THE EFFECTS OF QUANTITATIVE AND QUALITATIVE PRIOR KNOWLEDGE ON THE LITERAL AND INFERENTIAL COMPREHENSION OF SIXTH AND NINTH GRADE ABLE READERS

BY

BARBARA WYNES

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF EDUCATION

Faculty of Education
(Curriculum: Humanities and Social Sciences)
University of Manitoba
Winnipeg, Manitoba
April, 1990

ISBN 0-315-63333-6

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ACKNOWLEDGEMENTS

The writer wishes to express her gratitude to those who made this study possible. Special appreciation is extended to Dr. B. Zakaluk for her interest, encouragement, and guidance throughout all stages of the study. Appreciation is also extended to Dr. O. Cap and Dr. O. S. Trosky for their advice and recommendations, and to Dr. Z. Mate for his encouragement and interest.

In addition, the author wishes to acknowledge the statistical assistance of Dr. R. Balshaw.

Lastly, sincere appreciation is extended to the author's husband, Frank, her son, Andrew, and her family and friends for their support throughout this endeavour.

ABSTRACT

The purpose of this study was to examine the efficacy of a qualitative as opposed to a quantitative measure of prior knowledge for use in estimating literal and inferential comprehension of expository text. In addition, the study explored how students at different grade levels processed explicit and implicit text information.

The subjects were 123 sixth and 138 ninth grade able readers in suburban schools. To assess prior knowledge, free associations about key words were scored quantitatively, for the number of associations (Zakaluk, Samuels, & Taylor, 1986) and qualitatively, according to a language organization hierarchy (Langer, 1981). To assess comprehension, subjects read two 400-450 word passages taken from grade level science and social studies text, recalled in writing what they remembered, and answered literal and inferential open-ended questions. Retellings were scored for explicit and implicit ideas represented in the protocol clausal units (Drum & Lantaff, 1978; Malicky, 1985).

Following a descriptive analysis of the data, separate analysis of variance by grade and topic, by grade across topics, and by topic across grades were conducted.

The results led the researcher to conclude that: 1) a qualitative measure of prior knowledge is an effective predictor of literal comprehension for science. Neither a

quantitative nor qualitative prior knowledge measure consistently predict inferential comprehension;
2) the effects of prior knowledge differ depending upon whether science or social studies materials are being processed. Quality, not quantity, of prior knowledge appears consistently to affect the processing of science materials, neither type of prior knowledge consistently affected processing of social studies materials;
3) for younger and older able readers, prior knowledge has similar effects for literal comprehension processing; and
4) younger grade six readers tend to be less efficient in processing text in relation to prior knowledge.

It was hypothesized that, in general, a qualitative measure was a better predictor of prior knowledge because able readers organize their knowledge efficiently in superordinate categories. In contrast, a quantitative measure may not adequately identify quantity of prior knowledge for subjects who do not state subordinate ideas which are subsumed by highly organized knowledge structures.

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Chapter I

NATURE OF THE STUDY

Reading is one of the primary learning modes. As a consequence an important instructional objective is to help students develop strategies for enhancing the comprehension of informational text.

It is generally accepted by theorists, researchers and practising educators that prior knowledge influences the comprehension and retention of prose in important ways. Evidence shows that prior knowledge provides a thematic or contextual schema for text topics (Bransford & Johnson, 1972; Dooling & Lachman, 1971; Schallert, 1976) and that students with greater prior knowledge recall more after reading (Hare, 1982; Holmes, 1983; Pearson, Hansen & Gordon, 1979; Taylor, 1979). Many educators are aware that their students differ in terms of topic familiarity and that, as a result, their comprehension also differs. Based on their conviction that prior knowledge influences comprehension, such teachers employ pre-reading strategies to build and activate background knowledge prior to assigning reading. Yet many teachers are often not sure which students need, nor which students actually develop knowledge of the topic from such pre-reading activities, nor if the knowledge that is developed relates to eventual comprehension performance.

Little is known about how prior knowledge functions during comprehension or how best to measure prior knowledge as a predictor of comprehension. Research has provided support for the notion that prior knowledge has an effect on the ability to remember explicitly stated information (Hare, 1982; Holmes, 1983; Langer and Nicholich, 1981; Pearson et al., 1979) and that for both good and poor readers, prior knowledge aids literal comprehension (Taylor, 1979). There is some evidence (Langer, 1984; Pearson et al., 1979) that more prior knowledge also results in better inferencing, but this is not conclusive (Hare, 1982). Pearson et al. (1979) found that students with high prior knowledge, as measured by responses to 'wh' questions, performed better on implicit, inference type questions. Langer (1984) found a free association prior knowledge task, scored in two ways to produce both a quantitive and a qualitative measure of prior knowledge, was a good predictor of performance on both explicit and implicit 'wh' questions. Although Hare (1982) used the same free association instrument, she found that neither measure (qualitative nor quantitative) adequately predicted performance on implicit, open-ended kinds of questions. Moreover, Holmes (1983) found that poor readers were not as adept as good readers in answering text implicit questions, even when the prerequisite facts were known before reading the passage. This suggests that good readers use their prior knowledge differently from poor readers, and

that there is more to making inferences than the mere possession of appropriate prior knowledge.

Researchers have used varied approaches to measure prior knowledge. Some investigators manipulated or simply assigned topic prior knowledge familiarity or lack of familiarity, but did not specifically measure individual prior knowledge (Bransford & Johnson, 1972; Dooling & Lachman, 1971; Taylor, 1979; Schallert, 1976). Taylor (1979), for example, after pretesting a randomly selected group of students at the same grade level in the same school for prior knowledge of topic, extrapolated that information, inferring that the subjects she actually used in her study would be unfamiliar or familiar with her reading selections. Others (Holmes, 1983; Pearson et al., 1979; Stevens, 1980) risked contaminating post test results by administering pretest questions to assign levels of topic familiarity. Such pretest questions may serve as a set and cue subsequent comprehension.

Generally, measures that assess individual topic familiarity prior to instruction fall into two categories: quantitative or qualitative. The quantitative measures include 'wh' questions (Pearson et al., 1979), multiple-choice questions (Stevens, 1980), probe questions (Marr & Gormley, 1982), and a free word-association task (Zakaluk, Samuels, & Taylor, 1986). Langer (1981), however, distinguishes between general and specific prior knowledge

by scoring ideas students provide on a free association task according to topic relevance, thereby adding a qualitative element to prior knowledge measurement. While it may be that the administration of a quantitative prior knowledge measure (Zakaluk et al., 1986) is sufficient for providing teachers with information about student's prior knowledge of topic, Langer's work suggests a more discriminative approach is necessary. As opposed to a quantitative prior knowledge measure that should adequately predict literal comprehension, a qualitative measure of prior knowledge should be a better predictor of comprehension performance at inferential levels. Quantitative and qualitative measures of prior knowledge seem to provide different kinds of information about readers' pre-existing knowledge.

It is the thesis of this study, therefore, that a qualitative measure of topic prior knowledge would be a better predictor of inferential rather than literal comprehension performance. Further, that it is impossible to predict responses to inferential level comprehension questions based on a quantitative measure of prior knowledge (Zakaluk et al., 1986) because scores on quantitative and qualitative measures of prior knowledge do not indicate the same levels of topic familiarity. A high score on a qualitative measure of prior knowledge that is administered prior to reading should predict a high score on inferential comprehension.

Thus, it is implied that: 1) the way prior knowlege is measured (quantitatively or qualitatively) influences a teacher's ability to estimate literal and inferential comprehension performance; and 2) accuracy in predicting literal or inferential comprehension performance is achieved by using the more appropriate measure. Such information should increase our understanding of current theories of text processing that posit a relationship between a reader's prior knowledge and the comprehension of text. Identifying the differential relationship between the predictive powers of qualitative and quantitative measures of prior knowledge and students' actual literal and inferential comprehension performance also has the potential for adding an important dimension to educational decision-making.

For classroom instruction to be effective, teachers need to understand how students use prior knowledge for comprehension. With this information, a more appropriate match can be made between the kinds of concept building, prereading activities teachers provide to enhance comprehension. In order to do this, educators must know: first, how best to measure topic prior knowledge; and second, whether the type of prior knowledge students possess is sufficient and appropriate for the level of comprehension required.

Importance of the Study

This investigation has practical significance for the classroom teacher. Studies suggest that prior knowledge has an effect on comprehension. Research, however, has not clearly explained how or why it does. The means of measuring both prior knowledge and comprehension appear to influence research results.

This study follows the pattern of previous prior knowledge research, employing established quantitative (Hare, 1982; Zakaluk et al., 1986) and qualitative (Langer, 1981) measures of prior knowledge, and both recall and question measures of comprehension (Hare, 1982; Holmes, 1983; Marr & Gormley, 1982; Pearson et al., 1979). The study departs from tradition, however, in the scoring of the written recalls or retellings. Instead of scoring protocols for the total quantity of ideas recalled as in most prior knowledge research, retelling responses will be scored in two ways: once for ideas that are explicitly stated in the text and once for implicit ideas according to Drum (1978), Lantaff (1978), and Malicky (1985). This entails classifying retelling clausal units according to whether they are: text specific, text embedded, text evoked, text erroneous, or text external responses.

This study addresses the need to establish the efficacy of a qualitative as opposed to a quantitative measure of

prior knowledge for use in estimating literal and inferential comprehension performance. A secondary but related issue is to explore how topic familiarity is used in processing explicit and implicit textual information. The specific research questions addressed in the study are stated as follows.

Research Questions

1. Compared to a quantitative measure of topic prior knowledge, is a qualitative measure more effective in predicting sixth and ninth grade able readers' a) literal and b) inferential comprehension performance on science and social studies materials as evident in responses to 1) written retelling prompts analyzed for text specific, text embedded, text entailed, text evoked, text erroneous, and text external responses and 2) literal and inferential open-ended questions?

2. Based upon an analysis of written retelling protocols obtained from science and social studies material prompts, what similarities and differences are evident in how topic familiarity is used in the comprehension processing of sixth and ninth grade able readers?

Hypotheses

From the research questions the following hypotheses were generated:

1. For sixth and ninth grade able readers of high, medium, and low quantitative prior knowledge, there are no differences in literal comprehension performance as measured by the 1) text specific and text embedded clauses found in written retellings and 2) responses to text explicit questions on a) science and b) social studies material.

2. For sixth and ninth grade able readers of high, medium, and low qualitative prior knowledge, there are no differences in literal comprehension as measured by the 1) text specific and text embedded clauses found in written retellings and 2) responses to text explicit questions on a) science and b) social studies materials.

3. For sixth and ninth grade able readers of high, medium, and low quantitative knowledge, there are no differences in inferential comprehension performance as measured by the 1) text entailed and text evoked clauses found in written retellings and 2) responses to text implicit questions on a) science and b) social studies material.

4. For sixth and ninth grade able readers of high, medium, and low qualitative prior knowledge, there are no differences in inferential comprehension performance as

measured by the 1) text entailed and text evoked clauses found in written retellings and 2) responses to text implicit questions on a) science and b) social studies materials.

5. There are no differences between the prior knowledge measures (qualitative and quantitative) in predicting literal and inferential comprehension performance within and across grades.

Scope of the Study

The purpose of this study is to examine the role that pre-existing knowledge or topic familiarity plays in the comprehension of informational text using able sixth and ninth grade readers as subjects. Using literal and inferential comprehension as the dependent or criterion variables, as shown in the accompanying diagram, data were obtained by measuring student responses to a) written retelling prompts and b) open-ended literal and inferential questions. Student responses to a measure of quantitative (Zakaluk et al., 1986) and qualitative (Langer, 1981) topic prior knowledge were used as independent variables. Student responses were based on two grade level expository passages, one science and one social studies, for each grade level of students (grade six and grade nine). Passages were selected from commercially prepared text used for classroom instruction.

		GRADE 6								GRADE 9							
		Science				Social Studies				Science				Social Studies			
		RETELLING		QUESTIONS		RETELLING		QUESTIONS		RETELLING		QUESTIONS		RETELLING		QUESTIONS	
		LIT	INF	LIT	INF	LIT	INF	LIT	INF	LIT	INF	LIT	INF	LIT	INF	LIT	INF
PKQT	L																
	M																
	H																
PKQL	L																
	M																
	H																

Lit = Literal
Inf = Inferential
PKQT = Prior Knowledge Quantity
PKQL = Prior Knowledge Quanlity
H = High
M = Medium
L = Low

The measures were obtained in a group setting; therefore all responses were written. Testing took place in two sessions, with all measures for each topic obtained in one session, and topics counterbalanced so that half the subjects received the science and half the social studies topic in each session.

Assumptions

Underlying this investigation are several assumptions:

1. The prior knowledge measures tapped students' topic familiarity.

2. All prior knowledge and explicit and implicit information processed within the reader's head was reported on the paper-and-pencil tasks.

3. The prior knowledge measure did not cue comprehension.

4. Subjects were familiar with the task procedures and did not require special training because the tasks were school-like and the reading materials naturally-occurring school text.

Definition of Terms

Operational terms which have been used throughout this study have been defined as follows:

Prior Knowledge. Prior knowledge is the knowledge that one possesses about a thing, place or idea prior to reading a passage about that thing, place, or idea. For the purpose of this study, prior knowledge is represented by the subjects' free associations in response to key concept words taken from the expository text passages. The subjects are required to write down all the other words or phrases that the key word brings to mind. The association units are

scored to provide two measures of reader prior knowledge for text topic: a quantitative prior knowledge measure (Zakaluk et al, 1986) and a qualitative prior knowledge measure (Langer, 1980).

Quantitative Prior Knowledge Measure. A quantitative prior knowledge measure (PKQT) is a means of assessing how much a reader knows and understands about a topic prior to reading. This is determined by the number of free associations units made in response to stimulus words or phrases central to the main ideas of the topic and is expressed in three levels: low (0-2 association responses), average (3-6 association responses), or high (7 or more association responses) (Zakaluk et al., 1986).

Qualitative Prior Knowledge Measure. A qualitative prior knowledge measure (PKQL) is a means of assessing the importance of readers' topic familiarity in relation to the information in the text, as determined by assigning hierarchical categories (little, some, much) to students' free association responses to key word stimuli (Langer, 1980). For the purpose of this study, low quality is represented by a rating of "little"; average quality is represented by a rating of "some"; and high quality is represented by a rating of "much". (See Appendix A.)

Informational Text. Informational text is a term used to describe passages from social studies or science school

texts written in a style that presents or explains facts and ideas.

Able Readers. Able readers are students who are judged by their teacher to be average and skilled readers for their grade and who do not have word recognition problems that might interfere with comprehension. For the purpose of this study, teacher judgement was verified by percentile scores received on The Canadian Achievement Text (1981) previously administered by the teachers in the same school year as this investigation took place.

