

**Methodological Perspectives in Assessing and Extending
the Scope of Children's Contexts of Meaning: Context
Maps and Drawing Tasks**

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In an earlier study (Bloom, 1990), semi-structured, informal interviews were used to examine young children's understanding of biological phenomena. Analysis of the results led to the formulation of a theoretical framework referred to as contexts of meaning. This framework includes a variety of components that contribute to a child's construction of knowledge and meaning. In the present study, two methods are evaluated on their effectiveness in eliciting relevant data on the various components of children's contexts of meaning.

Rationale

When discussing "meaning," from either a psychological or an epistemological point of view, a major assumption is that meaning is semantic in nature (Bloom, 1990). In psychology, according to Macnamara (1982), meaning and concept are rarely distinguished. When Finley and Stewart (1982) discuss learning the knowledge of a particular discipline, they suggest (a) that meaning is attached to concepts and to the relationships between concepts and (b) that the intent is for students to "...learn selected networks of meaning" (p. 595). Consider the following supposition. If information about a certain topic is related or linked together according to logical principles and if that information is understood, then it is meaningful to the people who understand it. For example, if we were to examine an exclusive definition for amphibian, we might encounter the following: (a) amphibians are vertebrate animals (which would be linked to characteristics of both vertebrates and animals), (b) amphibians lay eggs underwater, (c) amphibians have a three chambered heart, (d) amphibians have moist skin, (e) and so forth. If someone were to understand these and associated propositions, then "amphibian" would have meaning for that individual. However, is such a notion of meaning a complete representation of what actually constitutes meaningful understanding to children? Is there more to personal meaning than sets of related propositions?

The assumption that the nature of meaning is semantic guides the way we design our research and the way we analyze and interpret our data. If we look at the methodological approaches used to explore cognitive structure and meaningful learning, few approaches have considered aspects of cognition other than semantic knowledge. The methodological strategies and approaches that have been employed include (a) informal and semi-structured interviews (Erickson, 1979); (b) a variety of structured and clinical interviews (Nussbaum & Novak, 1976; Albert, 1978; Erickson, 1979; Nussbaum, 1979; Pines, 1979; Rodrigues, 1980; Klein, 1982; Posner & Gertzog, 1982; Sneider & Pulos, 1983; Carey, 1985; Gilbert, Watts, & Osborne, 1985); (c) concept mapping tasks (Novak, Gowin, & Johansen, 1983; Novak & Gowin, 1984; Fraser & Edwards, 1987; Hoz, Tomer, Bowman, & Chayoth, 1987); (d) word association tasks (Battig & Montague, 1969; Shavelson, 1972; Preece, 1976; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Gussarsky & Gorodetsky, 1988); (e) sorting tasks (Chi, Feltovich, & Glaser, 1981; Dickinson, 1987); (f) tree construction tasks (Stewart, 1979; 1980); (g) a variety of tests (Novick & Nussbaum, 1981; Head & Sutton, 1985; Amir, Frankl, & Tamir, 1987); (h) a variety of content-specific and process-specific tasks (Gunstone & White, 1981; Finley, 1985; Stavy, 1987); and (i) a variety of more experimental procedures designed to probe into the specific structures and processes of memory (Rogan, 1988). Such strategies focus upon semantic knowledge. The results of

these studies have been important in furthering our knowledge of children's conceptual understanding, however the results fall short in providing a more complete view of children's understanding.

A recent study has described a number of semantic and non-semantic characteristics of meaning associated with young children's understanding of certain biological phenomena (Bloom, 1992). Such characteristics are involved in the personal construction of meaning and are referred to, as a whole, under the framework of "contexts of meaning." Contexts of meaning can be thought of as dynamic and ever-changing associations of multiple perspectives or multiple understandings. Even with the risk of creating a static framework, it is necessary to formulate a descriptive typology as a working model (model implies consistent processes and a static structure, but such a view is not necessarily the case with contexts of meaning). The typology includes (a) knowledge, semantic and episodic; (b) mental processes; (c) belief or interpretive frameworks; and (d) emotions—values—aesthetics. The contention is that children construct meaning with more than semantic knowledge alone. Personal experiences (or episodic knowledge) are commonly incorporated as significant components in contexts of meaning. The process of constructing meaning is often dynamic, involving inferring, generating metaphors and analogies, and so forth. Ideas change; new inferences are made; the content and character of contexts of meaning develop and change from moment to moment. In addition, anthropocentric, anthropomorphic, zoomorphic, and other interpretive frameworks, as well as emotions—values—aesthetics, come together to help form deeply entrenched personal meanings and to influence and guide associative and inferential processes.

