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ABSTRACT

An ethnographic study was conducted with the goal of comparing the botanical knowledge of nine sixth grade students with the botanical concepts developed in the elementary textbook series, Science, by Silver Burdett, 1985. The extent to which the child's conceptual framework resembles that of the scientist and the extent to which the textbook reflects the knowledge base and abilities of the child were determined. Each child's language, meanings, classifications, and interpretations of botanical phenomena were examined. The children participated in a series of six interviews and tasks. The children's names for plants and plant classification schemes were examined using domain analysis, componential analysis, and taxonomic analysis. Concept maps were made from both the children's botanical concepts and those found in the textbook. The concept maps were used to examine the development of each concept. The data revealed that the children have a large body of knowledge about plants and that children's botanical language and meanings appeared to be learned from the lay culture rather than from the textbooks. (28 references) (KR)

Elementary Textbooks versus the Child: Conflicting Perceptions of Biology

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Elementary Textbooks versus the Child: Conflicting Perceptions of Biology

Objectives

An ethnographic study was conducted with the goal of comparing the botanical knowledge of nine sixth grade students with the botanical concepts developed in the elementary textbook series, Science, by Silver Burdett, 1985 (Tull, 1990). The researcher wanted to determine the extent to which the child's conceptual framework resembles that of the scientist, and the extent to which the textbook reflects the knowledge base and abilities of the child.

Recent National Assessments of Educational Progress (Mullis & Jenkins, 1988) have shown a nationwide decline in student achievement in science. This decline has caused great concern among science educators. Project Synthesis (Harms & Yager, 1981) reported that more than 90% of 12,000 teachers surveyed rely on the science textbook for their science curriculum 90-95% of the time. Clearly, "the curriculum is the textbook, and the objectives are those implicit in the text" (p. 20). Thus, in evaluating the current status of children's knowledge in science, the content of science textbooks must be taken into account.

Theoretical Framework

Research in education has demonstrated that children come to school with a body of knowledge about the natural world. From the early studies of Piaget (1929) to the many studies of the past decade (see Carey, 1985; Helm & Novak, 1983; Osborne & Wittrock, 1983) researchers have examined children's explanations of natural phenomena. Ausubel (Ausubel, Novak, & Hanesian, 1978) has asserted that the conceptions children bring with them to the classroom strongly influence what they subsequently learn. Successful curricula will be based on the foundation of knowledge the child brings to the classroom.

Hills (1983, p. 268) has suggested that the child's explanations differ from that of the scientist because the child is working within a different conceptual framework. Kempton (1981) calls the knowledge of laymen folk knowledge. Curricula should be designed to assist the child in bridging the gap between folk knowledge and scientific knowledge.

Almost all recent research on children's explanations of scientific concepts has dealt with misconceptions about abstract concepts (e.g., Helm & Novak, 1983). In the field of botany, most studies have dealt with the concept of photosynthesis (e.g., Barker & Carr, 1989; Smith & Anderson, 1984; Wandersee, 1986) or photosynthesis and respiration (Murr, 1986; Treagust, 1988). Only a few researchers have examined elementary school children's explanations for concrete botanical phenomena (see Osborne & Freyberg, 1985). A large gap exists in our knowledge of what children know about botanical concepts. The current study was designed to help fill that gap. For example, to understand a child's explanation of photosynthesis or reproduction, we also need to find out what the child knows about leaves and flowers.

Research Design

Using ethnographic interviews (see Spradley, 1979), the researcher examined the botanical knowledge of nine sixth grade children in central Texas. The children represented a variety of economic and ethnic backgrounds. They had a range of sixth grade achievement test scores from low to very high (refer to Table 1). For full details of the research design, refer to Tull, 1990. The researcher examined each child's language, meanings, classifications, and interpretations related to botanical phenomena. The children participated in a series of six individual interviews and tasks. They identified 64 plants from slides and identified plants in two outdoor field trips. They sorted 74 photographs of plants into categories. The children developed concept maps of the botanical concepts plant, leaf, flower, tree. Each child was asked to explain the functions of leaves and flowers and other plant parts, as well as the environmental needs of plants, human uses for plants, the differences between plants and animals, and the differences between living and non-living. The researcher did not introduce any botanical terms, except the word plants, into the dialog unless the child had used the term. The children's names for plants and plant classification schemes were examined using domain analysis, componential analysis, and taxonomic analysis (Spradley, 1979).