Literal Comprehension. Literal comprehension is one's understanding of ideas that are explicitly stated in reading passages as measured by 1) an examination of post reading written retelling protocols with the purpose of identifying text specific and text embedded clausal units (Drum, 1978; Lantaff, 1978; Malicky, 1985) and 2) performance on explicit open-ended questions.

Inferential Comprehension. Inferential comprehension refers to one's understanding of ideas that a) are not directly stated in the text (implicit) and b) are reasoned from combinations of text information and the reader's world knowledge.

In this study inferential comprehension is measured by 1) an examination of post-reading written retelling protocols with the purpose of identifying text entailed and text evoked clausal units (Drum, 1978; Lantaff, 1978;

Malicky, 1985) and 2) performance on text implicit open-ended questions.

Literal Questions. Literal questions (QuesL) are text explicit questions for which both the inquiry and answer information are directly stated within the text of the material (Pearson & Johnson, 1978).

Inferential Questions. Inferential questions (QuesI) are text and script implicit questions for which the inquiry and response information is not directly stated within the text but is implied either in different sentences in the text or from the reader's prior knowledge of the topic, requiring the reader to combine separate pieces of information in order to respond correctly (Pearson and Johnson, 1978).

Written Retelling. A written retelling refers to the process by which subjects, without referring back to the passage, recall from memory and write down as much of the passage as they can remember from their reading.

The written retellings in this study are measured by clausal unit response categories: text specific, text embedded, text entailed, text evoked, text erroneous, and text external responses (Drum, 1978; Lantaff, 1978; Malicky, 1985). Text specific and text embedded responses reflect explicit text processing and represent literal comprehension; text entailed and text evoked responses reflect implicit processing and represent inferential

comprehension; text erroneous responses are incorrect in relation to the textual information; and text external responses have no relationship to the text. (See Appendix A.)

Text Specific Responses. Text specific responses (RC1) are those clausal units in the written retelling protocols that correspond to the text in exact form or that have specific references within a single unit of text. These clauses are restatements of text propositions and include: verbatim recall, partial recall, acceptable syntactic paraphrases, substitution of pronouns, and synonymy of elements (Drum, 1978; Lantaff, 1978; Malicky, 1985).

Text Embedded Responses. Text embedded responses (RC2) are those clausal units in the written retelling protocols whose information is specific to the text, but include information from more than one unit of text (Drum, 1978; Lantaff, 1978; & Malicky, 1985).

Text Entailed Responses. Text entailed clausal responses (RC3) are those clausal units in the written retelling protocols that integrate information. Either: a) specific elements from across the text are combined into one, put together in new ways or b) the reader fills in gaps or elaborates on the author's ideas with information derived from knowledge schemas. These responses are constrained by the text and are correct according to a content expert. This

category includes units of synthesis and inference (Drum, 1978; Lantaff, 1978; Malicky, 1985).

Text Evoked Responses. Text evoked responses (RC4) are those clausal units in the written retelling protocols that are elaborations or embellishments of the original text which include experiential intrusions and storyline additions not constrained by the text. These responses reflect the ability of the reader to use background knowledge when interacting with print (Drum, 1978; Lantaff, 1978; Malicky, 1985).

Text Erroneous Responses. Text erroneous responses (RC5) are those clausal units in the written retelling protocols that contain either a) incorrect specific text information, b) inaccurate or incorrect syntheses, or c) faulty inferences (Drum, 1978; Lantaff, 1978; Malicky, 1985).

Text External Responses. Text external responses (RC6) are those clausal units in the written retelling protocols that have no relationship to the text. They include recall conventions, self report statements, and repetitions (Drum, 1978; Lantaff, 1978; Malicky, 1985).

Organization of the Report

This study was designed to investigate the relationship between quantitative and qualitative prior knowledge and the reading comprehension of informational text by students in grade six and nine.

The first chapter delineates the nature of the problem. A review of literature reporting related theory and research is found in Chapter 2. Chapter 3 outlines the design of the study, including a description of the sample, the research materials, and data-gathering and analysis procedures used, while Chapter 4 discusses and interprets the data. Chapter 5 consists of a summary of the findings, conclusions, and limitations of the study. In addition, implications for both classroom instruction and further research are presented.

Chapter II

REVIEW OF RELATED LITERATURE

This section of the report looks at schema theory and related research in the area of text comprehension. The chapter explores the effect of background knowledge on prose comprehension in an attempt to clarify how and why prior knowledge is a factor in comprehension. Through an analysis of the strengths and limitations of the research, implications for both educational practice and further research are revealed, particularly in the area of prior knowledge measurement.

Theoretical Framework

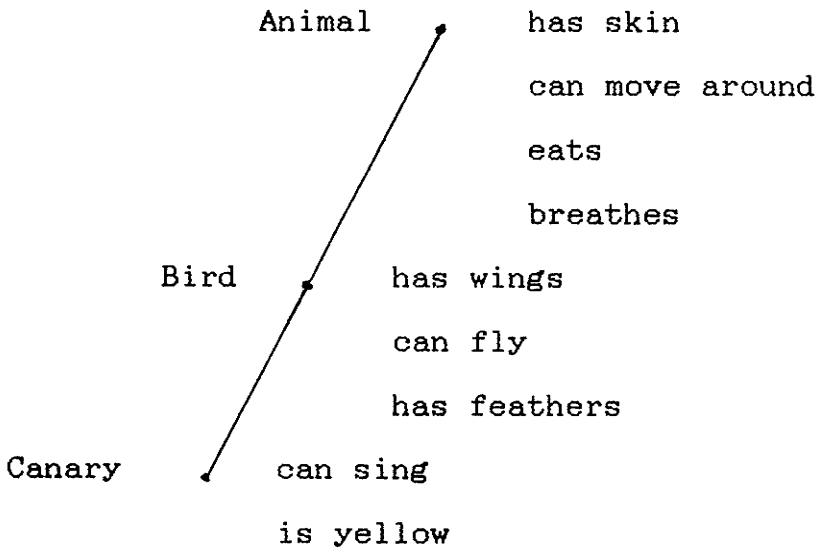
The concept of schema theory provides the basis for our understanding of how pre-existing knowledge impinges upon reading comprehension. Schema theory is based on the assumption that discourse does not in itself provide meaning. Rather, the construction of meaning is dependent upon the reader. The text simply provides direction for readers as they use previously acquired knowledge to construct their own meaning (Rumelhart, 1980), and comprehension occurs as a result of the interaction between newly acquired information and knowledge already stored in memory (Spiro, 1980). The units of knowledge, schemata, are

abstract structures or concepts that represent what is known to be true about situations according to experience.

Although the idea of schema has provided direction for research in cognitive psychology in recent years, the concept is not new. Bartlett (1932, p. 201) referred to schema as "an active organization of past reactions or past experiences." In his studies of the comprehension of text from different cultures, he found that recall was inaccurate and distorted to conform more closely to the subjects' own background and knowledge. He proposed that an individual forms general impressions, or a gist, of the story and on this basis, constructs the probable meaning from what is already known.

Recent theorists see a schema that is composed of a hierarchy of schemata embedded within one another (Rumelhart, 1980). As Rumelhart contends, "a total set of schemata instantiated at a particular moment constitutes our internal model of the situation" (Rumelhart, 1980, p. 37). The upper levels of the hierarchy are general enough so that they can represent a class common to many other events in that class. Lower levels of schema include more specific descriptions. Because long term memory is not infinite, people save space by storing information in the most inclusive levels possible (Collins & Quillian, 1969). Knowledge concepts common to many events (or objects) are stored together rather than stored repeatedly, thus saving

memory space. Collin and Quillian (cited in Anderson & Pearson, 1984, p.22) refer to this as "cognitive economy." They theorize that knowledge is organized in semantic networks which might be represented as follows:



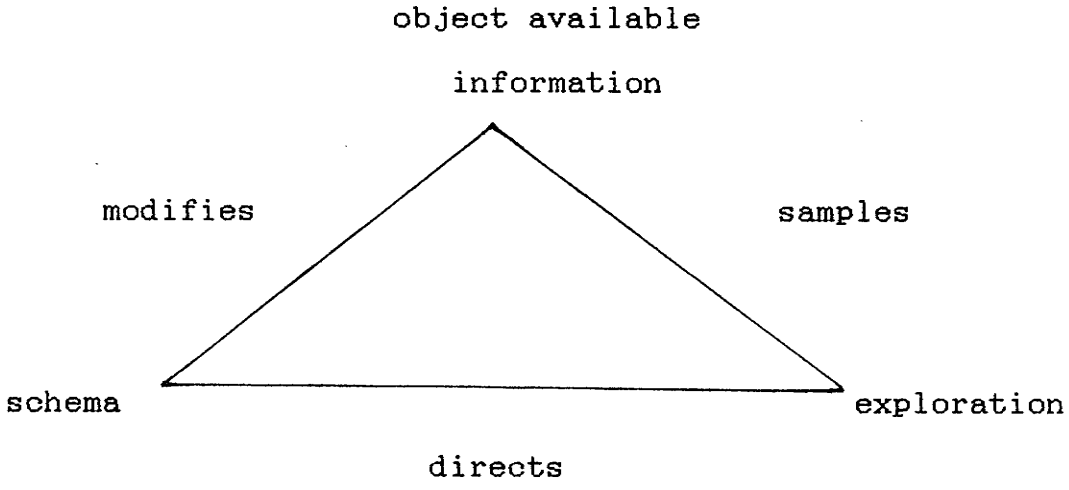
(cited in Anderson and Pearson, 1984, p. 22).

Accordingly, the schema for 'animal', because it must fit any situation for 'animal', must be much more general than the schema for canary. The degree of abstraction of the schema may vary from the very abstract to the very concrete.

Each schema is said to have a variety of roles depending on the situation and the time. The relationship of these variables, called "variable constraints", helps identify the various aspects of a situation (Rumelhart, 1980. p. 35). In addition, these variable constraints provide "initial guesses" or "default values" (Minsky, 1978)

that are inferences about unobserved aspects. That is, in comprehending text, salient words mentioning a component of a schema may activate the schema as a whole; once the whole is activated other parts are brought to mind. When reading text about a person driving down the road, for example, one would infer that the person was in a car or truck, even if the type of vehicle were not stated explicitly in the text. Furthermore, one would infer that the vehicle had a steering wheel, four tires, and headlights. Inferencing that is based on prior knowledge, then, plays an important part in reading comprehension.

Neisser 1976) saw schema as part of the perceptual cycle where schemata are the pre-existing structures which direct perceptual activity and modify that structure as new perceptions occur. Perception is a constructive process whereby the perceiver constructs anticipations of certain kinds of information as it becomes available. The schema accepts information as it becomes available at sensory surfaces and is changed by that information; it directs movements and exploratory activities that make more information available, thereby becoming further modified. In this way, schemata develop and expand with experience.

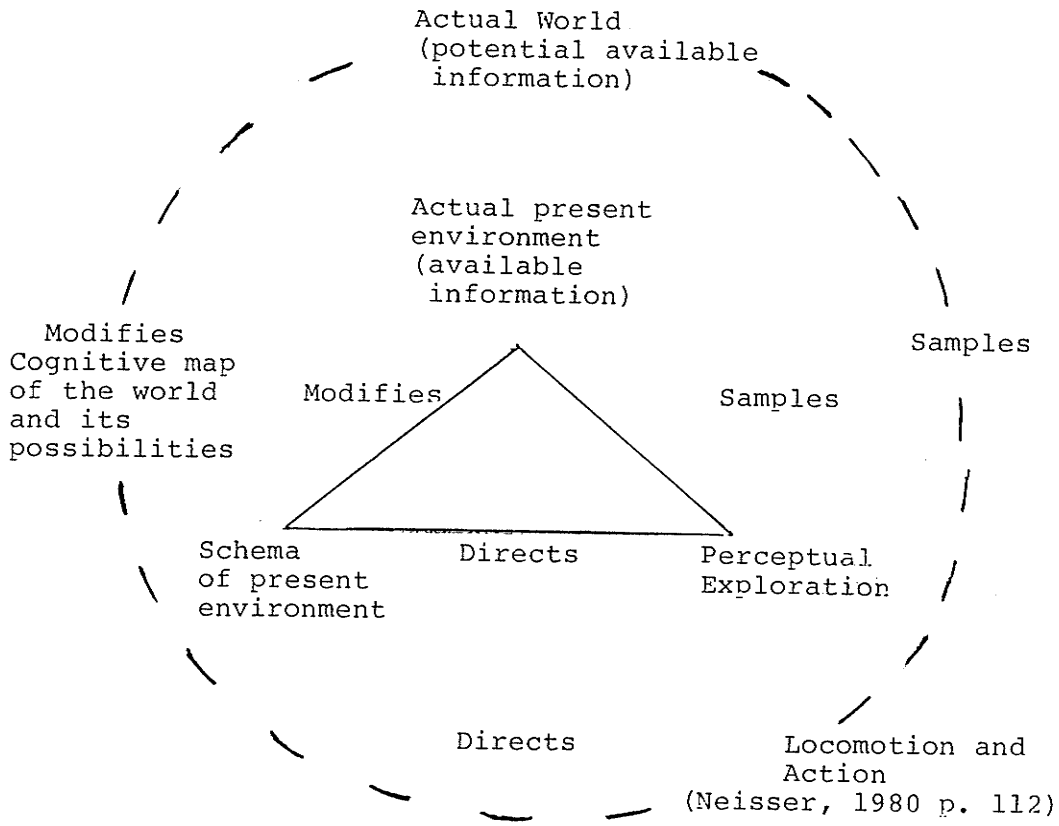


Perceptual Cycle

(Neisser, 1976, p.21)

Moreover, because one can see only what one knows to look for, it is the schema in combination with the information available at the time, that determines what will be perceived.

Furthermore, as Neisser (1976, p.112) explains, these schemata are embedded in a more inclusive cognitive map. Consequently, perception relies on the interactions and support of different levels, guided by a general cognitive map and a more specific perceptual schema as illustrated.



(Neisser, 1980 p. 112)

According to Neisser, the interpretation of wholes and parts takes place simultaneously. For example, while the shape of a steering wheel or tires suggests the possiblity of a car; the shape of a car may similarly activate the schema of the component parts.

Applying this notion to the comprehension of text, it is evident that certain letter or word combinations have their own schema. Some letters fit together providing the schema for a word. The evidence for one or two letters in

certain places gives reason for another letter. That is, 'a' in the first place and a 'd' in the third would indicate that an 'n' would most likely occur in the middle place. So it is with words in a sentence, because language is structured according to predictable patterns.