Many of the existing methods for investigating children's understanding of science concepts provide very useful information on the semantic aspects of understanding. However, if the personal construction of meaning involves more than semantic knowledge, then different methods of collecting and analyzing data need to be examined. The two methods employed in the present study provide some data on semantic relations. However, the present paper explores utility such methods in extending the range of relevant information, including (a) episodic knowledge, (b) mental processes (metaphors and analogies), (c) interpretive frameworks, (d) emotions—values—aesthetics, and (e) general features of the nature of contexts of meaning.

Method

Twenty-four fifth grade students were selected to participate in the present study. The students came from predominantly middle class neighborhoods in a small city in eastern Ontario. Thirteen of the students were girls and eleven were boys. All 24 students (with one exception due to an absence) participated in a variety of data collection tasks. The present paper focuses on two types of tasks: (a) two sets of context maps and (b) a set of drawing tasks. All of the students have been assigned pseudonyms beginning with the letter "E", which responds to the grade level (fifth letter of the alphabet for fifth grade).

The methodological techniques discussed in the present paper were two of seven used over a period of four months (March through June). The first task the students completed was a context map on "issues facing the world." Prior to beginning this task, the class as a group worked through an example context map on "school." Two weeks later, the

drawing tasks were introduced. Three weeks after the drawing tasks, the second context map on "forests" was completed. Each activity lasted for 30 to 40 minutes, which allowed enough time for all of the children to work at their own pace.

Context maps are constructed by connecting various descriptions and examples to a stimulus word or phrase (topic), which is located at the center of the page. The subjects then connect any relationships they see between these descriptions or perspectives by lines and label them appropriately. The resulting map has the perspectives arranged in a circular fashion around the topic word with labeled relations occurring between the items. In general, context maps impose minimal structure on students. Any organization of the information included in the maps is of the students' own making.

The drawing tasks involved having students respond to instructions to draw a picture (a) that links "human being" with "house fly," (b) of a walk on the beach, (c) of the beginning of life on Earth, (d) of a scientist, (e) of a walk in the forest, and (f) of death. After completing all of the drawings, the students were given another booklet in which they were to explain each of their drawings. A similar procedure has been used to investigate children's images of scientists, in which specific elements of drawings were used to develop an idea of children's images of scientists (Chambers, 1983). In contrast, the present paper uses drawing tasks to explore their utility in eliciting data of a non-semantic nature.

Results

The difficulty in discussing the data in the present paper lies in the perspective being taken. This paper does not use the data to establish or embellish the theoretical framework of contexts of meaning. Rather the data are used to evaluate the effectiveness of two methodological techniques in eliciting data relevant to contexts of meaning. The reader may find the original article on this topic, "Contexts of meaning: Children's understanding of biological phenomena" (Bloom, 1992), useful in providing a more detailed description of the framework.

The results of the context maps will be presented first followed by the results of the drawing tasks. In each section, the discussion of the methodology will follow the pattern of the contexts of meaning typology, starting with knowledge, then going on to mental processes, interpretative frameworks, and emotions—values—aesthetics.

Context Maps

As discussed previously, context maps impose minimal organization and structure. Any organizational scheme evident in the context maps is a function of the student. As it turns out, most maps show very little organizational structure. One exception is Emily's context map of issues facing the world (see Figure 1). Visual inspection of her map shows no apparent organization. However, during a follow-up interview she explains that,

...the issues were broken into several levels. At the first level *symptoms* of problems, words like "problem," "event." At the second level are words pertaining to *consequences of actions*, words like "election" and "drinking and driving." The third level is *issues, current events*. (emphasis added)

