only a few decades in the past, and certainly radically different than during the Middle Ages when schools first came about or even earlier. This is also why it is not necessary that students need to know some presupposed “basics” before moving on to engage in more advanced practices. In the course of our lives, we are formed in and through participation in collective activity, because “through the dispositions and beliefs that are part of the engagement in the game, all the presuppositions constitutive of the practical axiomatics of the field (the epistemic *doxa*, for example) introduce themselves right into the apparent intentions of the clearest kind” (p. 166). When the students use a digital thermometer as part of an instrument that also does colorimetry, chemical analysis, and other tests (see the second example that follows) they do not need to be able to read an old-style analog thermometer.

The societal context shapes the learner's dispositions, including the presupposed knowledge and mundane practices. This, then, leads to the fact that not only are there not equal opportunities for all but also that the school constitutes a selection mechanism for inequitable access to soci(et)al resources. Thus, although the stated aim of schooling is to give every individual the same knowledge, the fact is that the economies only work well if there is around 5 to 7% structural employment—competition for jobs keeps salaries down—and a certain number of capable workers who do not even look for work anymore (those on welfare lists and on the street). That is, even if every citizen in a country had a PhD, at least 10 to 12% would have to be unemployed or on welfare. Schooling is society's means for producing a hierarchy of individuals with differential access to coveted positions (Foucault, 1975). If activists contribute to the education of youth in a manner that simply reproduces the selection and hierarchization of individuals, the very idea of activism comes to be contravened and negated.

Over the past 12 years, my graduate students and I have conducted research among a number of activist groups, following them around in the everyday work, training of new adepts, workshops they provided to school students, and volunteer work they did by assisting teachers to introduce children to and allow them to participate in environmental activism. We have observed a lot of enthusiasm and empowerment among student and adult learners when the teaching occurred as part and in support of the general motive (e.g., Boyer & Roth, 2006), whereas we also found that when activists used the school mode for teaching, students tended to get turned off and what promised to be fun (learning outside the context of the school) no longer was. Once the motive of activism is gone, there is no mediation and orientation of the students' goals, with the result that they merely engaged in tasks that they experienced as antithetical to something that motivates (e.g., Roth, van Eijck, Reis, & Hsu, 2008). Going to the lagoon or science museum, rather than instilling interest, turned out to be experienced as just as boring as regular school; in some instances, there was more work involved, turning students off even more.

The purpose of this study is to provide two episodes and analyses that exemplify the alternate ways in which activists worked with students. In the first episode, which exemplifies students on field trips to be taught by activists how to use certain instruments (thermometer, Secchi disk¹), shows how activists may reproduce school modes of teaching, thereby leaving unrealized the potential and opportunities of activism for becoming educated generally. The second episode exemplifies an orientation where students also learn to operate an instrument (colorimeter), but they do so while pursuing their own research, that is, they learn how to operate the instrument and thereby come to understand conceptually what the instrument does for the purpose of expanding their agency and control over conditions. In both episodes, therefore, students are confronted with instruments, but in the first episode the instrument is the object of a task posed and supervised by environmental activists, but in the second the instrument is but a means toward a goal that itself draws its sense from the students' participation in environmental activism.

Activism in the Schooling Mode

Scientists and environmentalists alike often write up grants to be able to mount programs that teach the students in their community. However, scientists tend to conduct “dog-and-pony shows,” apparently to motivate students, where they show off spectacular events of which the purpose or the relevance seldom is clear to the students. Similarly, environmental activists often come to schools or, as in the present case, have school classes come to the sites that they have prepared with the assistance of funding from various organizations and governmental levels. As part of a center on scientific literacy, I have seen many situations of these two kinds—scientists and activists in the schooling mode. In such

situations, teaching certain skills, exhibiting certain phenomena, or teaching specific facts and theories takes over as the overall motive for organizing events. Because motivation is treated as separate from engagement in an activity, which comes with its own motive that motivates, dog-and-pony shows have no more potential to get a larger proportion of the population interested to participate in science (both to do and to contest it) than the regular school curriculum. In this case, therefore, the students have little or no control over what they do and why. They are shown instruments (tools) and exposed to language the organizational motive of which inherently are unclear, because the outcome of the events, the knowledge to be achieved, is precisely what lies outside the students' horizon of understanding.

The environmentalists operated a lagoon program designed to build confidence, self-esteem, First Nations culture and environmental awareness, class cohesion, and self-respect in the context of learning about the environment. The lagoon program consists of a day of explorations designed for upper elementary students, where groups of students move through three different stations: (a) a physical challenge of rowing an open water scull or paddling a 22-foot First Nations Canoe (the rowing station), (b) a scientific study of a salt water lagoon (dock station), and (c) a First Nations cultural awareness development through a study of the traditional ecological knowledge that first people used to live in that environment (wetlands station). The students attend a one-day in-school watershed model demonstration and a brief explanation of the equipment they would be using to analyze the quality of the water (i.e., training session about how to do sampling before the fact). After going to the lagoon, students engage in a one-day in-class task that is designed to review some important ideas and language associated with the visit. The regular teacher of the students prepares the materials utilized in the activity—basically stations with different sets of questions so that groups of students can rotate amongst them and work collaboratively to produce the answers.