It is important to keep in mind that schema variables are not rigid, and when activated, schemata merely provide a framework for interpreting a situation. For instance, words have different meanings in different contexts even when being used in the same sense. The word 'red' provides an illustration: red strawberry, red barn, red sunset, red hair. Concepts, not meanings, are stored in memory and word meanings are 'context sensitive' (Anderson & Pearson, 1984, p.27). There is, thus, more to schemata than their structures.

Since the majority of work carried out on schema theory has centered on its structure and not its texture or feeling, very little is known about properties of schema that cannot be broken down and analyzed. Bartlett (1932) referred to the general impression of the whole. In addition to the remembered events themselves, this implies the inclusion of qualities that relate to attitudes of happiness, confusion or anxiety surrounding the event, for example. These are durable qualities that precede and facilitate retrieval of information. As well, since only one thing can be analyzed at a time (Spiro, 1980), the fact

that the events can be both thought about and felt at the same moment adds to the reconstruction of the event. This provides further support to the idea that inferencing through the use of schema or prior knowledge plays an important role in comprehension.

Comprehension involves the co-ordination of all levels of schema in selecting the elements that correspond to the observed event, and then verifying that they do account for it. Knowledge is stored in fragmented form and is assembled or reconstructed when it is needed. In this sense schema activation is an ongoing process that determines and directs one's pattern of observation (Rumelhart, 1980).

In Bartlett's conceptualization (1932), comprehension is a top down process. He theorized that an individual adopts a general impression of the whole and, upon recall, reconstructs the probable details from what is already known. He supported this contention through research in which increasing distortion occurred in recalls as a function of increases in delay time and differences in cultural background.

More recent theories build upon Bartlett's work and explain comprehension as an interactive process where parts activate the whole, which in turn activates other parts of the schema (Carrell, 1983; Rumelhart, 1980). This would be consistent with Neisser's perceptual model which embeds the schema within a cognitive framework.

Spiro (1980, p. 10-12) hypothesized that those with comparable reading skills do not process in the same way. Some rely more on the text and others rely more on existing knowledge. He suggested that differences in comprehension processing may be attributed to a number of causes.

1. Differences in schema availability. General schema or particular schema may be unavailable, resulting in reliance on text-based processing.

2. Deficiencies in decoding skills. A perseverence or weakness in word recognition could result in more text-based processing. A need to escape word recognition deficiencies could result in guessing and the over use of top down information to aid text processing.

3. A misconception that reading is a bottom-up process or calling words correctly and that top down processing is inappropriate.

4. Difficulty in maintaining schema, resulting in ineffective use of background knowledge. An over-reliance on either top down or bottom up processing can cause comprehension problems. It would seem that the teaching of opposing styles would result in improved comprehension by raising the level of metacognitive awareness.

There are, therefore, a number of reasons why readers may experience comprehension difficulties, including lack of awareness regarding the interactive nature of text processing. There may be (Anderson & Pearson, 1984):

1. Gaps in knowledge that is relevant to the text;

2. Lack of awareness regarding which knowledge is relevant;

3. Lack of understanding regarding the flexible relationship between upper and lower levels of available schema; or

4. Inability to make inferences in order to make an overall representation of the information given in the text.

It seems, then, that if readers are not actively using their prior knowledge, a significant element of the reading process is not instantiated and the construction of meaning suffers (Carrell, 1983). This implies that good teaching should focus on a wide range of concepts with an emphasis on how and why things function and how ideas interrelate.

Related Research

Researchers have explored various aspects of the relationship between background knowledge and prose comprehension, both supporting and extending the view of theorists. This research has focused on three areas: 1) validation of prior knowledge as a factor in comprehension; 2) exploration of the effects of prior knowledge on comprehension, and 3) the development of appropriate measures of prior knowledge.

Prior Knowledge and Reading Comprehension

This section begins by tracing the development of research that validates prior knowledge as a factor in comprehension. It then reviews investigations that explore how prior knowledge affects comprehension.

During the past ten years, it has been generally accepted that what a person knows and understands about a topic facilitates comprehension. Several studies have suggested that prior knowledge plays a part in comprehension processing (Anderson, Spiro, & Anderson, 1978; and Pitchert & Anderson, 1977).

Dooling and Lachman (1971) demonstrated that knowledge of the theme of a passage facilitates retention of its words. Based on the findings of a study by Pompi and Lachman (1967) that showed, when given a word list, readers "recognized" theme related words as being in a passage when they were not, Dooling and Lachman controlled the syntactic and semantic constraints of language to demonstrate that knowledge of the theme or gist of the passage facilitates retention.

They conducted two experiments that were essentially the same, but differed according to the manner of measuring retention, either by free recall or paced recognition. For free recall, subject were to write in three minutes all words remembered. For the paced recognition task, subjects

were instructed to sort the test words in yes/no piles according to whether they were remembered as being in the passage or not. Syntactic constraints (random words, random phrases, and intact sentences) were also imposed by placing each word on its own IBM card and randomizing words and phrases by computer algorithm. Passages were presented either with or without a title, being created so that the important ideas could not be grasped in the initial reading unless the title were present.

Analysis showed significant effects for both thematic title and syntactic constraint. That is, those subjects who were given the thematic title recognized more words related to the content than function words, suggesting that thematic title is used as a mnemonic device in the retention of text.

Bransford and Johnson (1972) conducted a series of studies that showed contextual knowledge to be a relevant prerequisite for the comprehension of prose passages. The subjects, volunteer high school or university students, heard passages of normal English construction. They then predicted the outcome of their comprehension performance on a 1-4 scale and wrote all they could remember.

In Experiment I, it was predicted that subjects who received appropriate prerequisite knowledge would comprehend more easily and would recall relatively well. The prerequisite knowledge was presented either in the form of a contextual or partially contextualized picture. The passage

described events that could happen in that context, but did not describe the picture itself. Conditions varied as to whether subjects received a full or partial picture, or no picture and according to presentation time (before or after the passage). Findings indicated that presenting context before the passage had a clear advantage, resulting in both greater comprehension predictions and the recall of a greater number of ideas.

Bransford and Johnson reasoned that understanding context is a prerequisite to understanding the events of the passage. Receiving the context later is not helpful.

Subsequent studies by the same investigators were based on the premise that if a passage does not provide sufficient semantic context then the subjects are in a problem-solving situation and must find a suitable organization for their prior knowledge. Topics chosen were ones that the investigators thought were part of the subjects' pre-experience. Conditions varied: Experiment II - no topic, topic before, topic after listening; Experiment III - topic, no topic; and Experiment IV - no topic, topic before, and topic after.

Analysis in all three of these later studies indicated that both comprehension prediction ratings and recall were lower in the no topic or topic after conditions. Bransford and Johnson (1972, p. 724) concluded that "prior knowledge of situation does not guarantee its usefulness for

comprehension. In order for prior knowledge to aid comprehension, it must become an activated semantic context." In comparing the studies to those of Pompi and Lachman (1967) and Dooling and Lachman (1971), Bransford and Johnson suggested that the presence of 'topic' is more than a mnemonic device; it serves as a schema for remembering by creating a context that can be used during reading to help link what readers already know to the new information presented. This study presents some interesting findings regarding the use of topic as a context in the activation of prior knowledge.

Further insight into the influence of prior knowledge on comprehension is provided in a study by Dooling and Mullet (1973) who demonstrated that to be effective, theme must be available for encoding information during input. Dooling and Mullet found that the free recalls of stories with a clear coherent theme, that was difficult to grasp without the title, were better for subjects who received the thematic title before reading than for subjects who received the theme after reading, or for control group subjects who did not receive the theme. Recall performance of the 'after' and control groups was not significantly different.

Similarly, Sulin and Dooling (1974) found that on both immediate and delayed testing, subjects who were provided with a true character identity rather than a fictitious character identity, before reading a short biographical

passage, made a greater number of thematic false recognitions when presented with original and thematically related sentences. These results suggest that text is stored in schematic form and that thematic assimilation increases over time.

Focussing on how prior knowledge directs comprehension processing, Schallert (1976) investigated the effects of context and level of processing on both comprehension and memory for text. In contrast to the previously discussed investigations that used passages with unspecified referents, Schallert used passages which were highly comprehensible, but which could be interpreted in either of two ways. She predicted that if readers were primed by a particular context, their recall (free and cued) would reflect comprehension of the primed meaning. This prediction was based on the assumptions that: 1) subjects remember whatever semantic representation is formed during comprehension (Reder, Anderson and Bjork, 1974; Tulving and Thompson, 1973); and 2) readers process paragraphs at the semantic level, since only readers who are processing paragraphs meaningfully will be influenced by the context of their prior knowledge (Craik & Lockhart, 1972).

The results of her investigation indicate that a context title influences the comprehension and memory of text. On post reading recall and recognition tasks, subjects remembered more information related to the given

context when semantic instructions were given. In other words, context influences both how much a person remembers and the interpretation of text, hence, what a person remembers.

To ascertain if young children comprehend and reconstruct a story in relation to their preexisting schema in the same manner as adults, Brown, Smiley, Day, Townsend and Lawton (1977) conducted two investigations that reproduce, support, and extend the work of other researchers (Bransford & Johnson, 1972; Dooling & Lachman, 1971; Sulin & Dooling, 1974). These investigators provided students in grade two to seven with different backgrounds from which to analyze and construct the meaning of vague and ambiguous prose. After listening to the passage, subjects completed recognition tasks and recalls (Experiment I) or recalls and questions (Experiment II). Results indicated that: 1) children are capable of making more inferences than indicated in their recalls, 2) older children recall more than younger children; 3) the proportion of intrusions is the same across ages, but those of older children are more related to theme; and 4) recall is better when a framework is provided than when it is not. Brown et al. concluded that young children do use preexisting knowledge to elaborate retension of prose.

Summary

Prior knowledge of thematic title (Dooling & Lachman, (1971) and context (Bransford & Johnson, 1972) was found to influence both the understanding and retention of information. This is consistent with the theoretical notion that people store knowledge as abstract concepts and not as words, and moreover, that word meanings are "context sensitive" (Anderson & Pearson, 1984). This effect was shown to be greater during input or storage than at reconstruction, although a schema was found to have some effect at the time of reconstruction (Dooling & Mullet, 1973; Schallert, 1976).

As in Bartlett's studies, thematic intrusions during recall were found to be greater over time (Schallert, 1976; Sulin & Dooling, 1974). When studies were extended to include younger children, intrusions were found to be similar across ages, although the intrusions of older children were found to be more thematic (Brown et al., 1977).

Effects of Prior Knowledge on Reading Comprehension

The following studies investigated the effect of prior knowledge on different levels of comprehension.

Pearson, Hansen and Gordon (1979) investigated the applicability of schema theory to young children's ability to process explicitly-stated and inferrable information.

Based on schema theory research, Pearson et al. hypothesized that young children with strongly developed schema act like older children in a variety of cognitive tasks. First, those with high prior knowledge display superior comprehension of explicit ideas compared to those with less prior knowledge. Second, because of the slot-filling function of schema, high prior knowledge students also display superior comprehension of ideas partially specified in the text. Their study differed from earlier research in four ways, employing: 1) unambiguous text (basal reader selections) rather than contrived text; 2) young, above average grade two readers, instead of high school or university students; 3) assessment and control for individual prior knowledge using pretest questions instead of inserting schema in the text or readers' minds; and 4) comprehension assessment of both literal and inferential comprehension using 'wh' questions instead of recall.

Analysis showed the data to be partially consistent with the prediction; there was an overall prior knowledge effect on comprehension, but there was no significant question type interaction. That is, the strong schema group were able to answer more questions at both literal and inferential levels than the weak schema group. This would seem to imply that the quantity of prior knowledge affects both literal and inferential comprehension. However, further analysis indicated a significant relationship

between prior knowledge and inferential, but not literal, comprehension. Pearson et al. (1979) concluded that prior knowledge facilitates comprehension, in particular inferential comprehension. This study extends the applications of schema theory to young readers' comprehension of typical text.

Taylor (1979) attempted to gain insight into the reading strategies of poor readers, particularly their ability to use knowledge-based processing. She compared good and poor readers' recall of familiar and unfamiliar text. Based on the assumption that good readers use prior knowledge when reading easy, familiar text but rely on less effective text-based processing when sufficient topic prior knowledge is not available, Taylor proposed that given two passages, one familiar and one unfamiliar, good readers would comprehend less and, hence, recall less of an unfamiliar passage because they were forced to use test-based processing. Further, she proposed that poorer readers would show little difference in comprehension and recall between the familiar and unfamiliar passages, if they rely more on text-based processing.

Subjects, third and fifth grade students reading at a grade three level plus fifth grade students reading at grade placement level, read and orally recalled the content of two third grade passages. The passages, previously tested on other students from the same grades, were designated as

familiar and unfamiliar. The retellings were scored for number of ideas recalled. All groups recalled more on the familiar than the unfamiliar passage, supporting the idea that for both good and poor readers, prior knowledge aids comprehension and recall. Both grade five groups recalled more than the grade three groups on the familiar passage and the good grade five group recalled more than both the grade three and the poor grade five readers on the unfamiliar passage. However, the poor grade five readers had a greater difference in the amount recalled on the two passages than the third and fifth grade good readers. Taylor concluded that, although the findings cannot be generalized to other passages, they do support the notion that poor readers as well as good readers depend on schema-based processing and that comprehension and the ability to recall suffers when prior knowledge is restricted and subjects resort to ineffective text-based processing.

Marr and Gormley (1982) further investigated children's ability to comprehend expository texts that are familiar and unfamiliar. Their study was designed to use probe questions and retellings to examine the differential comprehension of structurally equivalent texts resembling those that children would likely encounter in the classroom. They predicted that the amount and type of information recalled from the text would be related to both the knowledge the children brought to the task (Pearson et al., 1979) and to the type

of comprehension task (Tierney, Bridge, & Cera, 1978-79). Retellings were expected to produce more textually explicit information and probe questions to produce more textually implicit information.

Grade four students, classsified as good, average, or poor readers, answered prereading probe questions, read expository passages, generated oral retellings and responded to probe questions. All students were tested individually on six passages, one familiar and one unfamiliar for each of three general topics: sports, insects and fruits.

The Marr and Gormley study differed from earlier studies designed to define prior knowledge. Prior to reading, students were asked explicit probe questions related to the specific passage. Pre and post question and retelling responses were categorized as textual or scriptal after Pearson and Johnson (1978). This facilitated the identification of general prior knowledge of the topic (scriptal) and specific prior knowledge of the text. Also, information obtained in the prior knowledge measure (prequestions) was eliminated from the retelling protocols and post questions to guard against cueing subjects and thereby contaminating post reading comprehension data.

