

COMMENTS AND CRITICISM

COMMENTS ON "THE ACQUISITION OF BIOLOGICAL KNOWLEDGE DURING CHILDHOOD: COGNITIVE CONFLICT OR TABULA RASA?"

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Dr. Lawson's (1988) exploration of children's naive conceptions of biology, in his article "The acquisition of biological knowledge during childhood: Cognitive conflict or tabula rasa?", raises a number of theoretical and methodological issues about conducting research into children's conceptions. In the following discussion, we will address problems with the assumptions, methods, and conceptualizations of Lawson's study.

First, we wish to show that one major assumption underlying the research design is not well founded. In introducing research into children's concepts, Lawson contends that the "implied teaching and research agenda is clear. Identify important topics in science instruction, identify students' alternative conceptual frameworks/misconceptions . . ." (p. 186). Here, Lawson assumes that identifying "important topics" is a precursor to exploring children's knowledge. By examining how he proceeds, we can see that this assumption weakens his case. Lawson selected 11 topics from a list of 15 found to be important in a study of biology teachers. These topics served as the focus for the clinical interviews with elementary children. Interestingly, four topics were thrown out for being too abstract, but we are not told why; for instance, is cellular respiration more abstract than cell theory or mitosis and meiosis to a six-, nine-, or ten-year-old? The notion of what is abstract is a primary concern. One of the first strategies human beings use in learning about phenomena is to classify or categorize information and objects (Bateson, 1979; Bruner, Goodnow & Austin, 1956; Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976). None of Lawson's topics or questions addresses categorization, even though this represents a suitable level of abstraction for children of the ages he studied. Furthermore, Lawson appears to have based his selection of topics on his contention that the biological sciences have a "more indirect relationship to common experience" (p. 187). This does not sit well with our understanding that

life-science phenomena (e.g., ants, birds, pets, insects, spiders, etc.) are just as likely to be experienced by children as physical science phenomena. Quite simply, Lawson has built his research argument quite aside from what children might see as important, interesting, and meaningful topics.

The second problem raised by Lawson in his agenda includes to “. . . design models of instruction and specific lessons to overthrow their misconceptions, and implant scientifically valid conceptions in their place” (p. 186). There are two difficulties here. First, empirical research is being advanced on a value premise that is essentially buried. Nowhere does Lawson argue why we should “overthrow” children’s alternative conceptions about science and “implant” scientific ideas. The second difficulty concerns the idea of implanting valid conceptions, because Lawson seems to have missed the significance of the child’s active participation in the changing and construction of conceptualizations. Most researchers would agree that one cannot *overthrow* a child’s alternative conceptions; nor can valid conceptions be *implanted in place of* the child’s alternative conceptions (Driver, 1987; Strike & Posner, 1985; Resnick, 1983). Although Lawson cites Posner, Strike, Hewson and Gertzog’s (1982) four criteria for conceptual change, he seems to miss the point that the child must decide to reject his own alternative conception. Once a child does this, however, the alternative conception does not disappear. The newly constructed conception could co-exist with the alternative conception or be combined in some way with the alternative conception.

Two other problems emerge in Lawson’s introduction. He claims that “to date . . . very little work has been done . . . in the biological sciences” (p. 186) in terms of research into children’s concepts. Although this may be a commonly held view, Wandersee, Mintzes, and Arnaudin (1987) did an extensive search of the literature and found 103 studies that focused on children’s concepts in the life sciences. Next, Lawson’s view that children are either “naive biological theorists” or “tabula rasas” is an artificial and misleading dichotomy. Gilbert, Osborne, and Fensham (1982), in their article on children’s science, have argued quite convincingly against the tabula rasa assumption. Again, if we return to a basic assumption of cognitive theory that children actively construct knowledge from their experiences (Resnick, 1983), Lawson’s dichotomy fails to recognize that the accumulation of knowledge is a continuous process from birth.

