

Constructivism in Environmental Education: Beyond Conceptual Change Theory

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Abstract

Constructivism, as a set of theories about how learners learn, has been an important discourse in the educational research literature for a number of years. Interestingly, it has been far more visible in science education research than in environmental education research. This article considers conceptual change theory within constructivism as a contested concept, outlines differing expressions of constructivism in science education and environmental education, and argues for approaches to environmental education that adopt socially constructivist perspectives with respect to the character of the subject matter content as well as to learners' apprehension of such content. In considering implications for research, this perspective is juxtaposed with a recent United States Education Act, which prescribes a far more objectivist approach to educational research and which serves as a reminder that research itself is a powerful factor in shaping how we construct the nature of subject matter, learning and the implications of these for teaching practice.

Introduction

Constructivism, as a set of theories about how learners learn, has been an important discourse in the educational research literature for a number of years. Many researchers have sought to explore explicitly the concept of constructivism and its implications for pedagogy, curriculum and professional development, or to adopt a constructivist framework in the analysis of educational situations. Historically, there has been a strong "conceptual change" perspective in science education research. However reviews of the environmental education research literature reveal a relative dearth of empirical research that overtly engages the issues of constructivism in the field of environmental education (see, for example, Robertson, 1994). This article considers conceptual change theory within constructivism as a contested concept, outlines differing expressions of constructivism in science education and environmental education, and argues for approaches to environmental education that adopt socially constructivist perspectives with respect to the character of subject matter content as well as to learners' apprehension of such content. In considering implications for research, this perspective is juxtaposed with a recent United States Education Act, which prescribes a far more objectivist approach to educational research.

The relative lack of an overtly constructivist perspective in environmental education is the more surprising given the particularly high profile it has achieved in science

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education, which historically has shared a close relationship with environmental education. A sense of the extensiveness of this literature on constructivism and science education can be gained from Tytler's (1997) review.

It would seem reasonable to expect a constructivist perspective to be even more highly visible in the field of environmental education than in science education. This is because one of the distinctive features of environmental education is its emphasis on the study of environmental issues. As I argue later in this article, an environmental issue is a human or social construct – it does not exist independently of human consciousness and it does not possess an independent ontological existence any more than do concepts like “democracy” or “human rights” or even “ecosystems” (see Kuhn, 1998). So a constructivist perspective that admits the socially constructed nature of both subject matter (in this case environmental issues) and the learning of subject matter in environmental education ought to at least be highly visible. But, as Robertson (1994) points out, this is not the case.

In his article entitled “Toward Constructivist Research in Environmental Education”, Robertson conducts a review of research on constructivism in science education and environmental education, and concludes that while there is clearly an established tradition of such research in the former field, much less has been conducted in environmental education. He claims, for example, that only three research papers published in the North American *Journal of Environmental Education* between 1989 and 1994 were styled in constructivist terms (he cites Brody, 1990/91; Brody & Koch, 1989/90; Lisowski & Disinger, 1992). The study of Wals (1992) was one of few explicitly constructivist studies published in the environmental education literature of the time. It is against the background of contestation about the epistemology and politics of research in environmental education (see Robottom & Hart, 1993) that Robertson “encourages the adoption of this [constructivist] epistemology in environmental education research” (Robertson, 1994, p. 29). And while there have been further articles that implicate the discourses of constructivism and environmental education, for example van Rensburg (1997), Robertson's contention that constructivism is an undertheorised concept in environmental education remains a credible claim.

Constructivism in Science Education: Conceptual Change Perspectives

Before proceeding to consider some of the resonances between environmental education and constructivism, I need to point out that the meaning of constructivism is contested. I will start by considering a sample of definitional and descriptive statements with a view to identifying some of the more commonly agreed ideas associated with constructivism, especially the conceptual change perspective.

this constructivist model can be summarised in a single statement: *Knowledge is constructed in the mind of the learner* (Bodner, 1986, p. 873);

knowledge is not an entity which can be simply transferred from those who have to those who don't... knowledge is something which each individual learner must construct for and by himself [sic]. This view of knowledge as an individual construction ... is usually referred to as constructivism (Lochhead, 1985);

knowledge cannot exist outside the bodies of cognizing beings. Learning is a process of making sense of experience in terms of prior knowledge. Of particular import is reflection on personal epistemologies, myths, customs, taboos, metaphors, and beliefs (Tobin, 1990);

learners construct their own meaning, using their own ideas, beliefs, experiences, etc., to interpret the messages conveyed by teachers (Gunstone, 1990);

