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TEXT ORGANIZATION AND STRUCTURE IN SCIENCE TEXTBOOKS

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The process approach to reading comprehension has received much attention in the literature (Anderson, et al., 1985; Durkin, 1978-9; Johnson, 1983; Pearson, 1985; Starr & Bruce, 1983). Recent research in the area of schemata theory, one aspect of the reading process, has resulted in a closer examination of the importance of text organization and structure. According to Meyer (1980), the organization and structure of the text has a great impact on the reader's comprehension.

Concomitant with the development of reading as a process has been the interest by educators in developing higher level thinking skills which are an essential part of problem solving. Science educators, in particular, have focused on the development of problem solving skills as a major component of successful science programs.

This study examined the text organization and structure of fourth and sixth grade science textbooks. This included prereading questions, advance organizers, margin notes, and type of text structure. In addition, chapter activities were classified as to the degree of problem solving skills developed by ranking the activities according to Bloom's (1956) taxonomy of cognitive skills.

Text Organization and Structure

Pre-reading question and advance organizers serve to cue the learner's attention to key ideas that will be discussed later in the text. Pre-reading questions have long been included as part of the directed reading activity (DRA)

outlined for basal reader lessons (Lapp & Flood, 1983). Such questions set a purpose for reading as well as helping to establish background information necessary for the reader to comprehend the passage.

Advance organizers, such as headings, also alert the reader to important ideas and concepts which follow in the text. Research by Mayer (1983) indicated that key concepts that were repeated and preceeded by advance organizers tended to increase recall and performance on problem solving tasks. Mayer also found the need for repetition of concepts was reduced when the use of advance organizers became more frequent.

Identifying the structural organization of a text has also been proven to be an effective reading strategy (Niles, 1974). For example, a reader who notices a writing pattern of comparing and contrasting will better understand the text being read. Mayer (1980) found that when familiar text structures were used to disseminate conceptual information to the reader, comprehension increased. The type of text structure Meyer identified as most commonly used in elementary level text materials were: problem/solution; comparison; antecedent/consequence; description; and collection (sequencing). Research points out that the ability of the reader to predict the type of text structure used by the author will affect how much information is retained (Meyer & Freedle, 1984; Thorndyke, 1977).

The importance of signalling in text material by the author to alert the reader to the type of text structure used has also been emphasized (Meyer, 1980). Signalling statements are usually presented in preview and summary statements. Signalling statements reveal information pertaining to structure rather than content. For example, a preview statement may be "The following is a comparison of. . . "

Problem Solving

Most educators agree that problem solving is a way of thought where people seek information and understanding through a set of processes (Welch, 1981). Science educators were surveyed to discover what they considered to be the most important outcome of their teaching efforts. Problem solving was rated as the highest desirable outcome (Chipetta & Russell, 1982).

The benchmark for problem solving is Dewey's (1910) five step model. This model includes: 1) identifying the problem; 2) forming a hypothesis; 3) collecting and analyzing data; 4) drawing conclusions; and, 5) testing the hypothesis.

In writing about the conceptualization of problem solving, Ausubel (1963) maintained that problem solvers who possess an adequate repertoire of prior knowledge for a given problem will be more likely to successfully complete the task. Thus, students who have had experience with magnets, for example, will better understand magnetic fields than students who lack such experience. Research by Thorsland & Novak (1974) supports Ausubel's theory.

The relationship between the conceptual knowledge of the individual and the individual's knowledge of procedures has been studied by Greeno (1978). Effective problem solving, according to Greeno, requires a union between the learner's ability to: a) execute the proper problem solving strategy, and, b) bring relevant conceptual knowledge to bear on a specific task. The interaction of conceptual knowledge (text content) with problem solving skills (processes) is significant in problem solving in science. Therefore, it is important that science text materials include problem solving as part of the text structure. This raises the question: Does the text promote the development of problem solving skills through an agreement between the text organization and structure with the presentation of concepts?

