Epistemological Renewal and Environmental Education: Science in Context

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Abstract The instrumental relationship to nature[1] and the realist epistemology that dominate the analysis of contemporary environmental issues have prompted me to develop an interest in a socialized conception of science in environmental education (EE) so as to throw into question a certain overappreciation of scientific expertise whenever the environment is at issue. This interest in an epistemological renewal has also impelled me to favour the socioconstructivist model of cognition in EE. The relevance of these various aspects is presented to the reader as the extension of a necessary epistemological renewal in EE, as various authors in this field of research have advocated.[2]

Introduction

Environmental education (EE) should represent a catalyst for social change in Western societies. One possible avenue for such a development consists in rethinking the instrumental rationality that appears to frame our ways of picturing environmental questions (Lash, Szerszynski & Wynne, 1996) and that contributes to the overappreciation of scientific expertise in the decisions adopted concerning these questions (Latour, 1999; Testart, 2000). From this perspective, looking to contemporary research in the sociology of science in order to mobilise a contextualised image of science (be this in the capacity of researcher or EE teacher) rather then to the more widespread conception in which science appears as being disembodied, realist, and empiricist (Désautels & Larochelle, 1998), will generate fertile reflections on the scope and limits of scientific discourses on environmental issues (Wynne, 1992). In the long term, the epistemological renewal I am advocating should foster greater accountability among scientists as to the knowledge they produce and, in addition, make it easier to open constructive dialogues between experts and concerned parties. This trend would entail an image more complex than the current image of science, which as a rule conceives such knowledge as stemming primarily from systematic procedures of investigation that tend to entrench a single explanation about a given object of study. This tendency to regard science as producing absolute truths about the world makes it an area of knowledge which allows for little negotiation.

In this article, I will present the relevance of certain aspects of the theoretical research framework that I have structured in environmental education and in science

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education (Bader, 2001), as an extension of the proposition of certain sociologists of science (Lash et al., 1996; Latour, 1999) and EE researchers (Gough, N., 2004, 1999; Gough, A., 2002; Robottom & Hart, 1993). In order to renew the empiricist and instrumental epistemological option in EE, I have also opted for the socioconstructivist model of cognition, which I discuss briefly at the end of this paper. Accordingly, I should like to begin my exposition by examining a certain sociology of science that has characterised current scientific expertise on the subject of the environment.

An Instrumental Relationship to Nature

According to the proposition of Scott Lash, Bronislaw Szerszynski, and Brian Wynne (1996), the Western manner of presenting environmental questions, which they have qualified as being "realist, disembodied, technicist, and cognitivist" (p. 2), tends to mask cultural and political dimensions of the contemporary environmental crisis. This manner of reifying environmental problems and defining them above all as disequilibria of "Nature" (Latour, 1999) — disequilibria that it would be better to understand, predict, and control according to a scientistic mode — is dangerously reductionist in their opinion. This approach to environmental questions, which is centred primarily on a certain mode of scientific expertise, is of no use for explicating — let alone challenging — the structuring regularities of our societies (be they beliefs, ideological orientations, power relations, or value choices) that have contributed to the emergence of contemporary environmental issues or that orient the decision-making processes bearing on this agenda.

Following these authors, illustration of this instrumental trend is to be found in the large-scale research projects that have been increasingly framing inquiry and debate on environmental issues. Groups of international experts attempt to predict how complex natural systems will function in order to subsequently control them more fully using technical and financial means. Thus, in the case of global warming, the instrumental type of relationship to nature has, under the aegis of the IPCC (Intergovernmental Panel on Climate Change, 1996), taken the form of a gigantic panel of experts who have been attempting to analyze and predict trends in climate change by heavily relying on technological instrumentation (Zehr, 2000). Likewise, and as these authors point out, the concept of sustainable development, which has, within these terms, made principles of equity and social justice an integral part of decisions on environmental issues, could have paved the way to greater recognition of the cultural and political dimensions of such questions. However, it has primarily taken the form of a "technologisation" of the environment. This instrumental rationality must thus be laid open to challenge. The main issue is our relationship to nature, and in that connection, the following passage serves to more fully illustrate the position of Lash et al., (1996):

> And indeed Horkheimer and Adorno's dire warnings of a dialectic of enlightenment in which reason would metamorphose into technology is nowhere more profoundly confirmed than in "man's" domination and instrumentalisation of nature — including human nature. [...] Humanity's colonisation of nature through technology has taken place through a whole apparatus of material resources, such as machinery and computers, as well as through a range of expert-systems [...]. Instrumentalist social science has only aided and abetted these trends and transformations. (p. 3)