An examination was made of the botanical concepts developed in the first through sixth grade textbooks from the Silver Burdett series

Science, 1985. All statements related to botany were classified as either concrete or abstract. All names for plants were classified as either being familiar or unfamiliar to children in central Texas. Concept maps were made from the botanical statements in the text. The concept maps were used to examine the development of each concept.

Interpretation of the Data

The Language, Meanings, and Classifications of the Child.

Many of the scientific botanical terms found in the text were never used by the informants in this study (e.g., monocot, dicot, photosynthesis). For other scientific terms, it was apparent that the children had poor understanding of their meanings. For example, at least seven children were familiar with the term pollen and could recognize some examples but no one had any idea of its function. The children in this study used many of the same folk botanical terms that the adult layman would use (leaf, flower, petal, seed). The children sometimes did not use these terms accurately. Although all the children could recognize accurately most examples of flowers and leaves, three children called leaves flowers on at least one occasion. Three individuals called some fruits flowers. Seven informants occasionally called petals leaves. In describing the parts of the flower, only one child used the term stamen and no one used the term pistil. At least two individuals did not recognize atypical leaf forms such as on yuccas and some informants did not consider blades of grass to be leaves.

Labels such as bud, seed, fruit, and berry were frequently confused. Several children did not know that seeds are inside berries. Most knew that when a seed is buried a new plant will grow out of it. But no one know how a seed is formed and some believed that seeds appear on trees but that flowers do not.

The children organized plants into categories. Most of the children's names for plant categories were similar to those of the adult layman. The categories used most frequently by the children were trees, flowers, bushes, plants, vines, grass, cactus, leaves, and weeds. Although they did not use a scientific classification scheme, the students' in this study did have a classification scheme that would be recognized by the adult layman. Students' meanings for some categories (particularly tree, vine) would be acceptable to a botanist.

The children organized their categories hierarchically, although the hierarchies were in many cases poorly defined and fluctuating. Only six informants knew that trees are included in the concept plants. Even these informants, however, tended to use plants mainly in reference to herbaceous, non-flowering plants.

Some botanical terms (e.g., fruit, herb) have different meanings in the folk culture and in the scientific culture. Adult laymen tend to use the label fruit in reference only to fleshy, edible fruits such as apples. Adult laymen also tend to use seed in reference to any type of dry fruit. The layman's meaning for herb is often strictly culinary. The children's uses of these terms indicated that they were using the folk cultural meanings rather than the scientific meanings.

Are Children's Concepts Naive, Idiosyncratic, Based on Folk Knowledge, or Based on Scientific Knowledge?

Although each child had certain idiosyncrasies (for example, differences in what specimens would be called bushes), there were many similarities between informants in overall meanings for categories (particularly prototypes), criteria for category selection, and other aspects of their botanical knowledge. Some misconceptions about abstract concepts (e.g., how plants get "food") were shared by the majority of the informants. These trends suggest that children's explanations for abstract concepts are less idiosyncratic than might have been assumed previously.

Some botanical concepts clearly have been learned as part of the language and meanings of the folk culture. Names for plants, names and meanings for plant categories, and the hierarchical relationships between plant categories all have a basis in folk cultural knowledge. The children's concepts in these areas are not naive or idiosyncratic, rather they have probably been learned from parents and peers. Even though some of the names and meanings for these concepts may not be acceptable from the point of view of the scientific framework, they do have validity in the framework of the folk culture. The data from this study lend support to Hills' assertion (1983) that the knowledge of the child is based on a commonsense (folk) theoretical framework.

Some explanations of botanical phenomena appear to be based mainly on text-taught terminology and it was clear that the students had a poor understanding of that terminology. This might indicate that virtually all of the child's knowledge for that subject was derived from the textbook and that the child did not have any prior knowledge in that area (e.g., photosynthesis, reproduction, the environmental needs of plants, and the "life processes"). When explaining some abstract botanical concepts, however, some notions from folk knowledge (e.g, that plants get "food" from the soil) played a role in the children's interpretations.

In some cases, the children did have experience with the phenomenon even though they had not learned the scientific explanation for that phenomenon. For example, the children in this study knew that plants need soil, water, and sunlight. This knowledge was likely to have come from first hand experience and folk cultural knowledge as well as from the text. Knowledge of how plants use sunlight, water, and soil, however, is probably not part of the folk cultural knowledge. The textbook did not always provide enough information to fill the gap between the knowledge available to the child from the folk culture and the knowledge available to the botanist from the scientific culture. Thus the child's explanations of some abstract botanical concepts tended to be idiosyncratic, based on a mishmash of text-taught terminology and folk knowledge, with little understanding about how the two fit together.