Method

Science text material for fourth and sixth grades was randomly selected from the following five science series: 1) Harcourt, Brace, Jovanovich's Science (1985); 2) Heath's Heath Science (1984); 3) Holt, Rinehart, and Winston's Science (1986); 4) Merrill's Accent on Science (1985); and 5) Scott Foresman's Science (1984). The presence of prereading questions as well as whether or not advance organizers (paragraph headings, etc.) were used were examined for each series. In addition, margin notes referring to key concepts were noted.

The text was also analyzed to determine which text structure was used by the author as defined by Meyer (1980). The five text structure patterns were: 1) problem/solution; 2) description; 3) comparison; 4) antecedent/consequent; and, 5) sequencing. Lastly, chapter activities were

described by the problem solving skills used. Each activity was analyzed in terms of Bloom's (1956) taxonomy of cognitive thinking skills: 1) knowledge; 2) comprehension; 3) application; 4) analysis; 5) synthesis; and, 6) evaluation.

Text Organization

Pre-reading questions were included in two of the series: Harcourt, Brace, and Jovanovich, and Scott Foresman. These questions were clearly presented at the beginning of the chapters either as a separate list or implied in an introductory paragraph.

Advance organizers were used by all five of the publishing companies examined. Headings and subheadings were typically presented in bold print. However, Harcourt, Brace, and Jovanovich and Heath were the only series that failed to include margin notes to highlight the meanings of important concepts. (See Figure 1 below)

Figure 1
Pre-Reading Questions, Advance Organizers, and Margin Notes for Key Concepts in 4th and 6th Grade Science Textbooks

Publishers	Pre-Reading Questions	Advance Organizers	Margin Notes
Harcourt, Brace Jovanovich (1985)	Yes	Yes	No
Heath (1984)	No	Yes	No
Holt, Rinehart, and Winston (1986)	No	Yes	Yes
Merrill (1985)	Yes	Yes	Yes
Scott Foresman (1984)	Yes	Yes	Yes

Text Structure

The five text structures examined in the study were those defined by Meyer, enumerated on the previous page. The degree to which the structures were used varied greatly. At the fourth grade level, Harcourt, Brace, Jovanovich, Mer-

Figure 2

Cognitive Level of Thinking Processes
of Activities in Fourth and Sixth Grade Science Textbooks

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Harcourt, Brace Jovanovich (1985)						
Fourth	Yes	Yes	Yes	No	No	No
Sixth	Yes	Yes	Yes	No	No	No
Heath (1984)						
Fourth	Yes	Yes	Yes	Yes	Minor	Minor
Sixth	Yes	Yes	Yes	Yes	Minor	Minor
Holt, Rinehart and Winston (1986)						
Fourth	Yes	Yes	Yes	No	No	No
Sixth	Yes	Yes	Yes	Yes	Yes	Yes
Merrill (1985)						
Fourth	Yes	Yes	Yes	Minor	Minor	Minor
Sixth	Yes	Yes	Yes	Yes	Yes	Yes
Scott Foresman (1984)						
Fourth	Yes	Yes	Yes	Yes	Yes	Yes
Sixth	Yes	Yes	Yes	Yes	Yes	Yes

rill, and Scott Foresman all relied heavily on the descriptive and sequencing text patterns. The text structures in Holt were predominantly descriptive, sequencing, and antecedent-/consequent. Descriptive text was prevalent in Heath which, unlike the other series, included comparison at the fourth grade level.

The examination of the sixth grade level materials revealed that four of the five series utilized descriptive and sequencing text as the predominant structures; Heath being the only exception. However, both Holt and Merrill included antecedent/consequent. Merrill also had a strong representation of comparison with some inclusion of problem/solution.