The following fragment derives from events at the dock station. Here students are asked to take measurements of pH, dissolved oxygen, temperature, turbidity, and salinity to assess the water quality. They also collect samples of plankton for further study in the near-by laboratory, which contains magnifier lenses. The students also find here an aquarium with sand dollars, crabs, snails, sea stars, clams, and mussels for closer observations. At this station, students encounter many of the tools that are others in their community (participants in environmental research, activism) use including a dissolved-oxygen meter, pH strips, a hydrometer, a Secchi disk, and a plankton net. The video clip begins while Nina is in the process of asking Daniel—prior to begin interrupted by another student asking her about what to do next—whether they would do a “take-up.” Orienting him to a line hanging from the dock into the water, she tells him that there is a sample of the things they measure (turn 01).

Fragment 1.1²

01 N: we want the thing at the end of this.
02 [(3.81)
[(Daniel pulls on the string, which has a thermometer attached to its
end, which Daniel begins to look at in what looks like an attempt to
read, Fig. 2)]
03 D: the
04 (0.39)
05 N: <<pp, all>what 'is that.>
06 (0.77)
07 D: da::
08 N: `what 'is that.
09 D: how cold it is [or how hot it is.]
10 N: [no its called a] thermometer. so, (0.34) REAd the red
(.) there it is ((points to the thermometer))

Daniel pulls up the string, takes the thing at its end in his hands, and gazes at its scale in the apparent attempt to read it (Figure 2). Before Daniel can say something, Nina asks with very low voice but really fast, “What is that?” (turn 05). There is a pause; then Daniel utters an interjection, “Da:” (turn 07). Nina asks again, now much louder, “What is that?” (turn 08). (We hear a question even though the intonation falls toward the end of the utterance [see period in transcript], and we do so because of the grammatical interrogative “what” and the rise of intonation in “is.”) Daniel utters, “how cold it is or how hot it is” (turn 09), but Nina already marks this as the wrong answer to her question while Daniel is still speaking, “No.” She then tells him that it (the thing) “is called a thermometer” (turn 09).



Figure 2. Daniel, closely supervised by Nina, has pulled up and reads a thermometer. © Wolff-Michael Roth, used with permission.

Here we are seeing an interactional sequence that is typical for much of traditional teaching. The interactional form is commonly known under the acronym of *IRE*, standing for (teacher) *Initiation*, (student) *Response*, and (teacher) *Evaluation* of the response. Other names for this pattern include *devised format question*—the question is not genuine, like when someone asks us on the street for the time, but the questioning person already has the correct response against which the answer will be judged. What this form of question actually does is to assert a difference between someone who knows, the teacher or here the activist Nina, and the person who may or may not know the answer. It is a question designed for knowledge assessment rather than to gain required information or information of interest to the questioning individual. This form of question sets students up for failure. The question is designed to reveal whether the student knows, thereby reifying the person as a student and someone who requires teaching. Teaching does not have to proceed like this, because there are productive ways of asking questions, which are genuine because the person asking does not already know the answer (Roth, 1996). Such questioning sets students up to select among alternatives relevant to their current interests and forms of knowing without having to fear repercussions or without having reason to feel inadequate. Productive questions tend to encourage feelings of ownership, empowerment, and control over learning, whereas *IRE* sequences tend to disempower those subjected to them.

But Nina does not stop after having told Daniel that the thing he has just pulled out of the water is a thermometer. She directs him to “read the red” and then points to the device saying, “here it is” (turn 10). She stresses the word “red,” which may suggest that there are other things to be read on the instrument. There is a pause, as Daniel gazes at the device, before he articulates drawing out the first syllables, “It’s at.” There is another pause, interrupted by Nina who utters what we hear as an admonishment, “Don’t touch the bottom ’cause that’ll affect the temperature” (turn 13). There is another conversationally long pause before Daniel proffers a reading, “It’s like nineteen.” Nina follows by offering a comparison, “Woo, its warm. So it’s gone up a degree since this morning” (turn 17). Here we hear a genuine and informative comment. The temperature has gone up since the class first arrived at the lagoon.