The Demand for Reflexivity Concerning the Current Image of Science

As it so happens, although the "technologisation" of the environment seems these days to be the preferred line of approach for analyzing these issues and dictating solutions,

other authors, such as Beck (2001), appear to agree that this same instrumental logic, when integrated into the industrial society, triggers risks for public health and the environment that can no longer be managed only by groups of experts. Science can no longer stand as the main arbiter of cases in which it also plays the role of prosecution and defence. In other words, the same instrumental rationality that contributes to generating risk cannot also have the legitimacy of serving as yardstick for defining issues and advocating solutions to them. Thus, this context calls for a civic-minded reflection about the conditions that have fostered the emergence of these risks and about the means to be implemented in order to limit the harmful and unsuspected impacts of the large-scale commercialisation of previously unknown technologies.

An education in reflexivity about science and the authority automatically vested in science in the context of environmental decision-making is thus particularly appropriate to the current times. This proposition should be placed side by side with an education in the principle of precaution, in the sense proposed by Wynne (1997) — that is, an education that would explicate, to the greatest degree possible, the limits of validity and the indeterminacy inherent to scientific knowledge, epistemological choices, and the economic issues that give a particular cast to the way such scientific knowledge is framed. By updating the current rhetoric on science, progress is likely to be made on activating a socialised representation of science among the research and education communities (Cunningham & Helm, 1998). Such a representation will make expert decisions more open to negotiation — epistemologically and politically — concerning, for example, issues that involve our relationships to nature.

Considerations similar to these have been common in the field of science education for several years now. For example, emphasis has of late been placed on pursuing emancipatory objectives rather than reproducing a relationship of submission to scientific expertise (Aikenhead, 2002; Roth, 2003). Attention has also been directed to integrating considerations of the epistemology and sociology of science into the curriculum (Roth & Désautels, 2002; Osborne, Collins, Ratcliffe, Millar & Duschl, 2003). Likewise, over the last several years, authors active in the field of EE have emphasised the importance of another epistemological context in EE. At this point I would like to briefly review a number of these considerations in EE so as to specify how my proposition can be located as a continuation of these positions.

The Limits of a Realist and Instrumental Epistemology of Science in EE

Propositions concerning the limits of a realist, instrumental epistemology and of an EE too closely associated with a more traditional type of science education have been found in the writings of many authors in the field of EE for a good many years now (Gough, N. 2004, 1999; Gough, A. 2002; Robottom & Hart, 1993; Robottom, 1987; Greenall Gough, 1993). My position is clearly a continuation of these reflections, which I intend to add to by integrating the contribution of a critical research that originates from a branch of contemporary sociology of science that has a bearing on questions of risk (Lash et al., 1996; Wynne, 1992).

Consider for a moment the manner in which the aforementioned authors characterised the epistemological orientation of research in EE during the 1980s. According to these authors, an initial phase of EE research was implemented on the basis of an instrumental, realist — "scientistic", Robottom would say (1983) — mode, anchored primarily in an epistemology of the prediction and technicist control of environmental issues. This description of an epistemology entrenched in the EE field mirrors the perspective developed by Lash et al., (1996) concerning the dominant approach to environmental issues taken at an international level. This initial phase in the institutionalisation of the EE field thus appears to have had the effect of

shifting the critical character of EE[3] toward forms of EE that were more acceptable for the established social order and that fit with teaching approaches in which the environment is viewed essentially in terms of a realist mode as an "ecosystem" or a "natural" environment. Such practices favour learning ecological concepts and propose technical solutions as a way of approaching environmental issues.

EE practices appear to have developed from the outset in close relationship with the usual approach to teaching science — and in more than one way at that (Gough, A., 2002; Gough, N., 1999). As was noted by Greenall Gough (1993), the main founders of the field in North America who attempted to give concrete form to the orientations proposed during the Belgrade and Tbilissi conferences were men who initially trained in science. Greenall Gough (1993) has pointed out that as a result, the realist and mechanistic vision of the world strongly coloured the type of approach implemented in EE until the early 1990s. The "Laplacian fantasy" of the deterministic predictability of "natural laws" — to borrow from Greenall Gough (1993, p. 42) — can thus be considered to be characteristic of the ontology dominant among the practices and research in EE during this initial phase.