The clustering and frequency of items on context maps reveal some of the more common exemplars in much the same way as word association tasks. For example (see Table 1), over 60% of the items in the forest context maps are descriptive of the environment. Such descriptions frequently involve examples of the kinds of natural things one might find in a forest. Almost 11% of the responses relate to recreational human uses. Over 7% include conservation issues, such as acid rain, pollution, poachers, fires, and overpopulation. Over 5% of the items involve more complex conceptual descriptions, such as food chains, hibernation, habitat, and predators. Over 4% involve items related to industrial, economic, and forest product features, such as wood, lumber mills, and paper. The categories themselves reveal a range of typicalities. For instance, environment features are more typical of the responses than are industrial, economic, and forest product features. Ranges of typicality also occur among subcategories and among the specific items. For example, under environment animal, plant, and physical feature exemplars are more typical than climatic and seasonal features or more general descriptions. Within the animal subcategory the two most typical components are "animal," mentioned 19 times (out of 24 students), and "bird," mentioned 12 times. The least typical exemplars include specific animals, such as grasshopper, squirrels, snakes, and wolves, each of which is only mentioned once.

The nature of the ideas or components of the map can be viewed globally as a cognitive context or more specifically as individual items in the typology. In Figure 2, two context maps of forests can be compared contextually. Eugenie's map is very simple with only four items, all of which are environmental features. Elise's more complex map with 18 items contains environmental features, as well as recreational and human features, biological concept features, and environmental conservation issues. In Eugenie's map there are no links, while in Elise's there are 12 links. The overall view of the maps shows an obvious difference in complexity. While the items in Eugenie's maps are concrete descriptions, Elise's items contain a more abstract biological concept, such as food chains, and several conservation issues, such as extinction, oil, and garbage.

Table 1. Categories of items on forest context maps and their frequencies of occurrence.

Item	Subcategory	Total		Category	
		#	%	#	%
Environmental Features				231	62.6%
	Kinds of plants	67	18.2%		
	Animals	52	14.1%		
	Physical features	46	12.5%		
	Parts of plants	34	9.2%		
	Climatic features	13	3.5%		
	Seasonal features	10	2.7%		
	General descriptions	9	2.4%		
Recreational and Human Use Features				40	10.8%
Environmental Conservation Issues				27	7.3%
Emotional and Sensory/Aesthetic Aspects				27	7.3%
Biological Concept Features				20	5.4%
Industrial, Economic, and Forest Product Features				16	4.3%
Other			6	1.6%	
Effects on Humans				2	0.5%
TOTAL				369	99.8%

Table 2. Summary of the number of items, links, and labels on the forest and issues context maps (N = 23).

Context Maps:		Forest		Issues	
Items	Mean	16.3	12.5		
	Median	15		11	
	Range _i	27	(4 to 30)	27	(3 to 29)
	Mode	13, 15		9	
Links	Mean	5.3	2.5		
	Median	3		0.5	
	Range _i	22	(0 to 21)	12	(0 to 11)
	Mode	6, 10, 12		0	
Labeled Links	Mean	1.4	0.7		
	Median	0		0	
	Range _i	12	(0 to 11)	7	(0 to 6)
	Mode	0		0	

Number of individuals' responding with items, links, and labels.

	ITEMS		LINKS		LABELS	
	Forest	Issues	Forest	Issues	Forest	Issues
N	23	24	13	12	5	6
%N	100%	100%	57%	50%	22%*	25%*
* Of those who included links:			38% labeled them on the forest maps			
			50% labeled them on the issues maps			

Relational knowledge does not always appear as links. For example, several items with elaborated relations appear in Elise's context map of issues (each item is also accompanied by an illustration): (a) "oils spills kill birds;" (b) "pollution (picture of factory with smoke stack) → air turns to rain → acid rain goes to lakes → fishes die;" and (c) ash from garbage, shipped to the ocean and spills." The relations that occur as labeled links or within items provide an important perspective on the complexity and substance of children's meaning.

Table 3. Examples of relations evident among the labeled links on the forest context maps.

Relation	Link	Label
Causal	acid rain--trees	"trees get killed by acid rain"
	damp to mud	"after rain"
Spatial	animals--trees	animals "live in" trees
	flowers--grass	flowers "grow in" grass
Temporal	seasons--weather	"different weather for seasons"
	seasons--birds	"birds come in different seasons"
Requisite	people--food	"people have to have food"
	trees--sun	"trees have to have sun"
Classificatory	animals--grasshopper	"they are both animals"
	vines--greens	"are plants"
Attributional	leaves--moss	"both soft"
	wood--rocks	"they are both hard"

At this point in the development of this data collection technique, the lack of links or other relational evidence does not mean that children do not understand any relations.