Fragment 1.2

10 N: [no its called a] thermometer. so, (0.34) REAd the red
(.) there it is ((points to the thermometer))
11 D: =its a:::t ((looks at the thermometer))
12 (0.86)
13 N: <<all>dont touch the bottom 'cause thatll affect the temperature.>
14 (2.46)
15 D: itsa:t like nineteen.
16 (0.20)
17 N: woo (.) its warm. (0.26) so its gONe Up a degree since this morning.
(0.73) <<f>nineteen degrees what.>

After the comment, there is a brief pause before Nina sets up another interactional sequence that takes the *IRE* form: “Nineteen degrees what?” (turn 17). There is a pause, and then Daniel proffers a response, “Nineteen degrees Fahrenheit” (turn 19). But just as with the previous question, Nina evaluates it negatively, “No?” (turn 21). The intonation rises in the utterance, which allows us to hear it as a question, which we might gloss by saying, “No, this is not the right answer, so what *is* the right answer.” That is, the “no” not only evaluates the preceding response as wrong but also reiterates the request to give it another try at responding. Daniel apparently attempts to follow the request, but he produces only interjections and a pause. There is an embarrassed chuckle. And then he utters what we might hear as an apology, “I just check it out” (turn 22). There is a pause before Nina asks again with a loud voice, “Nineteen degrees what?” In reiterating, Nina in fact co-articulates that what has come between it and the first instantiation has been insufficient. That is, not only did the evaluation come in the form of the explicit “No,” but also in the form of a reiterated question. Moreover, the reiterated question duplicates the request already available in the rising intonation of “No,” requesting another try.

Fragment 1.3

17 N: woo (.) its warm. (0.26) so its gONe Up a degree since this morning.
(0.73) <<f>nineteen degrees what.>
18 (0.68)
19 D: nineteen degree:s=fahrenheit.
20 (0.55)
21 N: NO?
22 D: <<f>ta a:h> (0.72) degree (.) in <<f>uah> uh: ((embarrassed chuckle))> i
just check it out.
23 (0.90)
24 N: <<f>nineteen degrees whaAT.>
25 (0.97)
26 D: u:h nineteen degrees (1.82) ((his arms are now arched up and his palms
open, Fig. 3a)) <<p>i forgot.> ahh. ((nervously smile and let his arms
drop, turns about, then brings up hand and appears to hide his face,
Fig. 3b)) (1.40) uh i keep forgetting [every]thing.
27 N: [dont ho]
its alright (0.20) its right. ((She stands up and puts her left arm
around his back, Fig. 3c)). theres <<f>NO such thing> as (0.26) as
being dumb. (0.49) <<p>dont forget that.>
28 (0.64)
29 N: <<f>okay, so what is this.
30 (0.60)
31 D: a::h (.) turbidity meter

There is another longer pause—in fact, in telephone conversations the standard maximum pause length tends to be of about 1 second—and then another attempt, “Uh, nineteen degrees” that turns into a pause. Daniel first raises



then drops his hands as if in desperation (Figure 3a) and then says with lower than normal speech intensity, “I forgot.” He turns about, brings his hand up as if covering his face (Figure 3b), another pause, and an apologetic “I keep forgetting everything” (turn 26). Nina begins a turn while Daniel is still speaking, then waits before uttering what we may here as a consolation, “Its alright, its right” (turn 27). She gets up, lays her arm around his shoulder (Figure 3c), then says, “There’s no such thing as being dumb” and then follows up, “Don’t forget that.” The two walk to the other side of the dock together; here Nina pulls something up on a string until a Secchi disk surfaces. And again, she asks a question that makes it apparent that she already has the answer and that she is testing Daniel, “So what is this” (turn 29). There is a pause, Daniel takes the next turn in the same pattern, then responds “turbidity meter”; but we leave them now to look closer at what has happened so far in this event at the dock station.

Figure 3. At the dock. a. Daniel tries hard to remember, making interjections of embarrassment when he does not have the right answer. b. He apologizes for “forgetting everything.” c. Nina consoles Daniel by placing her arm around him as they walk to the next instrument. © Wolff-Michael Roth, used with permission.

Here we observe not only a particular form of interactional sequence, *IRE*, but also the effect that this sequence has as it sets up this student for failure. Daniel does exhibit stress when he does not provide the correct the response, an assessment that is not laid upon the episode through my interpretation but that in fact is heard as such by Nina, who evidently engages in consoling behavior. She lays her arm around Daniel’s shoulders, telling him that it is alright, and adds that “there is no such thing as being dumb.” Now Daniel did not introduce the idea of being dumb, but Nina, in using it as a descriptor, makes available in this way a hearing of what Daniel has said before. Her utterance “being dumb” can be heard as her form of glossing the behavior and utterance Daniel has displayed before, and in saying “there is no such thing as being dumb” she lets the student know that he ought not feel in the way he does, a feeling that he has expressed in a way that it could be read from the situation, and has been read in this way by Nina.

Most notably, perhaps, is the fact that Nina has nothing but positive intentions. We have numerous interviews and situations on record that provide ample evidence of the fact that she wants to help. But the *way* in which she does, her mode of employing the *IRE* sequence, sets the student up for failure and, the sequence being characteristic of schooling, makes the experience more like school than anything else that Daniel might experience. The very process and form of questioning Nina employs works against her own declared goals of engendering positive attitudes towards science.