In response to the assimilation of EE with conventional science education practices, Robottom (1983, 1987) denounced the technocratic vision permeating EE and the belief in a standardised scientific method which, once transposed into EE practices, appears to reinforce the illusion of the potential of technical solutions for resolving environmental questions, at the expense of a more politicised conception of these issues.

By conserving and reproducing a technocratic view of the world — one centred on rationality, objectivity, truth, and control — environmental education as education *about* the environment creates the impression that environmental problems are susceptible to resolution through technical and scientific means. Based on such elements as fragmentation (through a division of knowledge into specialisms manifested in a division of labour between specialists and non-specialists), means-end thinking, eradication of values, and large-scale administrative and financial support, it promotes the view that a "logic of resolution" exists (Robottom, 1987, p. 103).

Robottom has also maintained the importance of explicating the relationships between knowledge and the choice of values that can be associated with them, versus the usual school conception, which views scientific facts as disassociated from ethical considerations (Robottom, 1983). It is clear that my position is located within the continuation of such reflections, which stand as an attempt to renew the epistemological context in EE, which otherwise has been too narrowly associated with conventional science education (Gough, A., 2002).

The general thrust is to implicitly convey a relationship of submission to scientific authority and to suggest that research is still performed according to the same logic in which scientific knowledge is transcendent and a-contextual. As a result, the dominant, instrumental vision continues to go unchallenged. The resulting paradox is one in which school practices and EE research reinforce, more often than not, an instrumental relationship to nature, as well as a certain overappreciation of scientific expertise. However, it is this type of relationship to nature and to scientific expertise that a more critical variety of EE — an EE concerned with emancipation — should call into question. In the next section, I examine briefly how this sort of critical questioning regarding the nature of science can be operationalised in EE.

For a Socialised Representation of Science in EE

Several authors and researchers have taken an interest in a socialised conception of science in EE, including, for example, Dreyfus, Wals, and van Weelie (1999). They have problematised environmental issues in the form of sociotechnical controversies, as I

have elsewhere in connection with the question of global warming (Bader, 2003; 2001). These authors base their observations on propositions such as those of Fourez (1997), Bingle and Gaskell (1994), and Driver, Leach, Millar and Scott (1996) to highlight the sociality of science, particularly in the case of issues surrounding the protection of biodiversity. Other sources that may be usefully cited include the research of Camino and Calcagno (1995) who have proposed teaching strategies founded on a problematisation of science with a view to demystifying representations of science and making it more open to negotiation.

In a similar vein, articles located within the framework of a more critical variety of EE (Gough, N., 2004, 1999; Fien, 1993; Greenall Gough & Robottom, 1993) appear to be based on a determination to flatten out the social hierarchy of knowledge. For these authors, being critical means primarily developing a conception of reality as a contextual social construction, wherein science is in the service of democracy and the common good. This consideration has also been emphasised by Robottom and Hart (1993) who argue that: "becoming critical means developing an analytic posture towards arguments, procedure, and language using a lens related to issues of power and control in relationships, and developing an action-oriented commitment to common welfare" (p. 10). As has been mentioned by Fien (1993), being critical amounts to challenging what the dominant vision of the world prompts us to take for granted in a given cultural context. Thus, what is required is to problematise that which we hold to be "true" and to question, in both the classroom and in EE research, the way in which some educational practices implicitly reinforce a dominant way of viewing the world and, in particular, in the present case, a dominant manner of viewing science and its authority whenever it is a question of the environment. Thus, in my view, explicating received ideas about science, and with it their power to influence, constitutes a step toward social change and emancipation.

More specifically, given what has been said about the authority of science over questions of the environment, a first step toward re-establishing the emancipatory ambitions of EE would consist in triggering a reflexive grasping of the way certain actors in the school system conceive of the production of scientific knowledge and, more specifically, certain aspects of the social character of science[4]. Thus, this epistemological renewal would involve overhauling the conception of scientific knowledge present in the classroom so as to foster the integration of a socialised conception of science.