There are interesting difficulties in Lawson’s research method, as well. To begin with, Lawson argues that he has exchanged “reliability and generality” for “validity.” We find this exchange to be at odds with the tenets of both qualitative (naturalistic) and quantitative research. Basically, while not all research can be generalized, all should be reliable and valid. Although it is unlikely that Lawson can generalize from his study, he can take steps to maximize variability by selecting subjects that represent a broad range of variables and so open the door to the larger population. When Lawson selected three subjects for this study, that was acceptable. However, when all three children were selected from the same family in an attempt to avoid the “. . . confounding of results due to differing . . . environmental influences . . .” (p. 187), Lawson closed the door to the population. His selection process minimized variability, and thus distorted his results.

Next, Lawson’s expressed concern for (internal?) validity is not manifested in his research design. The basic research question is “do children hold naive theories about biology?” So issues of validity should be concerned with the extent to which the methods and the data contribute properly to answering that question. As noted above,

his design employs 11 predetermined topics. The narrowness of the view of each child not only reduces the scope of possible conceptions, but also curtails the scope of each child's knowledge. If the verbatim reports included in Lawson's article are the complete record of questions (there is no indication of it being otherwise), then there is certainly a problem with the adequacy of the questioning strategy employed. From our experience (in a current study of children's concepts about animals), children often indicate that they know nothing about a particular topic when initially asked. However, after continued conversation and questioning they frequently come forth with all sorts of information and concepts. A lack of probing, as well as a short and hasty interview, can lead to missing much of what a child knows.

Lawson's questioning strategy also employed challenges to a child's stated knowledge, and we doubt that such challenges can yield useful data. Consider the challenge of a child's statement about where food goes: "If I told you that food went to your brain would you believe me?" (p. 193). An affirmative response may well be evidence of a child's submission to perceived adult authority, as much as it is evidence of a child's understanding. A major difficulty of research into children's conceptions is obtaining valid information about the knowledge children have constructed in a personally meaningful way. Children quickly become adept at reiterating or subscribing to a teacher's answer, while maintaining what they "know to be the right explanation."

Possibly, Lawson's difficulties over exchanging generalizability and reliability for validity arise from an incomplete view of qualitative research. He uses the small sample size of his study to make the point that ". . . this study constitutes qualitative research" (p. 188). Qualitative research or, better yet, naturalistic research is not necessarily determined by sample size alone. It is naturalistic in the sense that it seeks to *describe* the characteristics of particular phenomena in the context in which it *naturally* occurs (Goetz & LeCompte, 1984). Creating a natural atmosphere for interviews is difficult without the added threat to validity posed by authoritarian overtones.

In addition to problems in Lawson's assumptions and methods, there are two conceptual problems in his argument. The first concerns his definition of "dogmatic declarative knowledge" (pp. 192 and 193) as nonexperiential just because it is read out of a book. This definition skims over the issue of the sort of experience that reading is and ignores the possibility of meaningful learning occurring from reading. Neither are we shown why information recalled from experience is in principle less dogmatic than information recalled from reading. "Dogmatism," unfortunately, is undefined, except that Lawson credits scientists with nondogmatic thinking. As Popper (1965) points out, dogmatism is an important and necessary aspect of scientific thinking. In a research and academic setting, a study by Bloom (1988) showed evidence that some evolutionary biologists demonstrated inflexible thinking (which could be considered a more mundane view of dogmatic thinking). Scientists do not seem to have the corner on open-mindedness, as much as we might like to think so. If we just consider the everyday connotation of dogmatism, any kind of knowledge gained from any source can be used "dogmatically."

The second conceptual point concerns Lawson's contention that children's ideas need to be well articulated in order to qualify as naive theories. The attempt to describe the conceptual structures or frameworks of children is an attempt to provide a static description of a dynamic process. In our current work, we find that children may say one thing at one point, and then ten minutes later, in the middle of another topic, they return to modify their original statements. Essentially, we are looking at an ongoing

process that does not stop when we start our investigations. As Resnick (1983) says, children are actively involved in the construction of knowledge.

Lawson's requirement that naive theories be well articulated is counter to the possibility that much of the information children gather and process into their conceptual frameworks may not be verbal in nature or easily verbalized. Children can incorporate extensive images into their construction of knowledge (Paivio, 1979). Furthermore, many children (and adults) have difficulty verbalizing their ideas. Given this variety in the nature of information in memory and the variation in abilities to verbalize knowledge, alone with the brevity of the interviews, Lawson has insufficient grounds for pointing to the lack of naive theories.

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