Marr and Gormley found that the three groups did not differ significantly in textual or scriptal knowledge or in their memory of information. Textual responses were greater for the retellings than for the probe questions, although

textual responses varied with familiarity and topic, as expected. Results indicated that topic familiarity had a significant effect on comprehension. Like Pearson et al. (1979), Marr and Gormely concluded that this effect is greater for inferential comprehension, not textual comprehension. Scriptal information in the retelling and the probe questions varied as a function of the scriptal information in the prereading questions responses. However, further analysis indicated that the strongest indication of ability to make inferences about a topic is general prior knowledge, as measured quantitatively.

In summary, the Marr and Gormley findings support the research of others. Consistent with the findings of Brown et al. (1977), retellings elicited more text-based responses, whereas probe questions elicited more prior knowledge (scriptal) responses. General knowledge of the topic is the strongest predictor of ability to draw inferences, while reading ability appears to be a reasonable predictor of ability to recall specific textual information (Pearson et al. (1979). This is not supported by Anderson, Spiro and Anderson (1980) who suggest that prior knowledge has an effect on both textual and scriptal comprehension.

A study was undertaken by Holmes (1983) to compare good and poor readers' ability to answer post reading questions when passages are at the instructional level and when prior knowledge of the answers has been measured.

Holmes predicted that there is no difference in the ability of good and poor readers to answer questions when text is at their instructional level as suggested by Taylor (1979).

Prior knowledge on two topics, snakes and sharks, was assessed using open-ended, 'wh' and yes /no questions. For each idea in the passage, four pre-reading questions ranging from general to specific were used. Testing was conducted individually and subjects did not complete the full set of four questions when they were unable to answer. In this way, Holmes avoided cueing for passage content while rating subjects' levels of prior knowledge. Two passages were created for each topic, one for each level of reading ability. A week after completing the prior knowledge measure, subjects read the passage and for each of the ten paragraphs in the passage, answered four post reading questions orally. The questions fell into the following response categories: a) one-idea text explicit; b) one-idea text implicit; c) two-idea text explicit; and d) two-idea text implicit.

For analysis, subjects were grouped according to reading ability and topic prior knowledge: good readers with more topic prior knowledge; poor readers with more topic prior knowledge; and good readers with less prior knowledge. The results provide insight into differences in how good and poor readers use their prior knowledge to comprehend expository text. Holmes found that good and poor readers

used prior knowledge equally for explicit information. However, poor readers were found to have greater difficulty responding to implicit level questions than good readers, even when they had the correct information in their schema. As compared to good readers, poor readers had more difficulty in both changing misinformation and learning new information, suggesting inflexiblity in terms of being able to accommodate textual information that conflicted with their prior knowledge. Holmes suggests that activating the prior knowledge of poor readers may make them more aware of both contradictory and new information; that is, make them aware of what they do and do not know.

Summary

Research provides support for the notion that prior knowledge has an effect on the ability to remember explicitly stated information, while findings about its relationship to the ability to process implicit information are contradictory.

Readers with high levels of topic familiarity recalled more ideas than those with low topic familiarity (Hare, 1982; Holmes, 1983; Pearson et al., 1979). Further, when retellings were compared to text propositions and labeled textual or scriptal, a greater number of the retelling responses were textual (Marr & Gormely, 1982). This seems to hold for both good and poor readers who have adequate prior knowledge (Taylor, 1979).

Children were also found to make more inferences than their recall protocols indicated. Pearson et al. (1979) found that prior knowledge had a profound effect on the ability to answer script implicit questions. In their study of second grade students, readers with high prior knowledge were found to perform significantly better than those with low prior knowledge on scriptally implicit questions but not on text explicit questions. This is supported by Marr and Gormley (1982) who found that literal probes resulted in more scriptal responses.

Holmes (1983) found that although good and poor readers with high prior knowledge did not appear to differ in their ability to use prior knowledge for explicit information, good readers were better at using prior knowledge to answer text implicit questions. This would seem to indicate that the inference problem might be due either to something other than lack of prior knowledge or to the quality of the prior knowledge itself. That is, problems comprehending could be related to the ineffective use of prior knowledge resulting from difficulty maintaining schema.

Measuring Comprehension in Relation to Prior Knowledge

Comprehension involves establishing in one's mind a framework of the author's intended meaning. According to theory, this is accomplished by organizing information from

the text and one's prior knowledge according to a preceived causal chain (Johnston, 1984).

The effect of prior knowledge or comprehension has generally been established by assessing recalls. The earliest studies (Bransford & Johnson, 1972; Dooling & Lachman, 1971) used both recall and recognition tasks as measures of comprehension. Others employed only recalls (Dooling and Mullet, 1973; Sulin and Dooling, 1974; Taylor, 1979). The recalls were rated quantitatively, according to the total number of ideas and number of main ideas. However, many have criticized this procedure (Hare, 1982; Holmes, 1983; Pearson, et al., 1979) contending that scoring recalls quantitatively only assesses the recall of text explicit information, but not the inferences subjects have made. To correct this problem, more recent investigators have added probe questions to the quantitative assessment of recall (Hare, 1982; Holmes, 1983; Marr & Gormley, 1982; Pearson, et al. 1979). These studies are better able to evaluate the effects of prior knowledge on comprehension because they tap information not stated explicitly in the text. Wixson (1983) used such an approach in comparing the learning effect of question types on comprehension when she categorized recall propositions according to Pearson and Johnson's (1978) text explicit, text implicit, and script implicit question-answer relationships.

Thus, questions and the quantitative scoring of recalls used in conjunction with one another provide a convenient and objective means of assessing both literal and inferential comprehension. Nonetheless, as quantitative measures, they assess product and not process; hence do not easily facilitate the understanding of how prior knowledge affects comprehension, only that prior knowledge does affect comprehension.

Gambrell, Pfeiffer, and Wilson (1985) explain that recalls provide insights into the reader's assimilation and reconstruction of text information. These retellings usually include both text specific information and inferences that are textually implied and conceptually related to existing knowledge. Recalls thus may be used to measure both the product (facts, details, causes, sequence) and the processes (making connections between text and prior knowledge) involved in comprehending text. It is possible that a qualitative analysis of recall propositions would provide better information regarding inferential ability, if a scoring system designed to separate the information reproduced in exact form (explicitly processed) from information reconstructed according to knowledge already stored (implicitly stored) were employed.

Drum and Lantaff (1978) outline such a system for classifying recall responses. Their categorical analysis (text specific, text entailed, text evoked and text

external) applied to oral retelling responses indicated differences between good and poor comprehenders in the eighth grade. Able readers made more text derived inferences and case-linked arguments than less able readers. Less able readers mostly stated and repeated the same text proposition or elaborated on only one text proposition.

Malicky (1985) describes a similar categorization system for asssessing unaided recalls. In her research that used a qualitative system for assessing recalls (Beebe, Fagan, & Malicky 1981, cited in Malicky, 1985), she found that a combined category of synthesis and inference was a better predictor of comprehension performance than a text exact/specific or literal level category. Malicky contends that classifying recall units into such categories establishes the reader's ability to use both text explicit information and background knowledge to construct meaning that is consistent with the author's. Such a categorical analysis of text recalls would seem to help clarify how prior knowledge is used in the processing of text.

While it seems to be more appropriate to measure reading comprehension performance through a qualitative rather than a simpler quantitative analysis, there is little consensus regarding the measuring of prior knowledge. This topic is addressed next.

Measuring Prior Knowledge

The assessment of prior knowledge has provided a challenge for researchers. Important considerations have been: 1) efficiency regarding the preparation and scoring of the measure; and 2) interpreting the information. The first studies, discussed in an eaarlier section of this review of research, controlled for prior knowledge either by externally manipulating or by assigning prior knowledge as being present or absent. Subject prior knowledge was not measured individually. In these studies, researchers assigned either a thematic title (Dooling & Lachman, 1971; Dooling & Mullet, 1973), a thematic character - either real or fictitious (Sulin & Dooling, 1974), or a primed context (Bransford & Johnson, 1972; Schallert, 1976), assuming that the presence of these prompts would activate an already present schema. Passages were written to fit two meanings in order to provide for the change of title, character, or context. Thus, compared to children's regular reading materials, selections were contrived, being unnatural in both organization and length. Although these studies provide support for the notion that prior knowledge relates to thematic title and character, and that context influences comprehension, controlling prior knowledge in this way is not amenable to classroom practice.

Recent investigators have attempted to design studies which reflect natural reading practices and materials. These studies have either used actual school textbook materials (Hare, 1982; Pearson et al., 1979; Stevens, 1980) or created materials that closely resemble natural text (Holmes, 1983; Marr & Gormely, 1982). In addition, controls for prior knowledge have been based on the "internal" knowledge of the subjects. Passage familiarity or unfamiliarity has been based either on realor fictitious animals (Peek, van den Bosch, & Kreupeling, 1982); previous research use (Carrell, 1983); peer group field testing on subjects not used in the study proper (Taylor, 1979); or testing the prior knowledge of individual subjects (Holmes, 1983; Marr & Gormley, 1982; Pearson et al., 1979; Stevens, 1980).

While the field testing method used by Taylor (1979) provides some assurance that the categories of familiarity are likely true for a particular population and her procedure is efficient in terms of time, it does not provide information on individual differences in prior knowledge. Lacking this information, the investigation is not able to examine the relationship between prior knowledge and inferential, as opposed to literal, comprehension.

Individual prior knowledge measures are topic specific. Designed to measure individual subject's topic familiarity, they provide more information. Most, however, take both

time and effort to prepare. However, as research tools, the pre-testing 'wh' questions used by Pearson, et al. (1979), the multiple-choice questions used by Stevens (1980) and the probe questions of Marr and Gormley (1982) may have contaminated study results by cueing the reader as to which information in the text was important. This is of particular concern when pre and post questions are the same (Marr & Gormley, 1982) because the questions serve more as an advance organizer than a prior knowledge measure. Holmes (1983) sought to make up for this limitation by testing students individually and by organizing questions from general to specific and ceasing the prior knowledge questioning when a question was not answered correctly. This minimized the cueing effect, although her procedure was not an efficient measure in terms of preparation and administration time.

Langer (1980) developed a prior knowledge measure which is both efficient to prepare and to score, while at the same time eliciting information about individual prior knowledge. Prior knowledge was elicited through free associations with key concepts taken from the target passages. Following the free association task, 36 high school students from advanced English literature classes silently read the passage and wrote all they could remember. This procedure was followed for two passages, Schizophrenia and Parakeet, used by Meyer (1975). Prior knowledge was scored as 'little', 'some', or

'much' (1, 2, or 3 points) by categorizing the associations according to a system that reflected the organization of pre-reading topic knowledge. These categories were similar to Vygotsky's (1962) conceptual development categories and progressed from diffuse, personal responses to concrete, functional responses to abstract superordinate principles (Langer 1980; 1984). Recall protocols were scored using Meyer's (1975) text analysis system, with one point being given for the recall of content words and lexical predicates and two points for role relations and rhetorical predicates. Each third of the text structure was scored separately and then totalled.

Analysis indicated that there was a positive relationship between prior knowledge and recall. Responses in the top third of the structure correlated with prior knowledge but the other levels had low correlations. The levels of prior knowledge and recall of content words was constant across passages, while correlations between total recall and prior knowledge were not the same across passages, indicating that prior knowledge was passage dependent.

Langer, using Meyer's explanation to account for the low correlations, indicated that information in the lower levels of structure is not retained and recalled as well as information high in the structure. She concluded that information presented lower in the text structure possibly may not be related to prior knowledge.

Langer (1981) and Langer and Nicholich (1981) extended this research to validate the prior knowledge measure, using the same test conditions. These studies showed the level of background knowledge (as measured by Langer's qualitative measure of prior knowledge) to be highly related to recall, independent of either intelligence or general reading level. However, Langer did not attempt to compare her findings with prior knowledge measures used by others, offering no support for a qualitative prior knowledge measure nor reasons why her qualitative measure might be better that the accepted 'quantity' measures (Pearson, et al., 1979; Stevens, 1980).

Langer indicated two avenues for future research: to examine whether differences in prior knowledge levels makes a difference in what is retained, and to examine the influence of prior knowledge on the specific categories of retelling protocols.

To further investigate the relationship between topic-specific prior knowledge and comprehension, Langer (1984) conducted another study. The purposes of this study were to validate the prior knowledge measure further and to explore the usefulness of variations in calculating the measure of prior knowledge; that is, organization (quality) and frequency (quantity). In this study Langer used a larger sample (161 grade six students) and two passages selected from a school social studies text. The prior knowledge measure was prepared in the same manner as the

previous studies; comprehension was measured by 20 multiple-choice questions (10 explicit and 10 implicit) rather than the previously used written retellings scored for explicit recall. Subjects made free associations in response to target words, read the passages and answered questions. They were assigned to four groups according to types of prereading activity: 1) PReP, a discussion of key concepts; 2) motivation, a more general topic discussion; 3) no prereading activity; and 4) distractor pre-reading activity. Only questions and not free recalls were used to test comprehension, with the passage being available for referral. Prior knowledge free associations were scored two ways: 1) qualitatively, on a 3-point scale according to where in the text organization the idea was presented, as in the earlier studies, and 2) quantitatively, according to the total number of responses.

Results indicated that Langer's passage specific prior knowledge measure was a reliable predictor of 'wh'-comprehension with no consistent differences as a predictor of responses to textually-explicit and textually-implicit 'wh' questions. Langer concluded that these results, coupled with ease of administration and scoring, makes the qualitative prior knowledge scoring procedure a promising approach for the control of prior knowledge in research and for examining the effects of topic specific knowledge on comprehension. Langer also indicated

that the measure can be used as an individual or group diagnostic device to help teachers select text appropriate instructional texts and to identify students who require direct concept and vocabulary instruction.

The frequency counts or quantitative score showed significant relationships to comprehension. However, the proportion of the variance accounted for explained less than a tenth of that accounted for when the qualitative scoring procedure was used, suggesting that the qualitative score is more strongly related to comprehension than the quantitative score.

These latter results contradict those found previously by Hare (1982) who conducted a validation study of Langer's earlier research (Langer, 1981; Langer & Nicholich 1981) with 29 grade six students, using one passage from a school science text. Hare demonstrated that Langer's free association tasks, when scored both qualitatively and quantitatively, successfully predicted recall. However, the quantitative scoring was seen as a better predictor of recall (explicit comprehension) unlike Langer's 1984 explicit 'wh' questions. This is perhaps because in addition to free recalls, Hare used open-ended scriptually implicit questions to measure comprehension. Neither prior knowledge measure predicted performance on implicit open-ended questions adequately (Hare, 1982). These findings also contradict those of Pearson et al. (1979) who found that a

quantitative prior knowledge measure using 'wh' questions was related to successul inferential comprehension. Hare tried to account for these discrepancies by reasoning that her results may have been due to questions that were both too few in number and too difficult.