In/On Activist Territory

In the course of my research, I came to understand that the very good way in which activists can help students learn, develop positive attitudes, and grow into a responsible citizens is by letting them participate, in their own ways and on their own terms, in the activist movement. As a collective activity,

there is a motive; and by taking up the activity, realizing it in a concrete way, participants also take up the collective motive, realizing in their own goals and motivations. The role of activists would then be one of assisting students in such a manner that these continue to be in control of their way of concretely realizing the collective activity; in so doing, activists merely act such that the students experience an expansion of their room to maneuver and control over the condition in and under which they do the work of their own design. It is precisely because the students themselves design the work and the modes of their engagement that they not only take up the collective motive (here of activism) but also are motivated by what they are doing.

In 1998, I came to know the leader of an activist group concerned with the environmental health in the municipality of Central Saanich where I live. Part of the municipality lies in the Hagan Creek-Kennes watershed, which suffers from heavy demand on its aquifers for the farms and homes that are not connected to the watermain that supplies the remainder of the community. There is also heavy pollution deriving from farming run-off, wastes from animals grazing in and near the creek, and from local industries that shed some of their waste fluids into a side arm of the creek. The Hagan Creek-Kennes Watershed Project arose from the concerns about water quality of three watershed residents, a farmer, professor of environmental policy at the local university, and a research scientist working at a nearby national research laboratory, who obtained funding from a federal agency concerned with stream restoration. The Henderson Creek-Kennes Watershed Project, headed by a director and a 5–7 member steering committee, enlists the support of many other people (e.g., hired high school and university students doing summer jobs) and institutions within the region. The activists believe that they are working in and against an adverse political climate. The interests of farmers, industry, and other landowners are often opposed to those that motivate the activists. Since most of the land in the municipality is private, the activists feel that building and maintaining good relationships with everyone they possibly can is paramount to their success in bringing about desired changes. Their declared intent is to bring much of the creek back to the state in which it was prior to the settlement by the European settlers, a state in which it offers an environment for a healthy cutthroat trout population (see photos in Figure 1).

When I suggested to the director of the activist group to assist us in teaching a science course by allowing students to contribute to their cause, she was gung ho. (Following the project, during an interview about the students' involvement, she credited them and their participation for a significant part of the impact that the movement has had on the community.) So were the seventh-grade students, who initially came to know about the project through newspaper articles, one of which in particular called for community participation. The students, who immediately wondered what they could do to assist, then developed a variety of projects. The teachers, parents, environmentalists, and community elders who participated with us assisted students to achieve their goals that realized the collective motive, the improvement of the environmental health of the Hagan Creek-Kennes watershed. Some of these ways of working included direct actions in the creek, building riffles—structures from rocks and trees that oxygenate the water—and conducting research to document the changes that would happen as the creek was protected from foot and horse traffic and from changes to its riparian zones. The present episode fragment is extracted from the videos that recorded on student group interested in the stream as a trout habitat and in conducting tests for the suitability or unsuitability of certain reaches of the creek. The students found out that oxygen and the amount of floating materials in the creek contribute to its suitability as trout habitat. On this day, the group begins its work with a biologist, who accompanies the class on that day. He introduces the students to an instrument that they can use to measure parameters such as dissolved oxygen, turbidity, and other variables that the students on the dockside station also learned about (Figure 4). He does so right next to the spot where the students have decided to conduct their first measurement of the day; they subsequently also move to other reaches of the creek. The

photograph also shows their other equipment, including a plankton net, and a green bucket that contains more equipment of the kind that the children at the dockside used (temperature could be read with the same device as turbidity, acidity [pH], and dissolved oxygen). As the following fragments show, none of the patterns that characterized Nina's interactions with the students visiting her program are evident here. The fundamental difference between her program and the one featured here is that she designed the lagoon program, whereas in the present context it is the students who designed their work (research) and who decided what they would do, when, and how. The biologist merely



assists them to get to the point where they can employ the instrument for their own intentions, that is, here, the measurement of turbidity in the stream. The students therefore do not just learn to operate the instrument independent of the ends for which it is the means, but they learn to employ it as a means for the ends that they have envisioned as the outcome of their project.

Figure 4. A biologist-activist teaches three seventh-graders how to use the colorimeter so that they can make their intended turbidity measurements in the creek seen in the top left corner (composite from several off-prints). © Wolff-Michael Roth, used with permission.