constructivists subscribe to the idea of the individuality of personal constructs and deny a correspondence of the constructs to the notions of certainty and absolute truths (Cheung & Taylor, 1991)

students are now seen to come to science lessons with their own ideas about phenomena, meanings for words and explanations of why things behave the way they do. Learning, therefore, is not about filling students' empty heads or about student acquiring new ideas, but about students developing or changing their existing ideas. Learning is seen as conceptual change, the construction and acceptance of new ideas or the restructuring of existing ideas. This view of learning, called the "constructivist view of learning", recognises that students *construct* rather than *absorb* new ideas and that learners actively generate meaning from experience (Bell, 1993);

there are two sources of knowledge for the learner. One is the knowledge learners acquire from interaction with the environment, variously termed "gut", "naive", "intuitive" knowledge, or "children's science". It is influenced by language, by culture, the physical environment and by parents, peers and other people, and its primary characteristic is that it constitutes the person's reality, something the person believes in. The other source of knowledge is formal instruction, or school knowledge, which is someone else's interpretation of the world, someone else's reality. Its primary characteristic is authority (Bell, 1993).

In this view of constructivism, learning is not context free; it is embedded in a complex social, political and cultural milieu. Our own mental structures shape the way we perceive the world, and we build those structures through ongoing interactions with the world/context around us, both within and outwith formal instructional settings. In short, learning is shaped by the learner's biography and culture.

Having said this, what is curious about some research in constructivism in science education is that while the notion that learners actively construct knowledge and meaning in the course of their formal education is understood as central to the concept of constructivism, the notion that (science) subject matter is also socially constructed is less frequently acknowledged – at least not in terms as direct as those used by Beverley Bell:

- if a constructivist view of knowledge is adopted, our view of knowledge changes. Scientific knowledge is seen as something constructed by scientists and reconstructed by each learner (Bell, 1993);
- in teaching science, we have to consider the notions of both personally constructed and socially constructed knowledge. On the one hand, what the learners are doing during active learning may be seen as the personal construction of knowledge – each learner must construct the knowledge for him or herself, since the teacher cannot do it for him or her. On the other hand, the learner is constructing knowledge that is part of the socially constructed and consensually agreed knowledge of the community of scientists (Bell, 1993).

These comments suggest that knowledge (including subject matter encountered in the formal curriculum) is socially constructed, and further that the learning of such knowledge involves a personal construction of meaning – that is, that learners

personally construct their own meaning relating to knowledge that is *already* socially constructed. Also, it is clear that in both personal and social knowledge, context is a factor that needs to be taken into account. In the words of van Rensburg:

... a reduced re-interpretation of constructivist theory ... seldom provides more pedagogical insight than an imperative to do groupwork and encourage questions, as it tends to ignore the other implications of the recognition of the socially constructed nature of knowledge. One such implication is that environmental and scientific knowledge is socially constructed too! (van Rensburg, 1997)

An under-recognition of the socially constructed nature of scientific knowledge itself seems to be most evident in conceptual change research in constructivism in science education where there is a tendency to slide from a recognition that learners construct their own meaning in teaching/learning situations to an interpretation that such meaning constructions are in fact erroneous to the extent that they differ from those of the teacher or textbook -- that they are "misconceptions" that are simply wrong when judged against scientific explanations that are accepted as "correct". The retention of a "right"/"wrong" binary with respect to children's constructions of disciplinary science as content implies that such science is accorded an objective status.

In adopting a constructivist perspective in exploring how learners learn while at the same time preserving an objectivist (non-socially constructed) perspective with respect to the scientific knowledge constituting the subject matter of science curricula, conceptual change research itself constructs and addresses a pedagogical dilemma for science teachers – that of how to manage discrepancies between what teachers teach and what learners learn. For Tytler (1997):

these conceptions in many cases form useful prior knowledge that a teacher can build on. In some cases, however, students' "naive" conceptions can interfere with ideas we as teachers would want to develop ... students' "alternative conceptions" have proved surprisingly difficult to shift, and can offer a serious impediment to effective teaching (p. 1).