Zakaluk et al. (1986) developed a simple technique, adapted from Noble (1952), for estimating prior knowledge through word associations. This technique is similar to that used by Langer. Students made free associations to a stimulus word or phrase repeated on each line of the page to keep associations related to the key word(s) and to prevent tangential associations. For scoring, responses were awarded one point for each appropriate association. When a series of sub-items were generated, only one point was awarded. When these were subsumed under a named category, one point was also awarded for the category. Irrelevant associations received zero points. Based on research conducted by Zakaluk (1985), in which the association task correlated significantly with comprehension, Zakaluk et al. (1986) suggest classifying results into low, average, and high prior knowledge with 0-2 points indicating low prior knowledge, 3-6 points average, and 7 or more points high prior knowledge.

Summary

Three major areas were explored in this chapter to provide a rationale for the present investigation. First, relevant schema theory and prior knowledge research were examined with particular regard to the effects of prior knowledge on the comprehension of text. Second, measures of comprehension were reviewed with an eye to employing measures that discriminate quantity (product) and quality (process) of comprehension. Finally, research conducted to develop or validate prior knowledge measures was reviewed.

From the review of the literature it is evident that research supports and extends the views of theorists on the effect of prior knowledge on the comprehension and retention of text.

1. Consistent with the notion that knowledge is stored as abstract concepts and not as words, and that word meanings are context sensitive (Anderson & Pearson, 1984), prior knowledge of thematic title (Dooling and Lachman, 1971) or context (Bransford and Johnson, 1972; Schallert, 1976) was found to influence the understanding and retention of text information.

2. As in Bartlett's (1932) studies, thematic intrusions during recall were found to be greater over time (Schallert, 1976; Sulin & Dooling, 1974). Intrusions were also found to

be the same across ages, although those of older childer were more thematic (Brown et al., 1977).

3. Children were found to make more inferences than recall indicates. Probes resulted in a better show of inference ability (Marr & Gormley, 1982), supporting the Pearson et al. (1979) finding that prior knowledge has a profound effect on the ability to answer implicit questions. Rumelhart (1980) indicated this when discussing how variable constraints help in identifying various aspects of a situation, thereby providing 'initial guesses' or inferences about unobserved aspects of a situation. Holmes (1983), however, found contradictory results. Although good and poor readers did not appear to differ according to their ability to use prior knowledge for explicit information (Holmes, 1983; Taylor, 1979), good readers were better at using prior knowledge to answer implicit questions.

4. Mobilizing prior knowledge was found to be important. It is not enough to have a schema; to be effective it must be activated (Bransford & Johnson; 1972).

The effects of prior knowledge were generally measured by making comparisons between prior knowledge scores and comprehension as measured by recall performance. Early studies used recall and recognition tasks. Later investigators pointed out that recalls, scored quantitatively, measured only memory for explicitly stated text information and not inferences based on implicitly

processed imformation. To remedy this problem, in further research some investigators employed both recalls and implicit questions; while others used only questionsthat required both explict and implicit responses. While it appears that these studies measured both literal and inferential comprehension, scoring recalls quantitatively does not permit the examination of the processing of implicit information.

Both Drum and Lantaff (1978) and Malicky (1985) have suggested classification systems for the qualitative scoring of recall protocols. The use of their procedures should facilitate the examination of protocols for information that is implicit in the text and thus offer more insight into the role of prior knowledge in comprehension processing.

Measures of individual topic familiarity both varied in format and in their ability to guage prior knowledge. Quantitative measures were found to predict the total number of ideas recalled (Hare; 1982; Holmes; 1983) and the ability to make inferences (Marr & Gormley, 1982; Peason et al., 1979). Zakaluk (1985) indicated that an association task scored quantitatively correlated significantly with comprehension as measured by text explicit, text and script implicit questions. Langer (1981) developed a qualitative scoring procedure for free associations which she found to be an effective predictor of overall recall. Subsequent research (Hare, 1982; Langer & Nicholich, 1981; Langer,

1984) provided validation. Langer's (1984) finding that a qualitative prior knowledge measure was a better predictor of inferential comprehension as measured by 'wh' questions contradicts Hare's (1982) work that assessed inferential comprehension by means of open-ended questions and found that neither a qualitative nor a quantitative scoring of prior knowledge adequately predicted inferential comprehension.

Thus, research provides support for the notion that prior knowledge affects the comprehension and retention of prose. It would appear, however, that different measures of prior knowledge provide different indications of comprehension performance. There is some evidence that prior knowledge has a greater effect on the ability to respond to implicit questions, but this is not conclusive.

The present investigation builds on the findings of prior knowledge research. The study examines how quantity and quality of prior knowledge influence students' ability to respond to questioning at literal and inferential levels and to recall. It is anticipated that quality of prior knowledge will be a more effective predictor of inferential comprehension; while a quantitative measure will predict literal comprehension.

Chapter III

PROCEDURES

The present study examined the responses of sixth and ninth grade able readers on written retellings and literal and inferential open-ended questions to determine whether significant differences existed in their literal and inferential comprehension of informational text as predicted by quantitative or qualitative measures of prior knowledge.

The general purpose of this study was to examine the effectiveness of two topic prior knowledge measures as predictors of comprehension of expository text. For two factual passages, able readers at the sixth and ninth grade levels completed pre-reading topic prior knowledge measures, read the passages, and after reading, indicated passage comprehension by: 1) completing written retellings and 2) responding to open-ended literal and inferential questions.

Method

Subjects

The subjects were selected from among a sample of grade six and grade nine students in elementary and junior high suburban schools. Grade six and nine able readers were selected for this study because 1) they have had prior experience with expository text and 2) the three year differential provided the investigator with an opportunity

to examine data for developmental trends in the processing of expository text.

Upon permission from school division superintendents, administrators of elementary and junior high schools who expressed an interest in participating were contacted. Students in 7 sixth and 7 ninth grade language arts classes served as subjects.

The classroom teachers for the grade six students and the language arts teachers for the grade nine students were asked to identify, from their class list, the names of able readers. This selection was based on teacher judgment supported by the percentile scores on the Canadian Achievement Test (1981). By selecting able readers, only students who had no word recognition problems that would interfere with comprehension processing (Samuels, 1984) took part.

All able readers in the respective sixth and ninth grade classes participated in the study, except for two classes in which a letter of consent for some students was not received. (See Appendix C for Consent Letter.) The initial sample consisted of 261 subjects, 123 grade six and 138 grade nine able readers.

Research Instruments

Reading materials. The reading materials for this study consisted of four expository passages. The passages, one science and one social studies for each grade level,

were selected from randomly chosen school texts authorized for grade six and grade nine social studies and science curriculums (see Appendix D). Topics from two content areas were chosen to allow for greater generalization of the findings. Further, the specific topics of the reading materials were representative of social studies and science curriculum topics. Thus the subjects would possess measureable prior knowledge.

The passages for the sixth grade subjects were identified by the investigator. The social studies passage is found in Canada Growth of a Nation (Garrod, McFadden, & Neering, 1981) under the topic, The Red River Colony. The science passage, Classifying Living Things, is found in Discovering Science Six (Piltz & van Bever, 1970). The Fry Readability Graph (Fry, 1977) showed the readability level of both passages to be grade 6. The passages were approximately the same length (441 and 420 words; 33 and 34 sentences, respectively) and contained approximately the same number of clausal units (48 and 46).

The grade nine passages were those used by Zakaluk (1985) in a study for standardizing expository passages. The social studies passage, "Renaissance", is found in Long Ago in the Old World (Cassidy & van Duyn, 1969); the science passage, "Mutations"' is found in Focus on Life Science (Heimler & Lockard, 1969). The readability level for both passages according to the Fry Graph (Fry, 1977) was grade 9.

The passages were approximately the same length (421 and 435 words, 27 and 32 sentences, respectively) and contained approximately the same number of clausal units (41 and 44).

Directions for reading the passages were presented on a cover sheet attached to each passage. The directions were as follows.

> Read the passage twice. The first time read it to get the general idea and then read it again more carefully for understanding. Read it the same way that you would for a class assignment.
>
> When you are finished, you will be asked to retell all that you remember and to answer questions.
>
> (adapted from: Lantaff, 1978).

Prior knowledge measures. In developing the prior knowledge measure, certain factors were considered: 1) both the quantity and the quality (depth) of topic familiarity; and 2) the need for reading materials from naturally occurring text to ensure ecological validity. As a result, the apriori designation of a topic as familiar or unfamiliar, high or low using ambiguous text (Bransford & Johnson, 1972; Schallert, 1976; Sulin & Dooling, 1974); texts of manipulated theme (Dooling & Lachman, 1971); texts of assumed familiarity and unfamiliarity (Peek, van den Bosh, & Kreupling, 1982; Carrell, 1983); and peer group testing (Taylor, 1979) was not appropriate.

A further consideration in constructing the prior knowledge measure was the need to avoid instructing or

cueing comprehension prior to the passage reading. Many of the prior knowledge measures used by other researchers such as: 'wh' questions (Pearson et al., 1979), multiple-choice questions (Stevens, 1980), and probe questions (Marr & Gormley, 1982; Holmes, 1983) were therefore inappropriate.

The topic prior knowledge measure developed for this study consisted of a free association task similar to the qualitative measure of prior knowledge created by Langer (1980) and validated and extended by Hare (1982) as both a qualitative and quantitative measure of prior knowledge. Three stimulus content words/phrases chosen from the top half of the content hierarchy of each passage were selected for the free association task. Each of the three key words/phrases was presented on separate sheets, repeated on the left column of each line and followed by a lined response space. The purpose of repeating the key words/phrases was to prevent tangential associations (Zakaluk et al., 1986). Written instructions at the top of the page directed the subjects to write down anything that came to mind when they read/heard the word(s) and to write each thought on a new line. (See Appendix E: Prior Knowledge Measure.) In terms of being representative of key passage concepts, the appropriateness of the selected words/phrases, was rated independently by two science teachers for the science passages and by two social studies teachers for the social studies passages.

Data obtained in this way yielded both a quantitative and a qualitative prior knowledge score. A quantitative score was established by totalling and averaging the number of generated associations for the three key words. A quantitative score was established by rating the generated associations according to four topic relevant categories ranging from a high (3 points), for highly organized knowledge, to no knowledge (0 points).

Comprehension measures. Two instruments were used to measure the literal and inferential comprehension of the expository passages: 1) written retellings and 2) open-ended questions (see Appendix F: Comprehension Measures). Because subjects could not refer to the passages while completing the post reading comprehension measures, the measures required subjects to comprehend and to remember.

1. Written retellings. A lined page with written instructions at the top of the page directing subjects to write down as much of the passage as they could remember was prepared for the written retelling responses. Retellings allow a reader to structure a response according to personal and individual interpretations of the text and, as such, are "the most straightforward assessment of the result of text-interaction" (Johnston, 1983, p. 54). A retelling reflects a reader's assimilation and reconstruction of textual information and gives investigators the opportunity

to measure both the product and the process of comprehension (Morrow, 1988).

2. Open-ended questions. For each passage, ten follow-up questions were created. Five literal questions focussed on explicitly stated information in the text while five inferential questions required implicit processing requiring subjects to use either information provided across sentences in the text or their prior knowledge to respond appropriately. The two types of questions used in this study originated from the comprehension categories used by Pearson and Johnson (1978). The literature on post questioning suggests that readers perform better on explicit than implicit questions (Pearson et al., 1979). In addition, test explicit and text implicit questions appear to differ in at least two ways: 1) the number of ideas involved and b) the degree of cognitive processing required - explicit, rote memory; implicit, understanding and inferencing (Holmes, 1983). Questions provide a comprehension assessment format that is both convenient to administer and objective to score and are the predominant means of assessing comprehension (Readence & Martin, 1988).

Data Collection Procedure

All data were collected by the researcher over a period of four weeks near the end of the school year. To provide for the administration of two content area passages, subjects were seen in two sessions of approximately forty

minutes each. For each classroom involved, the sessions were conducted within a seven day period. In each session the data collection followed four steps: 1) free association prior knowledge task, 2) reading of the expository passage, 3) written retellings, and 4) open-ended questions.

To control for order effects, passage presentation was counterbalanced. One half of the subjects at each grade level read the science passage in the first session and the social studies passage in the second. The same procedure was followed at the second sitting so that one half of the subjects in each class read the passages in the reverse order.

Due to absenteeism during the second sitting, the number of students who completed science and social studies passages differed. Thus, the final sample for grade six was made up 119 subjects who read the science and 115 the social studies passage, and for grade nine, 126 subjects who read the science and 128 the social studies passage.

Anonymity was assured. All data collection materials were numbered according to subject and placed in a folder with a corresponding number. Within each folder, the task sheets were in procedural order, separated by colored paper to prevent any contamination that might occur if the subject previewed the tasks out of order. Upon completion of each task, the subject placed the task sheets into a brown envelope, that was labelled with a matching number. This

was to prevent subjects from referring back to previously completed tasks.

The first session began with a scripted explanation of the purpose of the study and the procedure. Following this, subjects were instructed to open their folders to begin the first task. The first task was the free association, prior knowledge task. The scripted directions were read orally by the investigator while the subjects read them silently. The second task was the passage reading. The subjects read the passage twice; once to get a general idea of what the passage was about and a second time for more detailed information. The directions were presented on a passage cover sheet. After reading the passage, the subjects completed the written retelling task, then responded to the questions.

Subjects proceeded from tasks two to four at their own rate, uninterrupted by the investigator. Thus, responses were a reflection of the students' reading comprehension and recall and not a reflection of time or lack of time to respond.

The second session for each class took place within a week of the first and began with a scripted review of the purpose and procedure, followed by the administration of the same tasks as outlined in session one.

Scoring the Data

Scoring of the data was conducted by the investigator. To ensure scoring reliability, 10 percent of the protocols on each task were selected at random and scored by two independent judges who had completed Master's level reading courses. Inter-rater reliability, based on Pearson product-moment correlations, were r=.96 for the quantitative prior knowledge measure and r=.96 for the qualitative measure. The inter-rater reliability coefficients for scoring the written retelling response categories ranged from .87 to .95. Inter-rater reliability for the open-ended questions was r=.95.

Prior knowledge task. The free associations were scored as a prior knowledge measure in two ways adapted from prior work: quantitatively (Hare, 1982; Zakaluk et al., 1986) and qualitatively (Langer, 1980; Langer & Nicholich, 1981).

