Defining and teaching environmental literacy

Lack of public understanding of the details of most environmental problems is often cited as cause of environmental deterioration, but it is a practical impossibility for citizens to be knowledgeable about all important scientific, economic, or political details (i.e. 'content') surrounding technically complex environmental science, technology and policy controversies. Good citizenship requires literacy about how the scientific and decision-making elements interact (i.e. 'context') – in short, familiarity with the social processes that accompany most environmental issues and some understanding of how the scientific method works. Politicians, journalists, business leaders and citizen-decision-makers should learn to ask the right questions of experts (not 'what to do?', for that is a value judgment about balancing costs and benefits or winners and losers)[1]. The three questions lay persons need to ask experts to be more literate in environmental policy debates are: (1) what can happen? (2) what are the odds? and (3) how do you know?

The notion of environmental literacy is, of course, not new. In fact, it is already present, for example, in the California Education Code (Section 8706). My concept of environmental literacy, however, is less oriented towards elaborating on the science content and much more directed toward illuminating the policy process as it deals with science and societal decision-making. Environmental literacy does not require the ability to evaluate the *technical merits* of opposing sides in conflicts, only the skill to evaluate the credibility of processes in which various scientific claims or sources of expertise are assessed. Such literacy does require the ability to discern what components of the debate deal with factual and theoretical issues and which are political value judgments. Just as a recreational gambler doesn't need a PhD in mathematical statistics to participate knowledgeably in most casino activities – only an appreciation of various consequences and their probabilities – a concerned citizen need not (and indeed cannot) understand all the technical details of an environmental policy debate. The citizen most needs competence in rating the credibility of the assessment process itself – the environmental literacy skill I believe is most lacking in our citizenry or its leadership. The short-cut to building such skill is to learn to ask repeatedly the three questions. Going through the detailed content of discipline after discipline is surely not the efficient path to public participation in complex technical debates.

Specific examples of actual environmental controversies at the interface of climate change and biodiversity protection are what I use to help students or citizens learn to differentiate: (a) issues of fact from those of value, (b) objective from subjective probabilities, (c) bottom-up (law-based) from top-down (empirical-statistical) forecast methods, (d) deterministic from stochastic from chaotic phenomena and systems, (e) large-scale from small-scale phenomena, (f) direct from indirect methods of validation and testing, (g) scientific methods from advocacy epistemologies, (h) theorems from paradigms, (i) responsible from irresponsible advocacy, (j) social equity from economic efficiency, (k) present from future valuation (i.e. economic and social discounting), (l) market from non-market valuation, (m) public from private rights, (n) legitimate simplification via metaphors from over-simplified, sound-bite explanations of complex issues, (o) careful science popularization from shallow or polemical treatments, (p) 'type 1' from 'type 2' errors (e.g. consequences of the forecast being wrong versus the consequences of the policy response being wrong), and (q) multidisciplinary from interdisciplinary activities. These issues are the core of my curriculum on environmental literacy aimed at making the too-often-baffling process of environmental assessment and decision making more transparent.

Part of environmental literacy [e.g. take point (q) above] is learning how assessment teams must integrate content (knowledge from in-depth studies within traditional disciplines) with context (interdisciplinary synthesis to address real world problem solving). I have long distinguished between multi- and interdisciplinary activities[2,3]. By 'multidisciplinary', I mean the assembly of material from many different disciplines, but with little integration across these disparate fields. By 'interdisciplinary' I mean the *combination* of knowledge, methods or paradigms from multiple disciplines that together help to explain some systems phenomena that cannot be understood by single disciplinary ways of knowing or help to solve a real problem. Interdisciplinary individuals or teams learn enough of the history, methods and paradigms of many fields to construct an original synthesis that would probably not emerge from the mere collection of multidisciplinary sub-components. Laying unintegrated multidisciplinary information on a table is not usually enough for environmental assessment; an active synthesis is required. It takes many years to develop such interdisciplinary synthetic skills, and quality environmental assessments require the active participation of both (1) front-rank specialists, to keep the content at the state-of-the-art, and (2) experienced integrators, people who have worked with the techniques of integrating multidisciplinary knowledge. I certainly do not anticipate that many experts, let alone lay citizens, will become such interdisciplinary experts. But anyone can be made aware of this interdisciplinary process and its connection to environmental assessment, which is critical to the evaluation of the credibility of assessments. Thus, any environmentally literate citizen (or expert who deals in an area where knowledge is needed from outside his/her expertise) needs to recognize these distinctions specified on my (a)–(q) list above.

In summary, environmental literacy is not simply being well versed in the knowledge and methods of related environmental disciplines, but includes having familiarity with the interdisciplinary integration process, the policy-making process, knowledge- versus advocacy-based assessments and the various gradations of uncertainty that necessarily accompany most environmental policy debates. If citizens or decision-makers feel so incapable of penetrating technically complex assessments that they don't participate, then they are, by proxy at least, turning their franchise to experts. Learning to ask what outcomes are possible, what (usually) subjective probabilities can be attached to each outcome, and what is the nature of the assessment process can reintroduce citizens as non-pejorative participants into the environmental policy arena so their values can get counted. That is my objective for an environmentally literate society, not the unattainable goal of teaching detailed knowledge of the content of all environmentally relevant disciplines.

Stephen H. Schneider

Dept of Biological Sciences, Stanford University, Stanford, CA 94305-5020, USA (shs@leland.stanford.edu)

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