In examining elementary children's explanations for biological phenomena, Lawson (1988) concluded that there was little evidence that the children had any self-generated theories. The concepts he studied were mostly abstract concepts (photosynthesis, reproduction, cell theory). The current data suggest that explanations of some phenomena (especially tangible phenomena) are derived from the folk cultural knowledge or are idiosyncratic interpretations based on folk cultural knowledge. When the phenomena are not observable, the children typically do not have theories and will tend to fall back on text-taught ideas, which are often poorly understood.

Some student misconceptions may have been learned directly from the text. For example, the idea that plants rely on carbon dioxide from animals was an erroneous concept found in the text. This misconception may also be part of folk cultural knowledge.

In summary, the children's explanations for botanical phenomena came partly from the folk culture, partly from idiosyncratic interpretation, and partly from the text.

What are the Children's Areas of Strength in Their Botanical Knowledge?

Despite limited coverage of ecology in the text, five children spontaneously provided accurate examples of food chains, and all five understood that plants are basic to food chains.

In the free listing task, the children remembered best the names for useful plants. Although no one had a large number of accurate common names for plants, all children displayed abilities to distinguish between plant specimens at the generic level. When naming plants, errors of overgeneralization revealed that the children recognized similarities between species belonging to the same botanical family.

In naming plants, students' wrong answers represented educated guesses rather than random responses. Types of errors made in naming plants (e.g., calling closely related species by the same name) suggested a greater knowledge of plants than the number of errors alone implies.

Several students gave richly detailed descriptions of plants. These descriptions were indicative of good observation skills. Most students displayed good classification skills. Two children excelled in their conceptions of plant categories, generally using category names that would be familiar to botanists and selecting specimens that would be acceptable to a botanist. Most of the children's plant categories (e.g., trees, flowers) were based mainly on structural (rather than subjective) criteria. There was general agreement among students concerning what characteristics were valuable in defining categories. Characteristics used to describe plants and to distinguish categories often were the same characteristics that a botanist would choose.

It was of interest to note that the two children who performed well on the plant classification tasks performed poorly in the plant naming tasks and scored low on their sixth grade science achievement test scores (refer to Table 1). The two students who performed the best in the plant naming tasks scored very high on science achievement test scores but performed rather poorly on the plant classification tasks. Learning names for plants is a rote memorization task whereas classification of plant categories is a process skill. Are the achievement tests examining only rote memorization and overlooking children's abilities to perform process skills? More research is needed to examine this trend in a larger group.

The children in this study were asked about their play preference (indoor versus outdoor, see Table 1). The two informants (5,6) who performed best in the plant naming task preferred outdoor play. Of the three informants (3,7,9) who performed best on plant classification, two preferred outdoor play. Four informants who preferred indoor play performed less well on both tasks. These four (1,2,4,8) had moderate to very high achievement test scores. The amount of time children spend playing outdoors may be the most important non-school influence on their botanical knowledge and skills. Further research is needed to examine this assertion.

The children displayed a preference for naming plants at the generic level of abstraction (e.g., oak) rather than at more abstract levels (e.g., tree, plant). The generic level appears to be psychologically basic even in a culture in which knowledge of generic common names is largely lost. In rural societies, it is not unusual for individuals to know the names for several hundred plants (see Brown, 1984). The research suggests that children desire to identify objects at the level of abstraction at which they can easily recognize them. Children can differentiate between trees, therefore they want to demonstrate that ability by naming the types of trees. When children do not know the generic names for trees and other plants, they frequently use strategies to avoid giving a more abstract response (e.g., guessing or making up a name, describing the plant rather than naming it, saying, "I don't know," or giving no response).

What are the Children's Areas of Weakness in Their Botanical Knowledge?

Students' misconceptions and lack of knowledge in botany cut across all individual differences. Regardless of gender, ethnicity, or achievement test scores, all the children in this study had major misconceptions about scientific concepts, both concrete and abstract.

No child correctly named more than 32% of the plants seen in the field or viewed in slides (using locally accepted common names as the standard). Five children named fewer than 20% correctly. Clearly, knowledge of common names for plants is no longer a part of the folk culture of these children.