For some researchers adopting a conceptual change perspective in constructivism, the implication of this perceived dilemma for teaching is that it is the teachers' role to amend ("correct") these misconceptions, as suggested in Tytler:

There is ongoing debate concerning the nature and status of these conceptions; whether they are fledgling theories, coherent belief systems, mistakes of fact or judgment, or necessary precursors to more powerful scientific conceptions. There are many terms used by researchers in this area that reflect these different views, including misconceptions, alternative conceptions, intuitive ideas, interpretive frameworks, children's science, commonsense beliefs, etc ... It has been pointed out that particular researchers tend to favour particular terms because of the underlying flavour they give to the status of these ideas... The term "misconception" implies, for instance, that ideas students have are simply wrong, when judged against "correct" scientific conceptions. The implication of this is that we need to develop pedagogical strategies to circumvent their development, and to teach them out when they are discovered (Tytler 1997 p.2)

Quite clearly, if we accept that children come to our classes with views that are to some extent sensible and coherent, but at odds with the science viewpoint, then learning cannot be seen simply as some sort of conceptual implanting

process, but involves the change /replacement/alteration of conceptions. We are inevitably led to a view of children as active generators of knowledge, with the process of learning involving an interplay between students' existing ideas and the knowledge or experiences they are exposed to in the classroom (Tytler, 1997, p. 3).

This perspective on the implications of research on constructivism in science education may represent a distinction between that field and the field of environmental education – the perceived pedagogical dilemmas arising from such research might be quite different.

Constructivism and Environmental Education – Reconstructing the Pedagogical Dilemma

In environmental education, to respond to a recognition that learners construct their own meaning in ways that differ from those of teacher or text by attempting to change/alter/replace these constructions – to “teach them out” – seems questionable.

Environmental education curriculum often takes the form of investigations, by teachers and students, of contested proposals for local environmental change (see, for example, Greenall Gough & Robottom, 1993). Any issue (environmental or otherwise) is constituted of differing opinions held by humans. According to *The Macquarie Dictionary* of 1981, an issue is “a point in question or dispute, as between contending parties in an action at law”, and “a point or matter the decision of which is of special or public importance”. In these definitions, the “contending parties” who dispute the point and who imbue it with “special or public importance” are parties of human beings. Hence an environmental event (or proposal relating to such an event) only becomes an issue when it is in contention and when its resolution is judged by humans to be of importance. Further, the meaning and significance of an environmental issue – that which is perceived as being of special or public importance – will tend to vary in time and space. The meaning and significance of a given environmental issue will be judged to be lesser or greater at some times in history and in some locations than in others. An example is the issue of feral animals in Australia: the presence of rabbits and field mice in European settings is acceptable and rarely contested in the same way as it is in Australia. In Australia, non-indigenous (or “introduced”) animals existing in uncontrolled (“wild”) populations are constructed as “feral”, notwithstanding the age-old phenomenon of species dispersal. Some feral animals are further constructed as “pest” when their economic value is less than the value of the environmental damage they cause (which will of course differ from one geographical context to another). This linkage between the construction of an environmental issue and the vagaries of the market is a clear example of the socially constructed and contextual nature of environmental issues (Robottom & Andrew, 1996).

Being educative about environmental issues, then, depends on an exploration of different constructions of environmental issues – of an exploration of how different people (including students) construct such issues. That is, we need to recognise that not only will learners approach a teaching/learning situation with a range of differing prior life experiences that will shape differently their personal constructions of meaning, but also that it is proper from an educative point of view to acknowledge and support the articulation of these views, often in the forum of an open classroom debate. On this view, alternative constructions of environmental issues ought to be recognised and celebrated (as grist for the mill of classroom debate and critique), rather than seen as something to “be taught out”. The pedagogical dilemma constructed by research into constructivism in environmental education is different from the conceptual change

perspective in science education – rather than needing to “be taught out”, alternative conceptions should be at the centre of activity in an environmental education curriculum. Cheung and Taylor consider some of the pedagogical implications of this position:

Crossing the Rubicon from the diversified constructs of personal knowledge to the domain of socially justified and publicly mediated knowledge requires the development of methods of group dialogue that allow the achievement of group consensus, during which the teacher plays the role of both diagnostician and mediator between public and personal knowledge. The simplistic notion that knowledge is imparted or acquired has limited credibility (Cheung & Taylor, 1991, p. 36)

The move towards a constructivist pedagogy generates a new agenda for the continuing debate on the notion of a common curriculum for the common school. The important point to note is that the implemented curriculum, instead of the common intended one, has to take into account the diversity of alternative frameworks and the habits of mind. These should be the starting points of any negotiating process in the construction of meanings... The design of appropriate learning tasks has to take into account the starting points of the individuals concerned (Cheung & Taylor, 1991, p. 36).