The fragment chosen to exemplify the kinds of interactions that we fostered in this project begins when the camera approaches the group including a biologist and three students, Mark, Jamie, and Stephen. (Any person who wanted was allowed to participate in teaching under one principal condition: “No answers, only questions the further inquiry rather than tests knowledge.”) The fragment begins when the biologist suggests that they first have to find the right test that they want to do on this day. That is, he assists them in achieving what they have set themselves as the goal, making a particular set of measurements. He does not set out to teach the instrument as a whole or even in part. He proposes scrolling through the testing sequence until they get to the one relevant to the day at hand. He then names the aspect that they want to measure: turbidity. Rather than doing it for them, even only to give an example, he immediately asks the students to “press the down arrow” (turn 01). Without much ado, the biologist asks the students to operate the instrument, which, initially, involves pushing the appropriate button to get to the test that the boys want to do on this day. While Stephen is pushing, the biologist's hand is not far from the instrument, which allows him to point and even to operate the instrument, when required, at the same time.

Fragment 2

- 01 B: you have to get the testing sequence. what you wanna do (0.44)
is=s=scroll through this testing sequence (1.11) u:m (1.50) to get to
the right test that you wanna do=today we are doing turbidity; (0.18)
so press the DOwn arrow
- 02 S: [(1.54)
[(the boys move forward; Stephen pushes the button as requested))
- 03 B: youre going down?
- 04 [(1.56)

05 B: [

you are going down?

 ((Stephen is pushing "down"))
06 (0.45)
07 B: so the star is right beside all tests (.) so one more time? (0.72) okay
and then press the [star
((points to a button, even as Stephen is still
pushing the down arrow, Fig. 5))
08 [(0.93)
09 B: then we get this BIG long last (.) u list of all the test that this
machine can DO (0.46) everything from aluminU:m ammo:nia (0.89) <<p,
all>pull down the square a little faster> (0.46) fluoride
10 (1.00)
08 S: <<p>fluoride at the square>
09 B: thats uh (0.22) chemical oxygen demand? [ts]
10 S: [ba-] whay?
13 (0.20)
11 B: how much (0.43) O:xygen in the water (0.33) is used up by all the
different chemical reactions that are going ON,

When Stephen has reached the required item (marked by the “square”), the biologist continues with his instructions, which the student implements. Then the biologist describes what they are looking at, “we get this big long list of al the test that this machine can do” (turn 09) and he makes a long waving gesture that iconically follows a long list on the screen. Here, the biologist does not use the name of the instrument or ask the students for its name—with the possibility of finding out that they do not know it. That is, a feature that exhibits the contrast between this and the dockside situation can be seen in turn 09. The biologist simply refers to the “machine” rather than naming it or asking the students to name it. This contrasts the type of questions Nina asked, including the names of the instruments. She thereby sets up the *IRE* sequences, whereas the biologist is oriented toward assisting students to do their research by allowing them to immediately do as much as they can, so that the instrument in fact become a “shared device” (Figure 5). The least students need to know at this point in time is to try memorizing yet another name that initially has little sense to them. The name eventually becomes familiar and makes a lot of sense, as my analyses reveal of events at the open house that the activists organized later. In that other situation, the students presently featured show the visitors to the open house how to operate the device, how to compare the sample of interest to a control sample, and so forth. And they do so as if they had used the instrument forever, including its name and the names of its parts.



Figure 5. The biologist takes the seventh-grade students, here Davie and Stephen (right) through the steps of using the colorimeter as they take turns pushing buttons. © Wolff-Michael Roth, used with permission.

The biologist continues with his articulation of the list the “machine” can do, testing for “aluminum, ammonia, fluoride” and he orients the boys to the square that is moving down as they push the button and that they ought to push it down faster. When the square is at the fluoride, Stephen articulates in a low voice “fluoride at a square,” which, as the next turn shows, comes to be realized interactionally as a question. The biologist explains, “that’s chemical oxygen demand” and, following another interjection with rising intonation (turn 10), he elaborates, “how much oxygen in the water is used up by all the different chemical reactions that are going on” (turn 11). Although this test does not play a role on this day, it will eventually, in the research that Stephen, Davie, and Mark will conduct. When the interest in oxygen eventually arises, it does so from the conjunction of having heard about the importance of oxygen levels to trout, the role of the riffles that the activists have built in one park for precisely that purpose, and from the fact of having heard about the possibility to measure oxygen levels using the device that they are currently using.

Throughout his interactions with the students, the biologist assisted them in achieving *their* goals, the ones they have set for themselves to realize activism in this watershed. On this day, their goal was to measure turbidity in several reaches along the course of the stream. The goals and the motive of activism mutually constitute each other, and the “teaching” occurred whenever students or teachers thought that there are possibilities for expanding the students’ room to maneuver and control over their own work. These forms of interaction were characteristic not only in the context of the seventh-grade students’ participation in environmental activism, but also in the teaching that my research team and I observed in this and other activist groups interacting with the residents of different villages and municipalities. The overall orientation always has been toward some outcome, the stream keepers who invite the activists to find out more about what they can do to make their creek trout-bearing again, the villagers who were interested in mapping eel grass in their environment, the stewards of the environment interested in expanding the range of their involvement. Each time, we observed interactions similar to those between the three students and the biologist in the present fragment—there were never devised format questions to test whether people know something, but there was always an orientation to the interests and current forms of participation of those *in whose interests the activist-teachers were acting*.