Several students with high achievement test scores had rather poor classification skills. One child relied on irrelevant attributes such as backgrounds in the photograph (e.g., sunset colors) for category selection. Some plant categories (e.g., flower, weeds, plants) were based on subjective criteria (e.g., pretty or not pretty) or unstable criteria (e.g., presence or absence of flowers).

As detailed above, the children had misconceptions about a number of concrete botanical concepts (e.g., flowers, leaves, fruits, seeds). Three children did not know that trees are types of plants. The children's lack of knowledge about names for plant parts may be the result of the lack of guided field experiences with plants. Research is needed to demonstrate the effectiveness of field experiences in eliminating these misconceptions.

The children had a poor understanding of abstract botanical concepts (photosynthesis, respiration, reproduction, differences between living and non-living / plants and animals, the needs of plants, the importance of plants to humans) despite the fact that most were repeated in the text in several grades. At least six children did not know there is a relationship between leaves and food production, and four did not know there is a relationship between flowers and reproduction. No one could adequately explain these relationships.

The children's explanations for many abstract botanical concepts revealed that they had not previously put much thought into the meanings of the concepts. The children probably had not previously expressed their knowledge about topics such as the differences between living and non-living, plants and animals, and human dependence on plants. The good news is that these concepts may not be dogmatically embedded in their minds, and thus may not be particularly resistant to change, as long as the scientific explanation can be seen to make sense in relationship to the children's folk explanations. Children's concepts, although tenacious (i.e., long lasting) may not truly be resistant to change. It may simply be that no one has ever showed the students the relationship of their folk knowledge to scientific knowledge thereby enabling them to bridge the gap between the two. Research is needed to demonstrate the effects of linking folk meanings to scientific meanings for concepts.

<u>The Language, Meanings, and Classifications of the Text.</u>

The textbook review provided an in depth analysis that helps explain some of the factors that may prevent textbooks from providing a meaningful learning experience for children. 50-79% of the botany related statements in the text for grades 4-6 were abstract in nature (see Table 2). For example, the concept that "plants make their own food" was introduced in grade 3 (the term photosynthesis was introduced in grade 5). Reproduction was explained in grades 4 and 5, at the same time that the names for the parts of a flower were introduced.

Of the 156 botanical terms (both folk and scientific terms) used in the elementary textbooks, 46% were not explicitly or adequately defined or illustrated (e.g., biological clock, buds, bloom, cones, ovary, spores) (refer to Table 3 for a grade-by-grade break-down of the data). Of the terms that were defined, 46% were used in context only once, not often enough to enable the novice to grasp their meaning. Some terms were inaccurately defined (e.g., evergreen). Berry was never used in the text.

Most visual examples of flowers in the textbook were growing on herbs, thus the text may promote the misconception that flowers grow only on herbaceous plants. The labels for the reproductive parts were not introduced before grades 4 and 5, although a pilot study by the author (Tull, 1986) demonstrated that some five year old children will describe stamens and pistils even when lacking a name for those flower parts.

Although the text accurately defined seed and fruit, in grades 2 and 6 dry fruits were mistakenly labeled seeds. The text did not differentiate between culinary and botanical meanings for herb and fruit. By its use of illustration, the text promoted the myth that all fruits are fleshy and edible.

A high percentage of the plants named in the text do not grow in central Texas and would, therefore, be unfamiliar to the children in this study (see Table 4). Using unfamiliar plants as examples may have the effect of placing the concrete in the realm of the abstract.

The researcher documented 38 false and misleading statements about botany related concepts in grades one through six. For example, the second grade text tells the reader that desert plants do not have leaves. The third grade text states that mushrooms are plants. The sixth grade text states that evergreen trees have needles (in Texas, many broadleaved trees and shrubs are evergreen). And in an aquarium example, the fifth grade text states that "Without the fish, the plants would die. Without the plants. the fish would die." This statement may have been responsible for the misconception stated by several children that plants cannot live without the carbon dioxide produced by animals.

In a multiple textbook analysis that included the same Silver Burdett series, Meyer, Crummey, and Greer (1988) found no errors in the textbooks. What caused the discrepancy between their results and those of the current study? The divergent results suggest the inadequacy of sampling from the whole text. An in depth review of a single subject area (in this case, botany) may be better suited to some aspects of textbook analysis.