Rather, it may be that by the time they get around to adding links, they are tired of the task and just do not bother constructing the links. Others may find the task of labeling links overwhelming. There are just too many possibilities. For instance, at the end of the forest context map session, Sean drew a circle around his map and said, "they're all connected." The overwhelming amount of information available may make the context mapping tasks more difficult for some children. It is interesting to note that on his first attempt at context mapping (issues), Sean listed three items and quit. He looked completely frustrated by the task. However, on the forest map he listed 30 items. After doing several doing tasks following the first task (issues context map), Sean may have felt more relaxed and confident with the research project when the forest context maps were presented.

The final aspect of semantic knowledge concerns alternative and weak conceptions. Although such conceptions may not be very elaborate on the context map itself, certain items point to areas in need of further exploration in follow-up interviews. For example, Ethan included monkeys and quicksand in his forest context map. When asked about where such things can be found, he said that they are found in any type of forest. Other examples that point to alternative or weak conceptions from the forest context maps are evident in the labeled relations between the items: (a) "both [leaves and flowers] *attached to bark*," (b) "animals *become* extinct," and (c) "animals *have* food chains" (emphasis added). Unlabeled relations are more difficult to recognize as pointers to vague or alternative conceptions, however a couple examples from the forest maps are, (a) slugs to insects and (b) forest fires to pollution.

The existence of the typological category of mental processes can only be inferred from the information contained in the maps. Some links appear to reflect the products of mental processes, such as inferring and comparing. Such processes may have been used to generate the relational links. However, the products of these processes may have been generated previously and incorporated into semantic knowledge.

Belief frameworks are not explicitly obvious in the context maps. Such frameworks appear to be alluded to in the students' choices of what to include in their context maps. For instance, items that concern human needs and desires, such as recreational and industrial uses of forests, may be connected with an anthropocentric framework. However, if the alternative notion of this typological component—"interpretive frameworks"—is used, other aspects of the children's context maps may be worth considering. For example, two rather different issues context maps were created: (a) Elizabeth's focused on "musicals" and (b) Evelyn's focused on "summer." Both of these maps seem completely out of place. When both children were asked about their maps, they responded in similar ways: (a) Elizabeth said that everything was related to musicals because she "loves acting" and (b) Evelyn said that she liked "it when the weather is warm." When asked again about issues, Elizabeth mentioned rain forests and acid rain and Evelyn specified only pollution. The issues other students listed were not as important to these two girls as were their own personal areas of interest and enjoyment. What Elizabeth interpreted as issues involved singing, speaking, scripts, applause, and so forth. Evelyn's issues centered around wearing flip-flops and shorts, swimming, and so forth.

Evidence for —values— aesthetics (EVAs) is found within the context maps of certain individuals. Ella's forest context map contains a number of EVAs, such as "dangerous," "scary," "nothing," "no stores," "dark," and "no one (alone)". These six items are among a total of thirteen. In addition, "no stores" and "no garbage cans" could fit into what appears

to be a very unpleasant view of forests. "Wolves," although not linked to any other item, appears just below scary and dangerous on her map. In a follow-up interview, Ella told of growing up in southern Africa and that in the jungles,

there are these people who like to wear masks and come through the grass and scare you....Like they chase you. I don't know why they do that.... Sometimes they'll catch you and take you....they'll kill you sometimes and steal all your things and run away....

She went on to describe a friend in Africa who tried to scare her with a mask. Her emotional view of forests appears to be based in some frightening experiences earlier in her childhood. In her issues context map, Ella includes "exhausted," "sad," and "worrying" along with three conservation issue items. "Exhausted" and "sad" are linked with no label. In her case, a consistent pattern of EVAs appears to influence her thinking.

Emily's forest context map contains a different assortment of EVAs. Out of 20 items, the following items appear to be connected with EVAs: (a) five items are colors ("green, brown, golden, orange, red"), (b) "clean air," "quiet," and (c) "peaceful." In addition, three other items include elaborated descriptions of potential perceptions: (a) "tree roots sticking out of the ground," (b) "animal tracks by a pine tree in the snow," and (c) "owl's call." Each of these items appears to have a more poetic slant, especially when seen in conjunction with the other EVA-related items. Here, again, 50% of the items are related to emotions—values—aesthetics. In contrast with Ella, Emily's view is inviting. Other children's maps contained items or labels making value judgments, such as Erica's labeling of the link between "drugs" and "drinking and driving" as "both not good." The point is that the thinking about and the meaning associated with the context map topics is influenced by very personal emotions—values—aesthetics.