Knowledge as Goal vs. Knowledge as Collateral

The purpose of this article is to articulate some of the findings from our research with respect to activists and teaching. I begin this article by pointing out that we can understand human (productive) activities in terms of cultural-historical activity theory, which assists us in attending to the collective nature of events and to the role a variety of mediating moments have on what happens and how it happens, which forms of knowledgeable practices come to be enacted and why. The activity theoretic framework brings out the differences between the two forms of interactions exemplified in the two preceding sections.

In the second example, the activists always serve as mediators in the authentic activities that their “clients” are involved. Thus, the biologist assists the students *in their work*, which consists of producing representations of the state of the creek in various reaches. As Figure 6 shows, the student-subjects of the activity have as object the creek water with the motive of knowing more about it in the different parts of the creek, the entirety of which lies within the boundary of their municipality. The students are interested in the water because, shared with the environmental activists, they want to know about the suitability of the various reaches as trout habitat. One of the tests of suitability is that of turbidity. To measure turbidity, the biologist, who is also part of the collective subject in this activity, *mediates* students’ access to the object by presenting them with the “machine” that can measure turbidity. That is,

there is a division of labor where one of the group, here the biologist, mediates the access of others to the object so that they can use the instrument as a means to realize their goal, the sense of which derives from the relation with the activist motive. This outcome, the knowledge they produce, is not just for getting the students ready to take a test—upon which they can forget what they learned. Rather, the knowledge they produce and the representations thereof, are to be reintroduced into their community (the activists who enter the student-produced data into a common database, the members of the municipality who come to be informed about the creek during an open-house event, etc.). These community members in fact “consume” the outcomes from the students’ work, which itself is part of activism and the collective activity system that it constitutes.

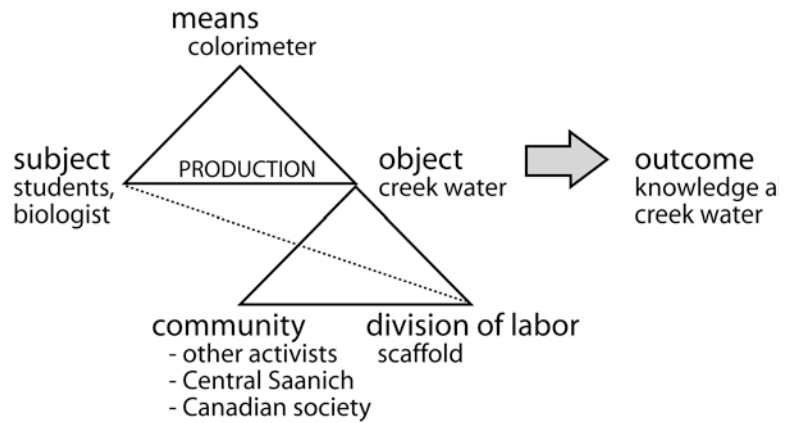


Figure 6. The activity system as realized at the creek bank, where the environmentalist motive mediates the goal of finding out about the capability of this reach as trout habitat. The colorimeter is a means and the biologist scaffolds students into using it rather than testing their knowledge.

The students at the dockside are in a very different situation. In fact, they are in a very different activity system. The students are part of a field trip to a center funded for the purpose of teaching student science with particular attention to attitudes and diversity. The activists who received funding and organized the lagoon center are, as we can see in the interaction between Nina and Daniel, intent to get the real science across. The field trip is preceded and followed up by particular tasks that integrate the day into the curriculum, including its modes of evaluation of student learning. But it turns out that the field trip is subsumed to schooling, with its clear motive of producing grades and grade reports, used in advancement and for the structuring of access to a variety of resources. Thus, Nina and the students are in the process of producing knowledge about the thermometer independent of some larger goal; and the *IRE* sequence becomes the means for teaching and assessing knowledge—where it is not clear that this sequence actually has achieved what it was intended for (Figure 7). That is, the dockside events are part of tasks students accomplish in the activity of schooling, which has as its motive the hierarchization of students as a mechanism to mediate access to subsequent educational and professional choices in a differential manner. In the course of the single event concerning the thermometer, there were repeated occasions to observe the *IRE* sequence at work; and as soon as Nina and Daniel arrive at the next part of the station, the same sequence comes to be enacted.