1. Quantitative prior knowledge. To establish the overall quantitative prior knowledge score for each subject for each passage, the free association responses for each key word/phrase were totalled and an average for the topic was calculated. All free association responses scored one point with the exception of repeated responses, which were discounted. Long lists of items that fell within the same category such as bears, wolves, foxes, and deer were given one point, while the the name of the category, if stated,

also received one point (after Zakaluk et al., 1986). It was felt that long lists reflected associations generated from new words and not the original key words, despite efforts to prevent this by representing the key words repeatedly on the left side of each line down the response page. The responses for each of the three key words were totalled and the three were averaged for an overall quantitative prior knowledge score for that passage. These overall scores were interpreted as low (0-2 points), average (3-6 points), or high (7 or more points) (Zakaluk et al., 1986).

2. Qualitative prior knowledge. To establish the qualitative prior knowledge score for each subject, the free association responses for the key words/phrases were classified according to the levels of prior knowledge developed by Langer (1980). The responses received a rating of a) much (3 points) when associations reflected the use of subordinate concepts, definitions, analogies, and concept linking, b) some (2 points) when associations reflected examples, attributes or defining characteristics, c) little (1 point) when associations were tangential cognitive links, morphemes, sound alikes, first hand experiences, and d) none (0 points) for incorrect associations or "I don't know" responses. Further clarification of Langer's (1981) classification system may be found in Appendix A: Quality of Knowledge: Categorization System.

Because more than one response was given for each stimulus word, the highest level response for each word was tabulated. It was assumed that if the subject produced one response at a level, the subject possessed knowledge at that level. The qualitative scores for the three key words/phrases were totalled and averaged to yield an overall qualitative prior knowledge score for each subject for each passage.

Written retellings. Using a retelling template of the passage, each subject's written retelling protocols were scored for literal and inferential comprehension by scoring the presence of explicitly stated information and the presence of implicit ideas. Template protocols of the passages and each subjects written retelling protocols were divided into clausal units that either contained a subject and predicate and could stand alone (principal clause) or assumed a subordinate function (adjective or adverb clause) and did not make sense on their own. The recalled units were then matched to the passage template units and classified according to recall categories adapted from Drum (1978), Lantaff (1978) and Malicky (1985) as being either: text specific, text embedded, text entailed, text evoked, text external, and text erroneous responses, and scored as follows. (See Appendix B for further description of the retelling categories.)

The retelling units received one point for each passage unit processed to produce the recalled unit. Text specific responses received one point for each unit in the category because there was a correspondence of one text unit to one recall unit. Units in the text embedded and text entailed categories and text erroneous units received one point for each text unit represented in the recall unit. For example, if 3 text units were embedded in one recall unit in the text embedded category, that recall unit received 3 points. Text evoked and text external responses received one point each as they did not match text units.

Each category was totalled to indicate a score of total units recalled by category. (See Appendix G for mean scores and standard deviations.) These scores were used for further analysis.

Questions. The open-ended questions were scored against a template of acceptable answers prepared by the investigator and an expert in the field prior to the investigation. Accurate answers contained the main points or the essence of template answers. Each acceptable answer received one point. For each subject, points were totalled by question type (literal and inferential) for each passage. (See Appendix G for mean scores and standard deviations.)

Design of the Study

The design of the study required, first: consideration of the relationship of prior knowledge to comprehension performance by grade level and passage, and second, the effectiveness of prior knowledge as a comprehension predictor across passages.

The study employed a 2 (grade levels) X 2 (measures of topic familiarity) X 2 (expository passages) factorial design. The independent variables were:

1. 2 measures of prior knowledge (quantity and quality) subdivided into 3 levels (high, medium and low),
2. 2 grade levels (six and nine), and
3. 2 expository passages (science and social studies).

Dependent measures included comprehension as measured by:

1. uncued written retellings categorized into literal (text specific and text embedded) and inferential (text entailed and text evoked) responses, and
2. open-ended questions (literal and inferential).

Analysis of the Data

Correlations were conducted to determine the relationship between the quantity and quality of prior knowledge and each comprehension measure. Separate analysis of variance by grade, one using the social studies, the other the science passsage were conducted. In addition,

analyses of variance by grade across topics were conducted. Analysis of variance was chosen because 1) the values of the independent variables were assigned numbers rather than constant interval values; 2) the dependent variable values were interval values; and 3) the means did not fit the assumption of straight line fit for linear regression (Andrew, Klem, Davidson, O'Malley & Rodger, 1981). A general linear model was used for the analysis of variance procedure because the subgroups contained different numbers of observations. The SAS system was used to conduct the analysis and produced results for two test types: Type I where the SS measured incremental sums of squares for the model as each variable was added and 2) Type III, partial sums of squares where the SS is the sum of squares due to adding that variable last in the model. The TYPE III analysis is principally used in situations that require comparison of main effects even in the presence of interaction (Crum, 1986). In the TYPE III analysis, each effect is adjusted for all other effects.

Summary

This chapter described the subjects who made up the sampling group and the methods used to implement the study. The testing materials, administration, and scoring procedures were outlined, followed by a statement indicating the data analyses procedures. The statistical analyses and findings are presented in Chapter IV.

Chapter IV

RESULTS and DISCUSSION

The purpose of this study was to determine the efficacy of a qualitative as opposed to a quantitive measure of prior knowledge for use in estimating literal and inferential comprehension performance measured by written retellings and open-ended questions. Text from two content areas was employed. Measures of prior knowledge and comprehension were obtained from 123 grade six and 138 grade nine able readers.

The goals of the study were to explore 1) the relative effects of the prior knowledge variables on comprehension performance and 2) how topic familiarity is used in processing explicit and implicit textual information.

Instruments to assess qualitative and quantitative prior knowledge (word association) and literal and inferential comprehension (written retellings and questions) were developed, administered, and scored by the investigator. The prior knowledge protocols were scored first as a quantitative measure according to the number of word associations (Zakaluk et al., 1986), and second as a qualitative measure according to Langer's (1981) categorization system. The written retellings were examined and scored according to 1) recall categories, text specific (RC1), text embedded (RC2), text entailed (RC3), text evoked

(RC4), text erroneous (RC5), text external (RC6), and 2) the number of text clauses processed to produce the retelling responses (Drum, 1978; Lantaff, 1978; Malicky, 1985). The questions were scored as correct or incorrect and totalled by type (literal or inferential). Three scores for each comprehension measure (retellings, questions) were thus obtained: literal, inferential, and total comprehension performance.

Data analyses were concerned with the relationship between the designated prior knowledge variables and the criterion variables of reading comprehension performance in order to determine what prior knowledge measure related most significantly to literal and inferential comprehension performance and what similarities and differences existed between the comprehension processing of grade six and grade nine able readers as indicated in the effect of topic familiarity on explicit and implicit processing required to produce the written retelling responses.

The Relationship Between Prior Knowledge Variables and Reading Comprehension

In order to determine the nature of the relationship between the respective prior knowledge measures with each other and with reading comprehension performance, correlation coefficients were computed and analysis of variance conducted, taking into account the two content area

factors of social studies and science and the two grade levels. For the analysis, the text specific (RC1) and text embedded response (RC2) scores were combined to provide a total literal comprehension score for the written retellings (RC1RC2), and the text entailed and text evoked response scores were combined to provide a total retelling inferential score (RC3RC4). Question response scores were totalled by type (literal and inferential). A total score of five for literal (QuesL) and five for inferential (QuesI) comprehension was possible. Using a general linear model to accommodate differing numbers of observations in the subgroups, analysis of variance was conducted by 1) grade and topic and 2) grade across topics. This analysis produced results for SAS Type I and Type III tests, where the Type I SS measured incremental sums of squares for the model as each variable was added, and Type III SS was the sum of squares due to adding the variable of interest last in the model (Crum, 1985).

Results of this analysis are described as follows. First, a descriptive analysis including correlations and mean performance is presented. Second, the inferential analysis is presented according to each of the research questions.

Descriptive Analysis

Correlations

The relationship between prior knowledge and comprehension was investigated first with the measures of prior knowledge (quantitative and qualitative) entered as the independent variables and the levels of comprehension (literal and inferential) for each of the comprehension measures (written retellings and open-ended questions) entered as the dependent variables.

Grade six. As indicated in Table 4.1, when the correlations between quantity and quality of prior knowledge were compared for grade six science, there was a higher correlation between inferential retelling responses (RC3RC4) and quality of prior knowledge (PKQL) (r=.41) than between inferential retelling responses (RC3RC4) and quantity of prior knowledge (PKQT) (r=.33).

For science, there were substantial relationships (Ekwall & Shanker, 1988) between: 1) literal questions (QuesL) and literal level retellings that combined text specific and text embedded retelling responses (RC1RC2) (r=.53); 2) literal questions and inferential level retellings that combined text entailed and text evoked retelling responses (RC3RC4) (r=.44); and 3) the two types of questions, literal and inferential (r=.47).

Table 4.1

Correlation Coefficients of Prior Knowledge With Comprehension Performance For Grade Six

Grade Six Science						
	PKQL	PKQT	RC1RC2	RC3RC4	QuesL	QuesI
PKQL	1.00000					
PKQT	0.32464	1.00000				
RC1RC2	0.33896	0.27303	1.00000			
RC3RC4	0.41245	0.34576	0.45417	1.00000		
QuesL	0.29394	0.28543	0.53196	0.43643	1.00000	
QuesI	0.23937	0.35417	0.20619	0.32351	0.46744	1.00000
Grade Six Social Studies						
PKQL	1.00000					
PKQT	-0.00591	1.00000				
RC1RC2	0.18166	0.18589	1.00000			
RC3RC4	0.21220	0.12773	0.26353	1.00000		
QuesL	0.16536	0.35519	0.51490	0.29939	1.00000	
QuesI	0.18388	0.27633	0.23116	0.30657	0.28180	1.00000

PKQL = Quality of Prior Knowledge
PKQT = Quantity of Prior Knowledge
RC1RC2 = Text Specific + Text Embedded Response Scores
RC3RC4 = Text Entailed + Text Evoked Response Scores
QuesL = Literal Questions (n = 5)
QuesI = Inferential Questions (n = 5)

For grade six social studies, however, correlation analysis revealed substantial relationships only between literal questions (QuesL) and literal level retelling responses (RC1RC2) (r=.51).

Grade nine. For grade nine science, as revealed in Table 4.2, correlations between quantity and quality of prior knowledge showed that there were only low relationships between prior knowledge quantity (PKQT) and the four comprehension measures. There were, however, substantial relationships between all comprehension variables in terms of the quality of prior knowledge (PKQL): r=.41 for RC1RC2; r=.55 for RC3RC4; r=.49 for QuesL; and r=.51 for QuesI.

There were also substantial relationships between literal questions (QuesL) and literal retelling responses (RC1RC2) (r=.51), and between inferential questions (QuesI) and inferential retelling responses (RC3RC4) (r=.46), as well as substantial relationships between literal questions (QuesL) and inferential retelling responses (RC3RC4) (r=.49) and inferential questions (QuesI) and literal retelling responses (RC1RC2) (r=.53).

In contrast to the pattern between prior knowledge quality (PKQL) evident in grade nine science, for grade nine social studies, there were no substantial relationships for either quantity (PQKT) or quality (PKQL) of prior knowledge and any measure of comprehension. There nevertheless were

Table 4.2

Correlation Coefficients of Prior Knowledge with Comprehension Performance for Grade Nine

	PKQL	PKQT	RC1RC2	RC3RC4	QuesL	QuesI
Grade Nine Science						
PKQL	1.00000					
PKQT	0.54714	1.00000				
RC1RC2	0.40962	0.16174	1.00000			
RC3RC4	0.54621	0.30728	0.36143	1.00000		
QuesL	0.49129	0.35361	0.51279	0.48633	1.00000	
QuesI	0.51477	0.30247	0.53100	0.46311	0.56909	1.00000
Grade Nine Social Studies						
PKQL	1.00000					
PKQT	0.28752	1.00000				
RC1RC2	0.28363	0.08872	1.00000			
RC3RC4	0.2468	0.34183	0.22947	1.00000		
QuesL	0.18121	0.19557	0.35444	0.38573	1.00000	
QuesI	0.23118	0.20037	0.49829	0.57440	0.36829	1.00000

PKQL = Quality of Prior Knowledge
PKQT = Quantity of Prior Knowledge
RC1RC2 = Text Specific + Text Embedded Response Scores
RC3RC4 = Text Entailed + Text Evoked Response Scores
QuesL = Literal Questions (n = 5)
QuesI = Inferential Questions (n = 5)

substantial correlations between: inferential questions (QuesI) and literal retellings (RC1RC2) (r=.50) and inferential questions (QuesI) and inferential retellings (RC3RC4) (r=.57).

Discussion. While substantial correlations between literal questions and literal level retellings were predictable, correlations between literal and inferential comprehension measures were not expected. These unexpected correlations may be the result of combining comprehension measures in the analysis: either combining across text and scriptal inferences in the inferential questions (QuesI), combining the two categories of literal retelling responses (RC1RC2), or combining the inferential level retelling responses (RC3RC4). Correlations for grade six and grade nine science seemed to indicate a more substantial relationship between inferential retelling responses and prior knowledge as measured by quality and not quantity. This relationship also seemed to be important for grade nine science where there was a substantial correlation between the quality of prior knowledge and literal, in addition to inferential, comprehension performance. There was no clear pattern relating quantity of prior knowledge and comprehension across either grade level or content area. Mean performances on the comprehension measures are examined next.

Mean Performance

Means were analyzed, first, in terms of overall performance according to each comprehension measure: literal retelling (RC1RC2) and literal question (QuesL) scores; and inferential retelling (RC3RC4) and inferential questions (QuesI). Mean performance was then broken down and examined by level of prior knowledge (high, middle, or low) as assigned a) quantitatively and b) qualitatively.

Overall Mean Performance on Literal Comprehension Measures

An examination of tables 4.3 and 4.4 indicates that for both grade six and nine readers, the mean performance on both literal comprehension measures was low. The mean number of clausal units processed to produce text specific and text embedded retelling responses (RC1RC2), reflecting literal comprehension, ranged from 4.79 to 5.9 when the number of clausal units on template protocols ranged from 41 to 48. Mean scores on literal level comprehension questions (QuesL) ranged from 1.8 to 2.69 out of a possible score of five.