Cognitive Level of Chapter Activities

Activities tended to emphasize knowledge and comprehension cognitive levels for all five series examined. At the fourth grade level, Harcourt, Brace, Jovanovich, Holt, and Merrill had little or no activities at the analysis, synthesis, and evaluation levels. These are levels considered to be vital for problem solving. Heath and Scott Foresman contained higher level thinking skills in terms of analysis, synthesis, and evaluation in the chapter activities, thereby having students utilize more problem solving skills.

Harcourt, Brace, and Jovanovich had knowledge, comprehension, and application level activities in the sixth grade text material. Heath, Holt, Merrill, and Scott Foresman all had activities at all six levels of Bloom's taxonomy (See Figure 2, next page). Only Heath and Scott Foresman included activities which require higher level thinking at both the fourth and sixth grade levels.

Conclusion

As stated earlier, effective science instruction involves a healthy "marriage" between concept development and the processes of science--problem solving. In relationship to the organization and structure of text structure, this study reveals some promising results. There was a fairly consistent use among publishers of pre-reading questions and advance organizers to develop conceptual knowledge as advocated by Mayer (1983). In addition, margin notes to further explicate key concepts were also utilized by most of the publishers.

The use of varying text structures identified by Meyer

(1980), however, were not used extensively. Publishers tended to limit the text to descriptive and sequencing structures as opposed to problem/solution, antecedent/consequent, and comparison structures. Thus, this study indicates the need for more varied use of text structures in content development of elementary science text materials.

Finally, this study revealed few activities that utilized analysis, synthesis, and evaluation to any extent. These higher level thinking processes are involved in problem solving and the application of such skills in activities is important. By far the majority of activities in all of the series included hands-on comprehension and application level work.

REFERENCES

Anderson, R. et al. (1985). Becoming a nation of readers. Champaign, IL: Center for the Study of Reading.

Ausubel, D. (1968). Educational psychology: A cognitive view. NY: Holt, Rinehart, and Winston.

Bloom, B. S. (1956). Taxonomy of education objectives. NY: David McKay.

Chippetta, E. & J. Russell. (1982). The relationship among logical thinking, problem solving instruction, and knowledge and application of earth science subject matter. Science Education, 66(1), 85-93.

Dewey, J. (1910). How we think. Boston, MA: Heath.

Durkin, D. (1978-9). What classroom observations reveal about reading comprehension instruction. Reading Research Quarterly, 14, 481-538.

Greeno, J. (1978). Understanding and procedural knowledge in mathematics instruction. Educational Psychology, 12(3), 262-283.

Johnson, P.H. (1983). Reading comprehension assessment: A cognitive process. Newark, DE: IRA.

Lapp, D. & J. Flood. (1983). Teaching reading to every child. 2nd edition. NY: Macmillan

Mayer, R. E. (1983). Can you repeat that? Qualitative effects of repetition and advance organizers on learning from science prose. Journal of Educational Psychology, 75(1), 40-49.

Meyer, B. (1980). Use of top level structure in text: Key for reading comprehension of ninth grade students. Reading Research Quarterly, 16(1), 73-101.

Meyer, B. & R. Freedle. (1984). Effects of discourse type on recall. American Educational Research Journal, 21(3), 121-143.

Niles, O.S. (1974). Organization perceived. In Perspectives in reading: Developing study skills in secondary schools, ed. by H.L.Herber. Newark, DE: IRA.

Pearson, P.D. (1985). Changing the face of reading comprehension instruction. Reading Teacher, 38, 724-738.

Starr,K. & B.C.Bruce. (1983). Reading comprehension: More emphasis needed. Curriculum Update. Alexandria, VA: Assoc. for Superv. & Curr. Development.

Thorndyke, P. (1977). Cognitive structures in comprehension and memory of narrative discourse. Cognitive Psychology, 9(5), 77-110.

Thorsland, M. & J. Novak. (1974). The identification and significance of intuition and analytic problemsolving approaches among college physics students, Science Education, 58(2), 245-265.

Welch, W. (1981). The role of inquiry in science education: Analysis and recommendations. Science Education, 65(1), 33-50.