For a more explicit educational rhetoric regarding the social characteristics of research practices, Cunningham and Helm (1998) offer a useful proposition. These authors make reference to the way sociologists describe the manner in which researchers work in the laboratory (Latour & Woolgar, 1986) as a means to illustrate how value choices, negotiations between researchers, evaluations, and persuasion strategies between peers contribute to the progressive establishment of "scientific facts" accepted by a community of scientists. Their model also provides an illustration of the characteristics of scientific rhetoric and the manner in which these help to gradually rid recounts of any trace of the uncertainties and indeterminacies associated with the research undertaking. Little by little, references to the context in which data are produced fade away as if, in the end, the data came to speak for itself, without having to be interpreted by various spokespeople: "Once the scientific truth is known it is forgotten that non-experimental and 'non-scientific' negotiation tactics were necessary if closure was to be attained" (Collins, 1985, p. 152, cited by Cunningham & Helm, 1998, p. 485). Educational practices in EE could thus draw inspiration from this so that communities of students could function, to a certain degree, like those of researchers, including engaging in reflections on the values given priority by this community of young researchers. This approach to teaching science would provide a

basis for proposing a picture of the scientific process as being riddled with negotiations, tensions and critical arguments, not to mention value choices. It would also question the credibility of science when scientists pretend to formalise environmental issues in a realist and instrumental way.

In addition, the proposed epistemological renewal would also apply with respect to the research strategies to be favoured in EE. Accordingly, the fact of presenting my own writing as structured around explicit theoretical choices would comply with the requirement for reflexivity and explication of a certain contextual inscription from any "expert" position, as called for by Hart (2000). In this instance, it is a matter of presenting one's own researcher's discourse as a writing framed by theoretical and ethical choices so as to avoid reproducing the sort of scientific rhetoric that presents scientific knowledge in an "objectivist," disembodied manner and that fails to locate this knowledge in a particular context or to associate it with certain ethical considerations. Accordingly, certain anchor points of the socioconstructivist model of cognition I have chosen in my work are presented later, following authors such as Heinz von Foerster (Segal, 1990) and Maturana and Varela (1987).[5]

Knowledge in EE

EE research and EE-inspired practices in North America are generally recognised as having been initially dominated by behaviourist approaches (Gough, N., 1999; Greenall Gough, 1993; Hart & Nolan, 1999; Robottom & Hart, 1993). To illustrate this tendency one may refer to the great majority of articles published in the 1970s and the 1980s in *The Journal of Environmental Education*. According to the behaviourist model, the central objective is the search for variables that would appear to match up with this or that type of behaviour deemed relevant to saving the environment. In this view, the objective is to identify and control the individual variables that purportedly determine individual behaviours. According to this mechanistic conception of the operation of human beings, very little room is left for integrating the historical, social, and political context in which these behaviours emerge (Robottom & Hart, 1993, p. 41), and very little room is left for considering the subject as a social actor, capable of reflexivity and free to create his or her own history within society.

The model of cognition put forward here is based on a completely different conception of the knowing subject. One of the important concepts of this perspective is the self-organisation of the subject. Foerster (1992) holds that it is not the external world that determines our experience, but rather our experience, understood as the history of our sensory-motor interactions with the objects and beings around us and the interpretation we make of them, that orients our understanding of the world. As Maturana and Varela (1987, p. 23) also emphasise: "Doubtless [...] we are experiencing a world. But when we examine more closely how we get to know this world, we invariably find that we cannot separate our history of actions — biological and social — from how the world appears to us." This may be compared with the following statement: the subject "admittedly interacts with the environment, but he or she processes it according to his or her own conditions, thus contrasting radically with the operations performed by a vulgar machine — that is, a machine driven from without on the basis stimulus-response type relationships" (Bougnoux, 1993, p. 467).

The subject would thus remain free to stipulate his or her own criteria for operating distinctions and acting, and to construct, over time, his or her own representations of reality. A conception of cognition in action of this sort is completely at odds with the usual perspective, which radically separates the object of knowledge and the knowing subject as if they could be envisaged as two distinct entities, independent of each other. Here, any description of an "environment" is necessarily associated with a subject or

group that defines this "environment" according to its own conditions and projects, and that can be considered responsible for the proposed description.

While what has been said makes it possible to characterise, to a certain degree, the knowing subject, another interesting aspect of this way of conceiving cognition is the central function occupied by language. According to this model of cognition, through language, the subject names and reconstructs his or her experience of the world *necessarily* in relation with others. Philosophically speaking, there is no choice but to postulate the existence of an "Other," whom one recognises as identical to oneself and who shares one's own language. Without this "Other," everyone would remain alone, sealed off inside his or her normality that only exists for him - or herself, a sort of madness independent of any social convention. It is in interpersonal relationships, through language, that meaning is created and that reality takes shape. As Foerster (1992, p. 8) has said: "I think, therefore we are". Reality at this point becomes "intersubjectivity". Moreover, language is considered as the constant expression of ethical choices: "In its appearance, the language I speak is my language. It makes me aware of myself: this is the root of consciousness. In its function, my language reaches out for the other ... And this is where Ethics invisibly manifests itself through dialogue" (Foerster, 1992, p. 54). For those interested in the ethical choices conveyed by discourses, particularly scientific discourses, therein lies a genuine source of inspiration.