A majority of the information included in context maps is semantic knowledge. Depending upon the child, a certain proportion of this information may be rooted in personal experience or episodic knowledge. In either case, the information varies in its complexity, elaboration, organization, and so forth. In general, context maps tend to be more superficial than concept maps. However, the advantage of context maps appears to be in their (a) generality, (b) allowance for freedom of expression, and (c) inclusion of a wider variety of information. Although context maps may lack detailed information on specific concepts, they can serve as a basis for follow-up interviews, which allows the researcher to probe into more depth.

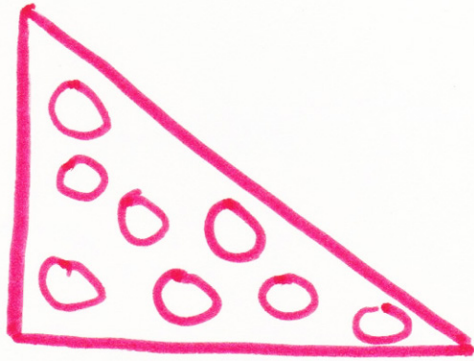
Drawing Tasks

The idea behind using drawing tasks is to de-emphasize the reliance upon semantic knowledge (i.e., written expression). The drawings show a wide range of typological components. As an example, Table 4 delineates the variety of expressions evident in the children's drawings of a walk on the beach. Approximately 40% of the discernable information appears to be something other than semantic knowledge. A greater percentage of what is listed as semantic knowledge may in fact be tied in closely to episodic or experiential knowledge. From the data given, it is impossible to tell whether what appears in the drawings has a basis in an image of a particular experience or experiences.

Table 4. A contexts of meaning typological delineation of children's drawings of 'a walk on the beach.' (N = 24)

Typological Component	Example	Number of Children
Semantic Knowledge	1. sand	24
	2. water, unspecified	13
	3. sun	10
	4. clouds	6
	5. wildlife (includes #8, below)	3
	6. lake	2
	7. ocean (includes #8, below)	2
	8. "Pacific Ocean" with "octopus, fish..., crab, and shell" washed up	1
Episodic Knowledge	1. specific friend at a specific beach	1
Mental Processes	1. visual metaphor: "footsteps in the sand"	1
Interpretive Frameworks	1. anthropocentrism (possible pointers to): - sidewalks on the beach	2
	- people lying under beach umbrellas	1
	- "boy...drinking a coke"	1
Emotion, Values, and Aesthetics	1. smiling people	13
	2. "This is the life!" and "Ah what a life"	2
	3. "...about to go for a swim on a hot day"	1
	4. "a big red sun in the background...person with bare feet walking in the cool sand"	1

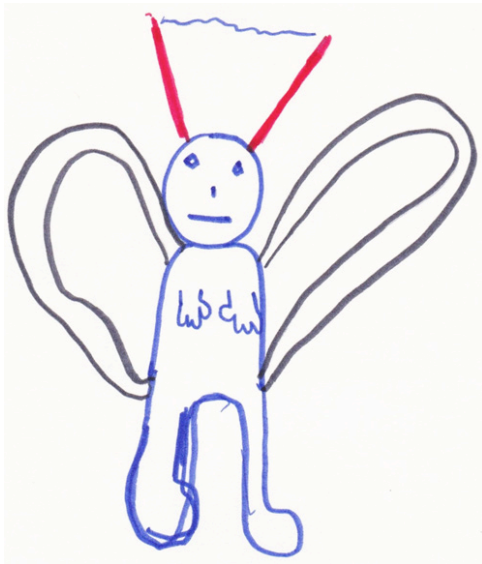
The significant semantic knowledge components of the drawings tend to be general in nature. For example, in the "beginning of life on Earth" drawings, 13 students depict an evolutionary view. Several students drew an oceanic mush, while others drew dinosaurs or global views of the Earth. Specific information about their knowledge of evolution is not available from the drawings. The particular items the students included may not be good indicators of what they know. If they included dinosaurs, does that mean they think dinosaurs were the first living things? Follow-up interviews would help to clarify their specific conceptual knowledge. In the same task other students decided to include mothers with babies and baby carriages. Such responses have more to do with how the students interpreted the question than with their semantic knowledge. On the other hand, the two students who drew pictures of Adam and Eve may have a different conception of the beginning of life on Earth.