In addition to false statements, a number of topics were unnecessarily repeated in several grades. For example, the idea that seeds can grow into new plants was repeated in grades 1, 2, 3, and 6. The needs of plants were presented in grades 1, 3, 4, 5, and 6. Germination is discussed in grades 3, 5, and 6. Cacti were used as examples for explaining water conservation in grades 4 and 6. Saguaro cactus was used almost exclusively as the example of cactus in every grade. The functions of roots and stems is repeated in grades 3 and 5. The idea that plants make their own food is repeated in grades 3, 4, 5, and 6. In addition, a review of the seventh grade textbook, Macmillan Life Science, 1986, reveals a 50-60% concept overlap with the elementary texts.

The researcher's concept maps of the text revealed that in the upper grades concepts were developed using a high degree of complexity. Three to ten hierarchical levels per concept are found in the concept maps. Research is needed to learn more about elementary school children's abilities to incorporate concepts with such complexity. Staver and Bay (1989) question whether textbooks are overloading the memory capacities of young children. In their own concept maps, the children in this study typically used two to five hierarchical levels. Only one child used five to seven levels for any concepts. Further study could be done using similar techniques to evaluate the hierarchical complexity of the child's concept development.

How Well Does the Text Bridge the Gap Between the Conceptual Framework of the Child and the Scientist?

The third grade textbook used a classification scheme similar to (but not the same as) that of the layman, stating that seed plants can be classified as trees, shrubs, herbs, or vines. The fourth grade text used a scientific classification scheme, classifying plants as seed plants or nonseed plants, monocots or dicots. The text did not attempt to show the relationship and differences between these two classification schemes. For example, no information was given that would assist the child in understanding how the folk category flowers would fit within the scientific categories monocot and dicot.

The text did not bridge the gap between the child's folk knowledge and scientific knowledge. The text generally failed to differentiate between botanical and folk meanings for terms (e.g., fruit, herb) and between folk and scientific plant classification schemes.

Through false and misleading statements the text may initiate but certainly perpetuates a number of student misconceptions. The language of the text may also promote misconceptions when folk meanings conflict with scientific meanings and when scientific terminology is inadequately defined and illustrated.

The natural abilities of the children (e.g., ability to identify plants at the genus and family level) were largely ignored by the text. The elementary textbooks did not introduce the concepts of species, genus, and family at all. Rather, the textbooks introduced only the more abstract levels of the scientific classification scheme (e.g., monocot, dicot).

Posner (1983) has asserted that students will not change their explanations for scientific phenomena unless they are dissatisfied with their existing conception. As presented in the text, the explanations for scientific phenomena probably do not challenge the students' existing ideas related to concepts such as plant classification. This may partly explain why the students' ideas have not changed after exposure to text-taught ideas.

Summary

The data revealed that the children had a large body of knowledge about plants. The child's botanical language, meanings, classification scheme, and interpretations of botanical phenomena were more closely aligned with that of the adult layman than with that of the scientist. The children's botanical language and meanings appeared to be learned from the lay culture rather than from the textbook.

The textbooks relied heavily on scientific vocabulary and abstract botanical concepts. The areas of strength for the children were areas neglected by the textbooks. The textbooks did not succeed in bridging the gap between the knowledge and abilities of the child and those of the scientist. The textbook neglected to guide the child into an early understanding of the concrete botanical phenomena (e.g., the names for the parts of a flower) necessary to the later understanding of related abstract phenomena (e.g., the function of those parts in reproduction).

Overemphasis on academic and abstract concepts and scientific vocabulary indicate that the textbooks have placed an emphasis on science as a body of knowledge rather than as a way of thinking. In its pedagogical emphasis, neglect of concepts related to human uses of plants, ecology and societal issues, and in its lack of inquiry based experiments, the textbook clearly does not reflect the recommendations for science education put forth by the National Science Teachers Association (NSTA, 1982 a & b), the American Association for the Advancement of Science (AAAS, 1989), and other education organizations.

Recommendations

This study provides a large base of data related to children's knowledge of botanical concepts. That data has important ramifications for science education and for those interested in the study of factors that affect learning.

The research points to a number of areas for improvement of science textbooks. Textbook publishers must reevaluate how concepts are developed in the text, taking into account the recommendations for science education developed by the NSTA (1982a & b) and the AAAS (1989). The amount of highly abstract concepts must be reduced, particularly in the lower elementary grades, where concrete, hands-on science must take precedence. The amount of scientific vocabulary in textbooks must be reduced and the remaining vocabulary must be carefully developed. New vocabulary should be used in context on several occasions and be accompanied with diverse verbal and visual examples. At the same time, non-essential repetition of trivial or highly abstract concepts can be eliminated from the text.