For the purposes of the present argument, let us maintain some of the components of this model of cognition. Reality is no longer something that exists outside the human being; in this scenario it takes shape through social linguistic practices. Thus, this manner of conceiving knowledge as constructing meaning in relation with the "Other" applies in the case of scientific knowledge. Consequently, scientific knowledge is considered as the product of a situated community whose standards and values can be studied, as can the discourse it produces (as in the manner proposed earlier, following Cunningham and Helm (1998)).

This position can be aligned with that of Gough, N. (1999), who emphasises the value of reconceptualising research and practices in science education and in EE as "postmodernist textual practices." Here, the main point of interest is subjects' "speech translated into action", in terms of what it can tell us about their ways of arguing about, constructing, and reconstructing the meaning of their experience. With respect to EE and EE research, by working according to the postulate of the recognition of the "Other," as previously mentioned, one is prompted to consider the histories that students bring with them as sources of insight into their manner of constructing their worldview. In the same way, environmental issues have to be addressed by bringing various legitimate, situated "language games" into dialogue with each other, without automatically according undue importance to those games that would appear to be imbued with a certain instrumental rationality.

As an outgrowth of the theoretical option just alluded to, I identified the arguments and counterarguments deployed by a group of 17-year-olds when interpreting the issue of global warming. This I accomplished in order to understand how they ascribed a certain authority to science and scientists in order to resolve this issue. Their empiricist, realist conception of scientific knowledge oriented their ways of interpreting this issue and helped reinforce their confidence in scientific expertise. But marginal positions were also expressed during the debate, which led to the authority of experts being tentatively challenged. Questions were raised about research practices. Some subjects refused to "believe" the experts' version without knowing how they went about determining whether the planet was warming up or not. One student, after discussing many arguments and counterarguments with one of her discussion

partners, who placed science on the same level as poetry as a way to interpret the world, acknowledged at conversation end that school does not teach young people to consider that there may be more than one legitimate way of interpreting reality (Bader, 2001). Instead, as she said, they are taught to believe, in a wholesale fashion, that is, without critical detachment, that scientific knowledge is the only true knowledge. However, if one follows the model of cognition described above and takes notice of the limits of instrumental, then there would be no cause for automatically imposing a scientific version of the world when thinking of the environment.

Conclusion

To sum up, since the early 1990s some authors have problematised the status quo representation of science in EE (Gough, N. 1999; Camino & Calcagno, 1995; Mayer, 1998-1999). The rationalist vision of the world leads to a certain overappreciation of science. This vision tends to reify environmental issues, thus masking their social and ethical dimensions. Clear indicators of an idealisation of science in the classroom have been reported (Aikenhead, 1997; Driver et al., 1996). These provide an array of arguments in favour of an epistemological renewal that would entail introducing considerations of epistemology and sociology of science into EE, while adopting a model of cognition that considers knowledge to be associated with situated subjects, who assume responsibility for the knowledge they promote.

Keywords: Instrumental relationship to nature, epistemology and sociology of science in Environmental Education, socioconstructivist model of cognition

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Endnotes

1. It is important to note from the start that "nature" refers to a social construct, since any given meaning that may be assigned to this notion derives from a specific context. The same proviso applies in any reference to "the environment."
2. A special thank you to Donald Kellough, who translated my article from the French.
3. That is, founded on a concern for social justice, challenging the power relations inherent in environmental issues and the dominant Western worldview, and aimed at bringing about social change (Robottom & Hart, 1993).
4. This is in essence what I have put forward in my research: by focusing on the "strong" ideas shaping students' conversations about science when 17-year-olds had to interpret a polemical discussion between two scientists, I have discerned what they consider to be receivable (or non-receivable) on the subject of science according to certain social norms that regulate their conversations. This research is elaborated in Bader, 2001 and Bader, 2003.
5. This section was developed in Bader (2001); only certain anchor points of this model of cognition are touched on here.