Eileen's *Human Being and House Fly*
"I drew a piece of cheese"



Earl's *Walk on the Beach*
"Foot steps on the sand"



Elvin's *Human Being and House Fly*
"A person that is half fly and half person"



Evan's *Walk in the Forest*
"I drew a guy looking at a tree."

Figure 3. Examples of visual metaphors that appear in the drawing tasks.

Explicit evidence for episodic knowledge is rare in the drawings. The instance in Table 4 (specific friend at a specific beach) is a good example of the influence of personal experiences. However, as mentioned previously, it is difficult to tell whether the individual inclusions in drawings have a basis in personal experience. Is personal experience the source of the specific information in the drawing of the beach that includes the Pacific Ocean along with a variety of animals washed up on the sand? The same type of question could be asked of other drawings.

The product of mental processes are evident in a number of drawings. Visual metaphors, such as those in Figure 3, are fairly common. Evan's "walk in a forest" drawings depicts trees in the form of arms and faces. Elvin's fly-human drawing depicts a being that is part fly and part human. Eileen's fly-human drawing is of a piece of cheese. Earl's drawing of a "walk on the beach" portrays footsteps in the sand. Each of these visual metaphors is a part of the meaning held by the individual child.

Table 5. Examples of details in drawings that point to belief or interpretive frameworks.

Details in Drawings	Possible Framework
Forest drawings: paths or sidewalks	anthropocentric
Beach drawings: paths or sidewalks	anthropocentric
Human being/house fly drawings: fly swatters	anthropocentric
Beginning of life on Earth drawings: Adam and Eve	Biblical
oceans with organisms	evolutionary
Scientist drawings: mad or weird scientists	pseudoscience
productive scientists	positivist
Death drawings: crosses, priests, angels	Biblical
gun and knife killings	violence
ghosts and skeletons	mystical
skeleton of "grandpa...in 10 years"	personal

Belief or interpretive frameworks in the children's drawings are not always explicit. In fact, data from the drawings themselves need to be supported by data from other sources. As with the context maps, some aspects of the drawings act as pointers to potential frameworks (see Table 5 for examples), which can be explored in more depth with follow-up interviews.

Emotions—values—aesthetics are evident in the drawings. For example, irritation and aggression are portrayed in 10 of the students' drawings of the connection between humans and house flies. Although this aspect of the drawings is considered to be a pointer to an anthropocentric framework (see Table 5), it is also an emotional and valuative perspective of flies. Such a perspective certainly influences the meaning of "flies" that is held by the children.

Other examples of EVAs are apparent in some of the other drawing tasks. Twelve of the pictures of "death" depict people frowning or crying. On the other hand, the beach and forest drawings show 13 and 11 people, respectively, smiling. The forest and beach drawings also contained items associated with EVAs: (a) in Elaine's forest drawing, "...walking along an enjoyable background in the summer's breeze;" (b) in Elizabeth's beach drawing, a mother and daughter are saying, "This is the life!"; (c) in Elise's beach drawing, a woman is saying, "Ah what a life," and (d) in Elaine's beach drawing she describes, "...a big red sun in...background and a person with bare feet walking...in the cool sand." It appears that each of these items can be interpreted as a combination of aesthetics and emotions. Each drawing and statement portrays the setting as pleasing, sensorially or aesthetically.

Discussion

In the original study (Bloom, 1992), the notion of contexts of meaning was uncovered quite accidentally. The intent was to look at children's questions about earthworms and then to look at their conceptions of the answers. Although some questions did arise, the

children became actively involved in talking about their observations, personal experiences, and knowledge of earthworms. As the transcripts were being analyzed, the children's use of more than just semantic knowledge became strikingly apparent. Interpretive frameworks, metaphors, emotions—values—aesthetics were evident in each child's conversation.