In Figure 7, we can see expressed the mediational relation operating at this instant—the absence of the “community” makes evident that this is not an *activity* in the sense that the developers of activity theory thought about the term in their German/Russian languages (i.e., *Tätigkeit/deyatel’nost’*). The students complete a series of tasks but they do not know why they do what they do. They just move from station to station as directed. Nina guides Daniel from the thermometer to the Secchi disk, but there is no inherent logic to this sequence and no overall goal for enacting the sequence such that it would make sense in terms of some overall motive. The difference with the other episode featured here is evident—Stephen, Daniel, and Mark know why they engage with the colorimeter and why they interact with the biologist. They want to measure turbidity to find out which reaches of the creek are suitable for trout habitat. They learn to operate the colorimeter not for its own sake but to conduct

measurements. This also allows the biologist to focus on what to show so that students can make some measurement, which is what interests them primarily and at this point, not what the name is, what the long list of items in the instrument menu contains, and so on. This name and other things they learn as they become more familiar with the device—which is a general pattern of learning new words, which never receive something like meaning but always accrue to familiar

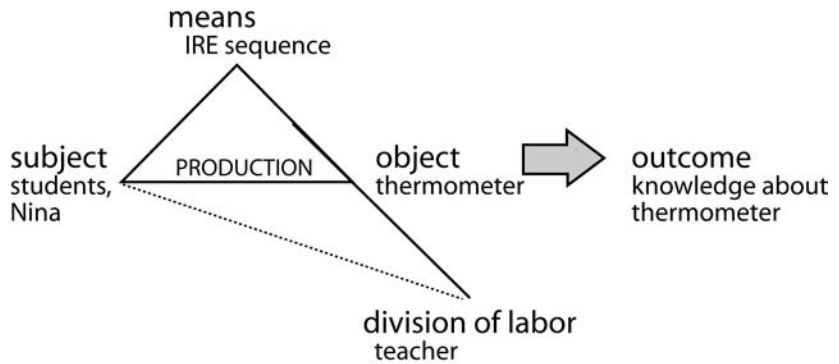


Figure 7. At the dockside station, it is not activism but the testing of knowledge that comes to be enacted. Nina teaches the instruments as if the practices required make sense independent of the purpose for which the instrument is used.

situations and the referential relations that are characteristic of them (Heidegger, 1977). Any name, any word, takes on a particular sense from the particulars of the instant it is employed, so that there is no such thing as knowing a word but not knowing how it is applied. In the same way, any material practice (action) has sense in its mutually constitutive relation to the activity as a whole (Roth & Lee, 2007). This is why learning something for itself makes so little sense. The same word used in different activities and even at different instances in the same activity takes on a different sense; the same word uttered twice or more often in a row changes its function each time (Roth, 2009). That is, learning to operate the device is subsumed to their interest of creating knowledge about the creek; it is a means to a different end, not an end in itself, as is the teaching of the thermometer and the Secchi disk in the lagoon center. In fact, as a result of his two-year observations, one of my graduate students (Giuliano Reis) came to the conclusion that many field trips frequently are not “fun,” for which they are designed. Rather, because they often merely concretized schooling in yet another way, its motive and goals are no different—everything geared to teaching knowledge and skills for their own sake (generally to be tested) rather than as knowledgeabilities that expand the room to maneuver and levels of control that the learners have in and over their environment. The students working in and on the creek see their room to maneuver expanded as they learn to operate the device prior to knowing its name and the functions and names of all the buttons and options. At the end of the day, they have collected a set of measurements that allows them to identify the reaches currently suitable as trout habitat and those unsuitable.

Activism and the Teaching for Expanding Room to Maneuver and Control

This article begins with an account of the change in my thinking about activism and science education, which occurred in the process of working with different activist groups intended on assisting a diverse set of people in learning about the environment and contributing to the collective cause. Initially I saw in activism but another context to teach science. But I realized in the course of doing the curriculum a number of times that teaching science is the problem, because teaching knowledge and skills independent of the big projects and orientations that characterize makes no sense. Human beings are not storage devices for information—declarative and procedural knowledge—computers are much better at this. Rather, human beings constitute a concretization of life itself, and the defining features of living organisms is the satisfaction of needs, primary, secondary, tertiary, and so on. Needs are satisfied in some way, and in the progressive division of labor that was constitutive of the development of

society, the products/outcomes of activity systems are exchanged with other products to satisfy needs throughout the collective.

When students participate in the fulfillment of collective needs, they participate in activities that have collective motives; and these motives give sense to actions and talk. As students become familiar with a particular activity, they can learn new discourses and material practice, because there is already a web of significations in which the new and heretofore unknown discourse and practice takes its sense. That is, we are no longer caught in the learning paradox, where students are asked to intend learning something that they cannot have any inkling about, *precisely* because it is the object of learning. The situation is changed as soon as we begin thinking about students in their familiar setting, where they can experience something new as fitting, making sense, and providing opportunities for expanding their room to maneuver and control over the environment. Mark, Jamie, and Stephen learn new things once they have taken up the collective activity concerned with the environment: now the colorimeter has a place, as it can be used to measure turbidity, and the discourse surrounding dissolved oxygen makes sense because it, too, has a place, in the lifeworld of a creek and its reaches un/suitable as trout habitat.