This notion of starting points has important implications for both curriculum development and professional development in environmental education. If we accept the constructivist proposition that knowledge is both personally and socially constructed, and the environmental education principle that curriculum ought to entail the educative exploration of environmental issues in local contexts, then the conventional curriculum development and professional development processes of top-down research, development, dissemination conducted by “central” agents for adoption by teachers in “local” contexts is problematic. The role of research itself in reproducing a limited construction of constructivism needs also to be considered, especially in a field like environmental education.

Research, Constructivism and Environmental Education: Back to the Future?

A recent development in United States educational policy may serve to illuminate the relationship among research and constructivism in a field like environmental education. The Elementary and Secondary Education Act (ESEA) was signed into law by President George W Bush on January 8, 2002. This Act has led to a re-examination of some of the assumptions concerning the way in which educational research is to be understood. In a sense, the Act flies in the face of methodological debates and developments in the past 15 years or so that have served to legitimate a broad range of approaches to educational research. The Act focuses on the concept of “scientifically-based research” and establishes this concept as the benchmark of acceptable research in the field. This phrase, or variations of it, appear over one hundred times in the Act. The strong impression conveyed in this Act is that only research that is “scientifically-based” will count as research at all. Scientifically-based research is defined in the Act as follows:

... research that involves the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs; and includes research that

- (i) employs systematic, empirical methods that draw on observation or experiment;
- (ii) involves rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn;
- (iii) relies on measurements or observational methods that provide reliable and valid data across evaluators and observers, across multiple measurements and observations, and across studies by the same or different investigators;
- (iv) is evaluated using experimental or quasi-experimental designs in which individuals, entities, programs, or activities are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest, with a preference for random-assignment experiments, or other designs to the extent that those designs contain within-condition or across-condition controls;
- (v) ensures that experimental studies are presented in sufficient detail and clarity to allow for replication or, at a minimum, offer the opportunity to build systematically on their findings; and
- (vi) has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review. (Section 9101) <<http://www.ed.gov/policy/elsec/leg/esea02/index.html>>

If we accept the argument that environmental issues are socially constructed, and the corollary that environmental education ought to be seen as (socially) constructivist in both the nature of its subject matters and the nature of the apprehension of those subject matters, there emerge some clear questions concerning the adequacy of the perspective on research prescribed in the Education and Secondary Education Act.

Notions of “objective procedures”, “experimental design”, “general conclusions” and “replicability” are at odds epistemologically with ideas of socially constructed knowledge and constructivist theories of learning. If environmental issues are indeed socially constructed in ways that are a function of contextual, personal interests and cultural conditions, and if it is conceded that knowledge workers (be they school-based learners or practising scientists) actively construct knowledge and meaning in ways that are shaped by their own biographies, then the requirement that educational research should “provide reliable and valid data across evaluators and observers, across multiple measurements and observations, and across studies by the same or different investigators” is an unrealistic and undesirable goal for research in environmental education. Methodological interests in objectivity, generalisability, replicability and reliability will only serve to support a construction of the pedagogical dilemma of environmental education in the way it constructs that of science education – as a hunt for and remediation of learners’ “misconceptions” rather than a celebration of diversity and critique of the manifold perceptions making up environmental issues.

Conclusion

Constructivism as a set of theories about how learners learn focuses on how each of us constructs our own reality through a process of interpreting perceptual experiences of the external world in ways shaped by our own biographies. By concentrating, in its earlier “conceptual change” formulations at least, on learners’ “misconceptions” of scientific knowledge, research on constructivism in science education has implied the existence of an independent ontology of scientific subject matters. This seems to have

led to a conceptualisation of a pedagogical dilemma for science teachers that exists when learners' constructions of scientific subject matter differ from those favored by teacher or codified in text.

But in environmental education the situation seems to be qualitatively different from that in traditional science education. At least to the extent that environmental education is concerned with the educative exploration of environmental issues, the existence of an external reality of subject matter in environmental education is necessarily precluded as such issues are by definition unavoidably human/social constructs. Not only do learners personally construct their own meaning and understanding of subject matter, but that subject matter itself is recognised as socially constructed. On this view, the pedagogical dilemma seems to be different from that in science education: rather than searching for and eliminating "misconceptions", the approach is to celebrate alternative conceptions as grist for the mill of debate and critique, leading to sharper and more sophisticated understandings of the complex and contextual nature of environmental issues.

Keywords: Environmental education; science education; constructivism; conceptual change; research.

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