Textbook writers may benefit from using concept maps as guides, to assist them in developing scientific concepts, and for use in comparing concept development from grade to grade. False statements made in the text can be minimized by the use of expert reviewers.

Teachers may erroneously assume that students share meanings for botanical terms with the teacher or the text. Teachers should address the differences and overlap between folk and scientific terms.

A textbook designed for nationwide distribution cannot introduce children to the names for plants in their region. Teachers can use regional field guides as supplements to text, thus enabling children to learn the names for local plants and introducing them to the great diversity of organisms in the plant kingdom.

The research indicates that elementary children should be introduced to the concepts of genus and family (and probably species) before being introduced to the more abstract levels of the taxonomic hierarchy. Children should be given the information needed to enable them to understand the relationship between the classification schemes of the layman and the scientist.

The discovery that children have misconceptions about concrete botanical concepts suggests that hands-on experiential science has been neglected in the study of botany. The researcher recommends that teachers provide children with numerous experiences with living plants of many different types.

The researcher suspects that student ignorance about concrete botanical concepts forms a barrier to their ability to understand related abstract concepts. Concrete concepts (e.g., names for flower parts) can be introduced in the early grades so that these concepts will serve as stepping stones to related abstract concepts (e.g., reproduction) that can be introduced in later grades. For example, waiting to introduce the names for flower parts in grade 4 (as does the text) may be too late. It may be as absurd as waiting till then to introduce the names for familiar objects such as chairs and cars. Field trips, slides, and photographs can all be used to expose the child to the diverse forms in which flowers can appear. By the time reproduction is introduced, the child may have developed a natural curiosity about flower function. A longitudinal study is needed to determine whether the elimination of misconceptions about concrete botanical concepts will result in better understanding of related abstract concepts.

Due to the problems with textbooks, this researcher would like to see less reliance on the textbook in elementary science. In the primary grades, a textbook may be unnecessary. For example, botany text could be replaced with children's stories about plants and with regional field guides to plants. The researcher reiterates the NSTA (1982a) recommendation that in grades one through four 50-75% of science instruction should involve the development of science process skills. This research demonstrates that children have natural abilities in classification and observation, abilities that need to be encouraged and developed in the elementary years. The outdoors is a natural laboratory for encouraging students to manipulate plants, make observations, collect data, and express their inferences and hypotheses about what they have observed.

Although this study was conducted with only nine informants, a large amount of data was collected from each child. The use of a variety of types of tasks, both structured and unstructured, provided triangulating evidence in support of the internal validity of those data. Despite differences in gender, ethnicity, and achievement test scores between the students in this study, much of their performance was remarkably similar. Further study is needed to examine the extent of specific trends in the larger population. In comparing the children's plant naming strategies with those of children in two other plant naming studies (Dougherty, 1979, in California, and Stross, 1973, in Mexico) some notable similarities emerge. For a report on the similarities and differences between these three studies, refer to Tull, 1990.

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Table 1
Informant Profiles

Profile	Informant Identification Number								
	1	2	3	4	5	6	7	8	9
Male/Female	F	F	M	M	F	F	M	F	M
Ethnicity[a]	AN	AN	MA	AN	AN	AN	AF	AN	MA
Indoor/Outdoor	I	I	O	I	O	O	O	I	I
MAT Scores[b]									
Complete Battery	99	93	29	97	98	99	50	87	71
Science NP[c]	99	67	50	99	99	99	83	72	59
Science Stanine	9	6	5	9	9	9	7	6	5

[a]Ethnicity: AN=Anglo-American; AF=African-American; MA=Mexican-American
[b]MAT=Metropolitan Achievement Test 6
[c]NP=National Percentile

Table 2
Percentage of Abstract Botanical Propositions in Elementary Science Textbooks by Silver Burdett

Grade	Ratio	%
1	5/30	17
2	13/61	21
3	40/117	34
4	59/117	50
5	149/196	76
6	135/170	79

Table 3
Percentage of Botanical Terms Not Defined in Elementary Science Textbooks by Silver Burdett

Grade	Ratio	%
1	11/13	85
2	13/16	81
3	31/48	65
4	35/55	64
5	27/60	45
6	53/85	62

Table 4
Percentage of Unfamiliar Plant Names in the Elementary Science Textbooks by Silver Burdett

Grade	Ratio	%
1	2/10	20
2	1/17	6
3	9/91	10
4	29/72	40
5	8/24	33
6	14/51	27