Once I began to think in this way, I came to understand that we might have to rethink schooling—in fact I used to use the concept of *deinstitutionalization* similar to what happened in the prison and psychiatric systems, which already Foucault (1975) likened to education. Rather than thinking of schooling as an institution designed to discipline bodies and minds to prepare students for work on assembly lines, we ought to think about organizing *education* (rather than schooling) around ways in which the students, whatever their age, already contribute to the production of things—even knowledge does not exist as such but is embodied in discourse and representations that need to be produced—that fulfill some collective need. All of a sudden I came to understand the potential in society that currently is not realized—the possibilities that exist once every student is treated as a full member of society who contributes to its reproduction and transformation rather than as a diminutive being whose knowledge deficiencies need to be fixed.

Here, then, activism has an important role to play, as it is one of the forms of activity that students can engage in all sorts of cultural-historical settings and environments. But, and this is the central point of this article, activists must not see themselves as purveyors of information and skill trainers separate from the actual motives of the collective activity, environmentalism, that they themselves realize. To make any sense at all, learners of all ages need to frame what collective motives to realize and how to realize them, for these motives are constitutive of the sense they can make of their actions. These motives also frame motivations, so that we would no longer need psychologists to fix our children so that they are better motivated for schooling. Schooling is the source of motivational problems, not the children and students. The role of the activists as teachers, then, is one of assisting learners in expanding their room to maneuver and control over conditions—in the way the biologist has done it—rather than as purveyors of information and reproducers of knowledge inequities—in the way Nina does it in fragments featured here.

In conclusion, therefore, there is a lot of potential in bringing together education and activism, but when activism is subservient to the aims of schooling in the way it exists today, then I do not see much change in learning or in the attitudes that the students might develop. Those students who concretely realize activism in their way are permanently changed and are more likely to become interested in the environment and environmental issues than those students who in fact are turned off from science because of its traditional orientation on right and wrong answers, generally enacted as in the present examples, by means of particular turn-taking routines that have as their goal the assessment of knowledge and the assertion of knowledge differentials. In a society where knowledge can be said to grow exponentially, and in the face of limited memory capacities that humans have, any knowledge that

might seem superior today will be inferior tomorrow with the consequence that the knowledge/power relations invert themselves repeatedly within our own lifetimes.

Coda

In this article, I do not mean to suggest that environmental activism constitutes the only form of activism. Rather, there are many forms of activism that constitute an appropriate context for educating our young generations. But activism itself is an ideal context, because it realizes a Marxist diction, eternalized in the eleventh thesis on Feuerbach: whereas philosophers have tended to understand the world, the real point is to transform it. Activism inherently is about transforming the world and making it a better place. By participating in activism, students can experience empowerment that comes with successful transformation of the world. They learn how to participate in society for the purpose of transforming the world. That is, Stephen, Mark, and Jamie not only learned about the creek, they not only learned about how to use a colorimeter, but they in fact learned how to participate in activism to transform the world. This is empowering, as our interviews with the students show, especially when they noticed that they knew so much more about the environment and the Hagan Creek-Kennes watershed than their older fellow citizens. If there is anything that interests me in teaching, then it would be this: assisting students in empowering themselves so that they no longer accept the societal and natural world as it is but that they actually orient to transform the world to make it a better habitat for themselves and other human beings. I care little about testable facts that students can regurgitate and a lot about human beings changing rather than just complaining about their conditions. As a teacher, this is what I set as my goal. Having students complete my tasks and test them whether they remember the names of instruments and their parts does little to entice students into taking control. So my own mode of teaching resembles that employed by the biologist, aiming at the expansion of room to maneuver and increased control.

Acknowledgments

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Notes

¹ The Secchi disk is a disk on a marked rope that is lowered into the water. The maximum depth at which the disk can be seen is an indication of the amount of (biological, physical) material suspended in the water.

² The following transcription conventions have been used.

we want – all words are written with small letters;

DA – capital letters used to indicate emphasis (which speakers can create by a variety of means, including increasing speech intensity/volume, speaking slower, raising the pitch);

(3.82) – numbers enclosed in parenthesis denote pause in seconds;

da:: – colon mark lengthening of syllable, about 1/10th of a second per colon;

[what]

[no its] – brackets in consecutive lines precisely indicate overlap;

;.,? – punctuation marks denote intonation toward the end of the utterance, slightly falling, strongly falling, slightly rising, and strongly rising, respectively;

^^ – rising, falling, and rising-falling intonation;

(.) – pause of less than 1/10th of a second;

<<x> what> – marker for particular speech characteristics, where X takes the values p = piano, lower than normal speech volume, pp = pianissimo, much lower volume, all = allegro, faster than normal; f = forte, louder than normal;

= – latching, that is, no space between previous speaker or word and subsequent speaker, word;

((looks at)) – double parentheses enclose transcriber's/observer's comments.

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