Table 4.3

Grade Six Means and Standard Deviations for Literal Comprehension

Variable	N	Mean	Standard Deviation
Science			
RC1RC2	119	4.98319328	3.81563064
QuesL	119	1.80672269	1.45134252
Social Studies			
RC1RC2	115	5.97391304	4.86927508
QuesL	115	2.68695652	1.45918276
Topics Combined			
RC1RC2	234	5.47008547	4.38407702
QuesL	234	2.23931624	1.51756283

RC1RC2 = Text Specific + Text Embedded Retelling Responses
QuesL = Literal Questions (n = 5)

Table 4.4

Grade Nine Means and Standard Deviations for Literal Comprehension

Variable	N	Mean	Standard Deviation
Science			
RC1RC2	126	4.79365079	3.74660905
QuesL	126	1.83333333	1.50598805
Social Studies			
RC1RC2	128	4.30468750	3.52841914
QuesL	128	2.52755906	1.15350929
Topics Combined			
RC1RC2	254	4.54724409	3.63933988
QuesL	254	2.18181818	1.38238161

RC1RC2 = Text Specific + Text Embedded Response
QuesL = Literal Questions (n = 5)

Overall Mean Performance on Inferential Comprehension Measures

As was the case for literal comprehension, overall mean performance on both inferential comprehension measures was low. See tables 4.5 and 4.6. The mean number of clausal units processed to produce text entailed and text evoked retelling responses (RC3RC4), reflecting inferential comprehension, ranged from 5.06 to 6.23. Mean scores on the inferential comprehension questions ranged from 0.80 to 1.38.

For grade six, mean performance on both inferential comprehension measures seemed higher for social studies than for science. For grade nine, however, subjects scored higher on science than on social studies for inferential retellings. For the questions, the reverse was true. Grade nine subjects scored higher on social studies than on science. Further, mean performance on both comprehension measures was greater for grade nine science than for the grade six science. Conversely, mean performance on both measures for grade six social studies was greater than for grade nine social studies. However, when topics were combined, mean performance on both inferential comprehension measures, retellings (RC3RC4) and questions (QuesI), was similar for grade six and grade nine readers.

Table 4.5

Grade Six Means and Standard Deviations for Inferential Comprehension

Variable	N	Mean	Standard Deviation
Science			
RC3RC4	119	5.18487395	5.28824470
QuesI	119	0.79831933	0.87894228
Social Studies			
RC3RC4	115	6.22608696	5.36404677
QuesI	115	1.38260870	1.23247440
Topics Combined			
RC3RC4	234	5.69655812	5.33972772
QuesI	234	1.08547009	1.10459555

RC3RC4 = Text Entailed + Text Evoked Retelling Responses
QuesI = Inferential Questions (n = 5)

Table 4.6

Grade Nine Means and Standard Deviations for Inferential Comprehension

Variable	N	Mean	Standard Deviation
Science			
RC3RC4	126	5.83333333	5.66356778
QuesI	126	1.21428571	1.23681619
Social Studies			
RC3RC4	128	5.06250000	4.87763658
QuesI	128	1.32283465	1.31463214
Topics Combined			
RC3RC4	254	5.44488189	5.28579585
QuesI	254	1.26877470	1.27510242

RC3RC4 = Text Entailed + Text Evoked Retelling Responses
QuesI = Inferential Questions (n = 5)

Mean Performance Analyzed by Prior Knowledge Level

Quantitative prior knowledge ratings and mean literal comprehension performance. As would be expected, for both grade six and grade nine, mean literal comprehension performance on retelling responses (RC1RC2), with the exception of the grade six science passage, was greater for those subjects with high quantity prior knowledge ratings than for those with medium or low quantity prior knowledge ratings. Similarly, compared to the comprehension scores of those with low quantity ratings of prior knowledge, literal level retelling comprehension scores were higher for those with medium prior knowledge.

In addition, mean comprehension performance on the literal questions (QuesL) was greater for those subjects whose quantity of prior knowledge was rated high than for subjects whose quantity of prior knowledge was rated either medium or low. See Table 4.7.

Thus, with the exception of the grade six science literal retelling scores (RC1RC2), results were in the predicted direction. Subjects rating high on quantitative prior knowledge scores also had higher mean comprehension performance, and those with medium quantitative prior knowledge ratings had higher mean comprehension scores than those who received low quantitative prior knowledge ratings.

Table 4.7

Mean Performance on Literal Comprehension Measures of Readers with Different Prior Knowledge Ratings

Variable	PKQT			PKQL		
	High	Medium	Low	High	Medium	Low
Grade Six:						
Science						
RC1RC2	5.875	5.947	3.478	7.8	6.2	4.027
QuesL	2.375	2.070	1.283	2.3	2.457	1.432
Social Studies						
RC1RC2	7.609	5.875	4.857	7.267	6.509	4.889
QuesL	3.608	2.641	2.036	3.2	2.745	2.444
Topics Combined						
RC1RC2	6.897	5.909	4	7.48	6.389	4.353
QuesL	3.103	2.372	1.568	2.84	2.633	1.815
Grade Nine:						
Science						
RC1RC2	6.048	4.843	4.259	8.467	5.216	3.517
QuesL	2.762	2.020	1.296	3.267	2.235	1.133
Social Studies						
RC1RC2	4.929	4.395	3.894	6.667	4.796	3.419
QuesL	2.923	2.618	2.211	3.25	2.528	2.387
Topics Combined						
RC1RC2	5.6	4.575	4.109	7.667	5	3.467
QuesL	2.835	2.378	1.674	3.259	2.385	1.770

PKQT = Quantity of Prior Knowledge
PKQL = Quality of Prior Knowledge
RC1RC2 = Text Specific + Text Embedded Retelling Responses
QuesL = Literal Questions (n = 5)

Qualitative prior knowledge ratings and mean literal performance. In both grade six and nine, mean literal comprehension scores on the written retelling responses (RC1R2) was greater for those subjects with high quality prior knowledge ratings than for subjects with medium or low

quality prior knowledge ratings, and also for subjects with medium quality prior knowledge ratings and low quality of prior knowledge (Table 4.7).

The same mean comprehension performance pattern was evident on literal questions, except for the grade six science passage where the mean score for those with medium qualitative prior knowledge ratings was greater than for those with high qualitative prior knowledge ratings (Table 4.7).

Quantitative prior knowledge ratings and mean inferential performance. As seen in Table 4.8, for both grades six and nine, mean inferential comprehension performance on the retelling responses (RC3RC4), with the exception of the grade six social studies passage, was greater for those subjects with high quantity prior knowledge ratings than for those with medium or low quantity ratings. As expected, inferential comprehension scores were higher for those subjects with medium quantity prior knowledge ratings, compared to those with low quantitative ratings. For inferential level questions (QuesI), comprehension performance was greater for those subjects whose quantity of prior knowledge was rated high, than for subjects whose quantity of prior knowledge was rated medium or low.

Thus, with the exception of the retelling performance on the grade six social studies passage, the mean

inferential comprehension performance on both retelling and question measures was greater for those subjects with high quantitative prior knowledge ratings than for subjects with medium or low quantity ratings of prior knowledge. (Table 4.8)

Table 4.8

Mean Performance on Inferential Comprehension Measures of Readers with Different Prior Knowledge Ratings

Variable	PKQT			PKQL		
	High	Medium	Low	High	Medium	Low
Grade Six:						
Science						
RC3RC4	8.25	6.035	3.065	8.9	7.839	3.432
QuesI	1.563	.807	.523	1.1	2.086	.623
Social Studies						
RC3RC4	6.696	6.703	4.75	8.067	6.818	4.889
QuesI	1.870	1.438	.857	1.733	1.509	1.111
Topics Combined						
RC3RC4	7.333	6.388	3.703	8.4	7.211	3.983
QuesI	1.744	1.141	0.649	1.48	1.344	0.807
Grade Nine:						
Science						
RC3RC4	9.571	5.862	4.351	12.867	6.902	3.167
QuesI	2.095	1.157	.926	2.933	1.275	.733
Social Studies						
RC3RC4	11.429	4.421	4.	8.5	5.389	4.113
QuesI	2.387	1.224	1.158	2.25	1.377	1.097
Topics Combined						
RC3RC4	10.314	5	4.207	10.926	6.124	3.648
QuesI	2.206	1.969	1.022	2.630	1.327	0.918

PKQT = Quantity of Prior Knowledge
PKQL = Quality of Prior Knowledge
RC3RC4 = Text Entailed + Text Evoked Retelling Responses
QuesI = Inferential Questions (n = 5)

Qualitative prior knowledge ratings and mean inferential performance. With the exception of performance on inferential questions (QuesI) for grade six science, the expected pattern of mean comprehension performance was evident for high, medium, and low quality topic prior knowledge groups for both grade six and grade nine on inferential retelling responses (RC3RC4) and on inferential questions (RC3RC4) (Table 4.8).

The question of whether a qualitative measure of prior knowledge is better than a quantitative measure of prior knowledge in predicting literal and inferential comprehension performance was addressed by carrying out an analysis of variance, separately by grade and topic and by grade with topics combined. Results of these ANOVAS are presented next.

Inferential Analysis

Question One

Compared to a quantitative measure of topic prior knowledge, is a qualitative measure more effective in predicting sixth and ninth grade able readers' a) literal and b) inferential comprehension performance on social studies and science material as evident in responses to 1) written retelling prompts and 2) literal and inferential questions?

The issues are examined according to 1) the effects of prior knowledge on literal comprehension and 2) the effects of prior knowledge on inferential comprehension. The effects of prior knowledge on literal comprehension are examined according to quantity of prior knowledge; quality of prior knowledge; and interactions between quantity and quality of prior knowledge. The effects of prior knowledge on inferential comprehension are discussed following a similar organizational pattern; first, in terms of quantity of prior knowledge; second, in terms of quality; and third in terms of interactions between quantity and quality.

Results of SAS TYPE III ANOVA, where SS is the sum of squares due to adding the variable of interest last in the model, are reported. In addition, SAS TYPE I (sequential sums of squares) ANOVA findings that differ from the TYPE III analysis are noted.

Effects for Quantity of Prior Knowledge on Literal Comprehension

Quantitative Prior Knowledge and Literal Retelling Responses

Grade six. Although sequential sums of squares, SAS TYPE I, test results showed the effect of quantity of prior knowledge levels on literal comprehension as seen by literal retelling responses (RC1RC2) for the grade six science passage to be significant, $F(2,118)=3.24$, $p<.05$, results (SAS TYPE III) indicated a nonsignificant effect, $F(2,118)=2.15$, $p<.05$, (Table 6.1, Appendix H). Similarly, for grade six social studies, the effect of quantity prior knowledge ratings on literal comprehension performance on the retelling responses (RC1RC2) was nonsignificant, $F(2,114)=1.61$, $p<.05$. When results were combined by grade across topics, quantity prior knowledge did not have a significant effect on literal comprehension as measured by written retelling responses (RC1RC2), $F(2,233)=0.76$, $p<.05$ (Table 6.3, Appendix H).

Grade nine. The ANOVA revealed that quantity prior knowledge levels did not significantly affect literal comprehension on written retelling responses (RC1RC2) for either the grade nine science, $F(2,115)=1.12$, $p<.05$, or social studies passages, $F(2,127)=0.18$, $p<.05$ (Table 6.4, Appendix H). Analysis by grade when results by topic were combined, indicated that there were no significant effects

for quantity of prior knowledge on literal comprehension reflected in written retelling responses (RC1RC2), $F(2,233)=0.99$, $p<.05$ (Table 6.6, Appendix H).

Quantitative Prior Knowledge and Literal Questions.

Grade six. The ANOVA showed the effect for quantity of prior knowledge on comprehension performance on literal questions to be nonsignificant for the grade six science passage with $F(2,118)=0.86$, $p<.05$. Findings for social studies indicated a significant effect according to TYPE I, sequential sums of squares test results, $F(2,114)=9.53$, $p<.05$, but a nonsignificant effect for the TYPE III, partial sums of squares test, $F(2,114)=0.16$, $p<.05$. See Table 6.1, Appendix H. When results were combined across passages, although quantity of prior knowledge had a significant effect upon literal comprehension performance on questions (QuesL) when Type I test results were examined, $F(2,234)=9.72$, $p<.05$, results for the Type III test were not significant, $F(2,233)=0.51$, $p<05$ (Table 6.6, Appendix H).

Grade nine. Results for grade nine revealed that the effect of quantity of prior knowledge on literal comprehension, as seen on literal questions (QuesL), was not significant for either the science, $F(2,125)=0.17$, $p<.05$, or the social studies passage, $F(2,127)=1.67$, $p<.05$ (Table 6.4, Appendix H). Similarly, when results were combined across passages, there were no significant effects for quantity of prior knowledge and literal comprehension as measured by

questions (QuesL), with $F(2,233)=1.00$, $p<.05$ (Table 6.6, Appendix H).

Summary. Thus, for both grade six and grade nine, initial analysis indicated a consistent nonsignificant effect for quantity prior knowledge levels on literal comprehension performance as measured by retelling responses (RC1RC2) and questions (QuesL), both within and across passages. The effects for quality of prior knowledge on literal comprehension are examined next.

Effects for Quality of Prior Knowledge on Literal Comprehension

Qualitative Prior Knowledge and Literal Retellings Responses

Grade six. For the science passage, the ANOVA revealed that there was a significant effect for quality of prior knowledge on literal comprehension as measured by written retelling responses (RC1RC2), $F(2,118)=7.61$, $p<.05$, but for the social studies passage, the effect was nonsignificant, $F(2,114)=2.74$, $p<.05$. (See Table 6.1, Appendix H). With respect to analysis by grade across topics, a significant effect for quality of prior knowledge levels and literal comprehension on retelling responses (RC1RC2) was evident, $F(2,233)=8.84$, $p<.05$ Table 6.3, Appendix H).

Grade nine. Although the SAS Type I, sequential sums of squares test results indicated a significant effect for quality of prior knowledge on literal comprehension for both

grade nine passages, results for the partial sums of squares test (SAS TYPE III) revealed a significant effect for quality of prior knowledge as measured by retelling responses (RC1RC2) for science, $F(2,125)=5.61$, $p<.05$, but a nonsignificant effect for social studies, $F(2,127)=2.71$, $p<.05$, (Table 6.4, Appendix H). Further analysis, when scores across passages were combined, indicated a significant effect for quality of prior knowledge and literal retelling responses (RC1RC2), $F(2,233)=6.85$, $p<.05$ (Table 6.5, Appendix H).

Qualitative Prior Knowledge and Literal Questions

Grade six. As with the retelling responses, a significant effect was found for quality of prior knowledge on literal questions (QuesL) for grade six science, $F(2,118)=5.19$, $p<.05$. A nonsignificant effect was evident for social studies, however, $F(2,114)=0.86$, $p<.05$ (Table 6.1, Appendix H). Across passage analysis for grade six also revealed a significant effect for quality of prior knowledge on literal questions (QuesL), $F(2,233)=5.57$, $p<.05$ (Table 6.3, Appendix H).