The free exploration in such informal interviews allows children to be themselves. Although the presence of the researcher certainly influences what children do and talk about, interviews of this sort provide a view that more closely approximates natural cognition. Metaphors evident in conversations are not forced; emotional reactions are not artificially stimulated. What arises in the children's conversations does so naturally. As an aside, similar earthworm interviews were conducted with nine of the fifth grade students who participated in the present study. The results of these interviews support, and were surprisingly similar to, the findings of the original study with first, second, and third grade students.

By comparison, the two data collection strategies used in the present study impose some limits on the way children express themselves. Context maps are written tasks and the drawings are primarily visual tasks. Within these constraints, however, both tasks place very little restriction on what is included and how it is represented and organized. The results of these tasks do depict each child's personal construction. Nevertheless extensive claims made on the basis of either strategy are best made in conjunction with one or more other data source. As mentioned in the results section, follow-up interviews based on items in context maps and drawings are very useful.

Context maps tend to show general patterns of cognition within a specific topic. For the most part, specific conceptual details are not evident in context maps. However, general featural and concept descriptors are included. When included, links between items explicitly or implicitly depict relations between features and concepts.

At this point, I am hesitant to assert that the differences between context maps are due necessarily to individual differences in cognitive ability, knowledge, or other aspects of cognition. Some individuals include a variety of emotional and aesthetic items, while others do not. A few maps contain predominantly concrete descriptive features, whereas others delineate more abstract concepts. Some students list large numbers of items and others include only a few. Several maps contain explicitly linked relations and many other maps contain no links at all. Can such differences be attributed to individual characteristics? Obviously, some of the variation is due to individual differences, but to what extent are such differences an artifact of the task? Does Eugenie, who listed only four concrete features of forests on her forest context map, have a very limited knowledge of forests? Or was she tired of doing or turned off by context maps? Is writing viewed as a difficult chore? Claims about the extent of knowledge and the extent of personal contexts of meaning cannot be made without more data. Items that are included in context maps do exist, but the question is one of what is not included. The usefulness of context maps, therefore, lies in their delineation of general patterns which can act as pointers to aspects that can be explored in more detail through interviews or other data collection strategies.

In contrast to context maps, drawing tasks allow a wider latitude in the way children can express themselves. On numerous occasions, following the introduction of these tasks, the children asked if they could do more drawings. However, when the children were told to write comments about their drawings, they asked if they had to spell everything

correctly. Their hesitation about writing can limit the freedom and extent of their expressiveness. On the other hand, drawings allow children to express their ideas much more freely.

As might be expected, the usefulness of drawings in delineating semantic knowledge is limited. Items included in drawings which can be considered semantic knowledge tend to be concrete featural descriptions. The particular strengths of using drawings lies in their depictions of metaphors, potential interpretive frameworks, and emotions—values—aesthetics. Making claims about children's contexts of meaning based on evidence of these components in drawings is limited. For instance, Ella's drawing of a walk in a forest is rather ordinary and seemingly pleasant. On the other hand, her forest context map contained numerous emotional or emotionally-related items and her follow-up interview indicated her personal experiences of being frightened by people in a particular jungle in Africa. Using the drawings as tools to guide interviews, once again is useful approach.

With both tasks, the tendency is to view the information contained within them as static. From the perspective of contexts of meaning, any information from interviews, drawings, context maps, and so forth is seen as undergoing constant change. Such information is not static. Another tendency of researchers is to view the contents as a complete description of an individual's perspective or understanding. Again, from the point of view of contexts of meaning, a particular individual can hold numerous and even conflicting perspectives or understandings. So, when we look at children's context maps and drawings, what we see is a component of their personal contexts of meaning, but it may not be a complete picture.

In contrast to informal task-based interviews, context maps and drawing tasks, most previous and current research in children's conceptions overlooks significant aspects of meaning. The underlying assumption that meaning is semantic focuses attention on semantic knowledge components. Concept maps, as described by Novak and Gowin (1984), focus on semantic knowledge: "concept maps are intended to represent meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels linked by words in a semantic unit" (p. 15, emphasis is that of the authors). Sorting tasks, word association, and tests similarly limit and focus the content on semantic knowledge.

Much of the research on children's conceptions in science has missed important facets of the construction of meaning. The utility of alternative methodological strategies in eliciting rich and elaborate data on various aspects of children's contexts of meaning is an important step in widening the scope of our understanding of how children construct highly personal contexts of meaning.

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