Grade nine. Consistent with the results for the literal retelling responses (RC1RC2) for grade nine, sequential sums of squares test (SAS TYPE I) results indicated asignificant effect for quality prior knowledge ratings on literal questions (QuesL) for both grade nine passages. However, partial sums of squares findings, SAS

TYPE III test, revealed a significant effect for quality of prior knowledge on literal questions (QuesL) only for the science passage, $F(2,125)=5.24$, $p<.05$. A nonsignificant effect was evident the social studies, $F(2,127)=0.46$, $p<.05$, (Table 6.4, Appendix H). Across topic analysis also indicated a significant effect for quality of prior knowledge on literal questions (QuesL), $F(2,253)=4.68$, $p<.05$ (Table 6.6, Appendix H).

Summary. In contrast to the effects of quantity of prior knowledge on literal comprehension performance, the ANOVA revealed that quality of prior knowledge levels had significant effects on literal comprehension performance, both for literal level retelling responses (RC1RC2) and for literal level questions (QuesL) for grade six science. For grade six social studies, quality of prior knowledge did not significantly affect literal comprehension on either the retelling or question measures.

Similarly, for the grade nine science passage and qualitative ratings of prior knowledge, results indicated a significant effect for literal comprehension on both retelling responses (RC1RC2) and questions (QuesL). Results for the grade nine social studies passage, however, were nonsignificant.

Analysis by grade, when results by topic were combined, showed a significant effect for quality of prior knowledge on literal comprehension as measured both by retelling

responses (RC1RC2) and by questions (QuesL) for both grade six and grade nine.

Thus, an identical pattern was evident for grade six and grade nine with regard to the effects for qualitative levels of prior knowledge on literal comprehension. For the grade six and nine science passages and for both grade six and nine when literal comprehension performance was combined across passages, there were significant effects for qualitative prior knowledge levels on literal comprehension as measured by both retelling responses (RC1RC2) and questions (QuesL). This significance when scores were pooled was quite likely due to the influence of the performance on science. For both grades six and nine social studies, the effects for qualitative prior knowledge levels on literal comprehension were nonsignificant as measured by both retellings (RC1RC2) and questions (QuesL).

A summary of these results is presented in Table 4.9.

Table 4.9

Summary of the Effects of Prior Knowledge on Literal Comprehension

Dependent Variable	Quantity Ratings		Quality Ratings	
	Grade Six	Grade Nine	Grade Six	Grade Nine
	Science			
Retelling (RC1RC2)	NS	NS	Significant	Significant
Questions (QuesL)	NS	NS	Significant	Significant
	Social Studies			
Retelling (RC1RC2)	NS	NS	NS	NS
Questions (QuesL)	NS	NS	NS	NS
	Topics Combined			
Retelling (RC1RC2)	NS	NS	Significant	Significant
Questions (QuesL)	NS	NS	Significant	Significant

RC1RC2 = Literal retelling responses
QuesL = Literal questions
NS = Not significant

Interactions Between Quantity and Quality of Prior Knowledge Related to Literal Comprehension

Grade Six

Separate analysis by grade and passage revealed no significant interaction between quantity and quality of prior knowledge in relation to literal comprehension performance on both measures for grade six science, $F(4,118)=1.84$, $p>.05$ and $F(4,118)=1.80$, $p>.05$ (Table 6.1,

Appendix H). There was, however, a significant interaction between quantity and quality of prior knowledge in relation to literal comprehension on both measures for grade six social studies, with $F(4,114)=4.14$, $p<.05$ on the retelling responses (RC1RC2) and $F(4,114)=3.20$, $p<.05$ on the literal questions (QuesL) (Table 6.1, Appendix H).

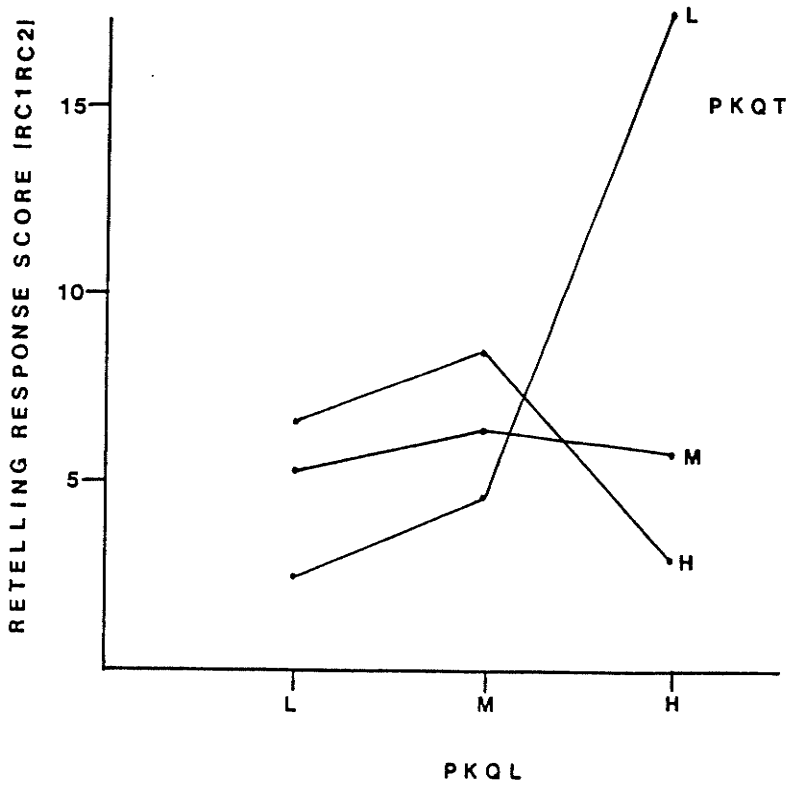


Figure 4.1. Interactions between quantity and quality of prior knowledge related to literal retelling response scores (RC1RC2) for grade six social studies. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=Medium; L=low)

When interactions related to literal retellings were plotted, Figure 4.1, high comprehension performance on literal retelling responses (RC1RC2) for the grade six social studies passage was indicated for subjects with low quantity/high quality prior knowledge compared to those with high or medium quantity with high quality prior knowledge ratings. This was true despite the fact that low comprehension performance on literal retelling responses (RC1RC2) would have been expected for low quantity prior knowledge.

Conversely, those subjects with high quantity/high quality topic prior knowledge ratings had unexpectedly low comprehension scores compared to low and medium groups, when there should have been a correspondingly high comprehension score (Figure 4.1).

To analyze this phenomenon further, box plots, Figure 4.2, representing the quartile range of scores, the extreme five lowest and highest scores and the mean literal comprehension performance on retelling responses (RC1RC2) of a) the high, medium, and low quantity prior knowledge groups and b) the high, medium and low quality prior knowledge groups, were constructed. An examination of the box plots for the low quantity (PKQT) but high quality (PKQL) prior knowledge groups revealed that, while quartile ranges differed, the overall range of scores was the same due to a) one subject in the low prior knowledge group achieving a

high comprehension score compared to other subjects in the low quantity prior knowledge group and b) a lower literal comprehension performance for the first quartile of the high quality prior knowledge group than for the medium and low quality prior knowledge groups. It is possible that the low quantity prior knowledge subject with an unexpectedly high comprehension score may have studied the topic recently and may have possessed highly organized knowledge, and hence, expressed few, if any, subordinate ideas in the free association task scored quantitatively. This would result in a low rather than high quantity prior knowledge rating in connection with high quality. Further, writing skill may have interfered with the written retelling of those in the high quality prior knowledge group, resulting in unexpectedly low comprehension scores .

Additional examination of the box plots (Figure 4.2) revealed that two subjects in the medium quality prior knowledge group had unexpectedly high comprehension scores. These subjects may have possessed some highly organized (high quality) prior knowledge and may have actually belonged with the high quality prior knowledge group. They were nevertheless classified as having a medium qualitative prior knowledge rating as a result of the scoring procedure in which the three, free association scores per topic were averaged.

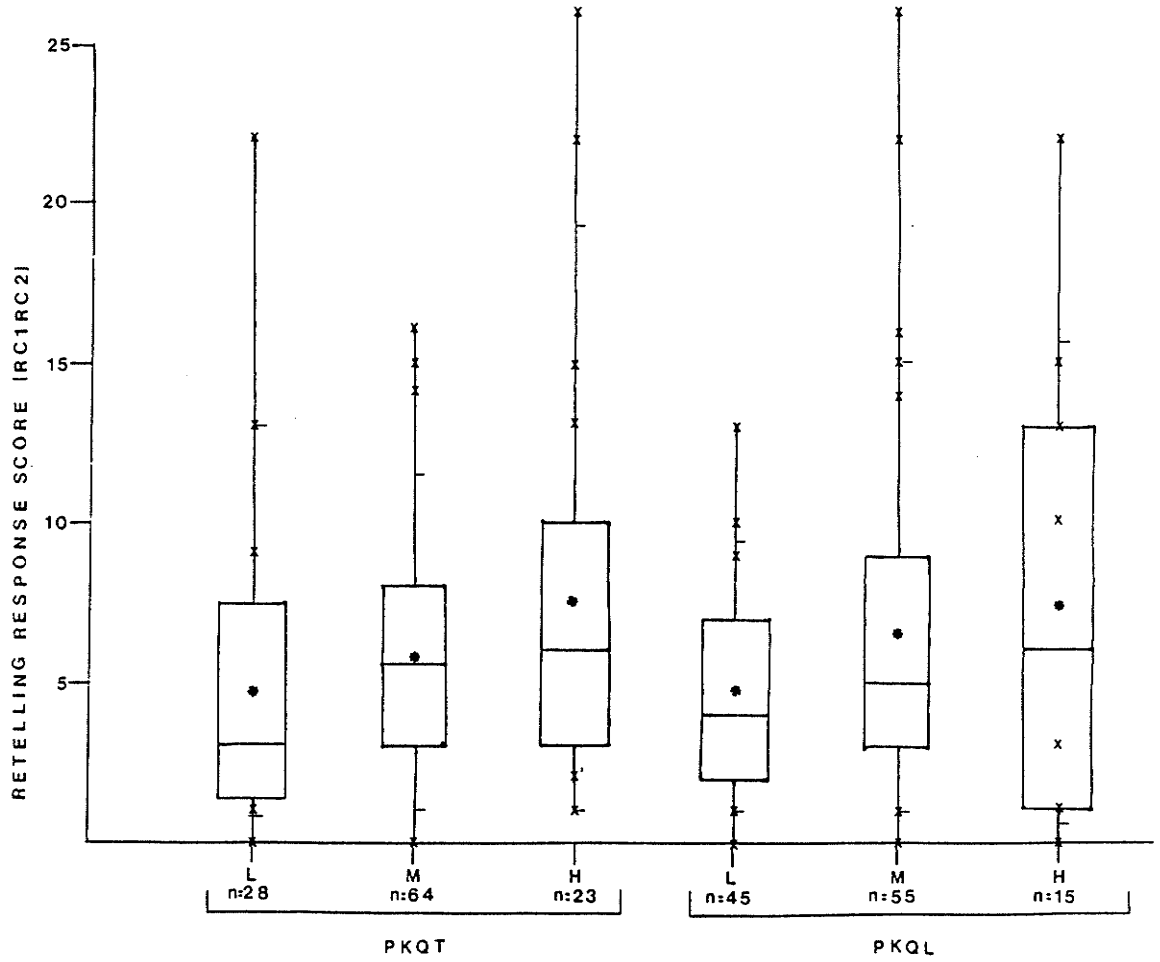


Figure 4.2. Box plots illustrating the range of literal retelling responses (RC1RC2) according to quantity and quality of prior knowledge (high, medium, low) for grade six social studies. The middle 50% of subjects are shown within the box, with the remaining 50% represented by the vertical line, either above or below. The dash (-) indicates the 90% range. (PKQT=prior knowledge quantity; PKQL=prior knowledge quality; n=number; H=high; M=medium; L=low; *=mean; X=extreme scores)

As Figure 4.3 indicates, the same pattern held true in the interaction between quantity and quality of prior knowledge for grade six social studies on literal questions (QuesL). Subjects with low quantitative/high qualitative prior knowledge ratings scored higher for literal comprehension on questions than medium or high quantitive prior knowledge groups with high qualitative prior knowledge ratings. Conversely, subjects with high quantitative/high qualitative prior knowledge ratings scored lower than low and medium quantity subjects with high qualitative prior knowledge ratings, when the reverse should have been true.

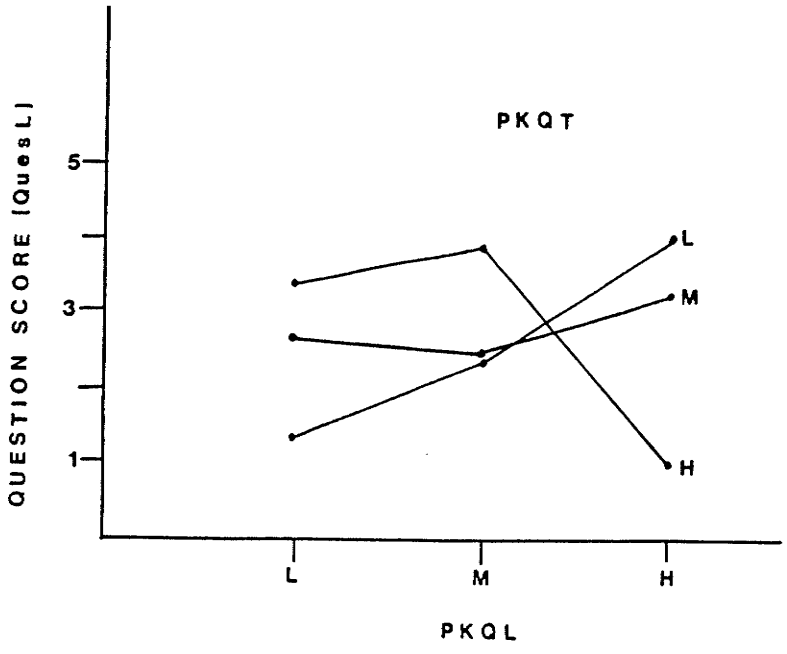


Figure 4.3. Interactions between quantity and quality of prior knowledge related to literal questions (QuesL) for grade six social studies. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=Medium; L=low)

Analysis for grade six, when science and social studies were combined, revealed a significant three-way interaction among topic, quantity, and quality of prior knowledge on literal retelling responses (RC1RC2), ($\underline{F}(4,233)=3.56$, $\underline{p}<.05$) (Figure 4.4). In addition, a significant interaction was evident between quantity and quality of prior knowledge on both literal comprehension measures for grade six when scores were combined across passages with ($\underline{F}(4,233)=3.07$, $\underline{p}<.05$ for the retelling responses (RC1RC2) (Figure 4.5).

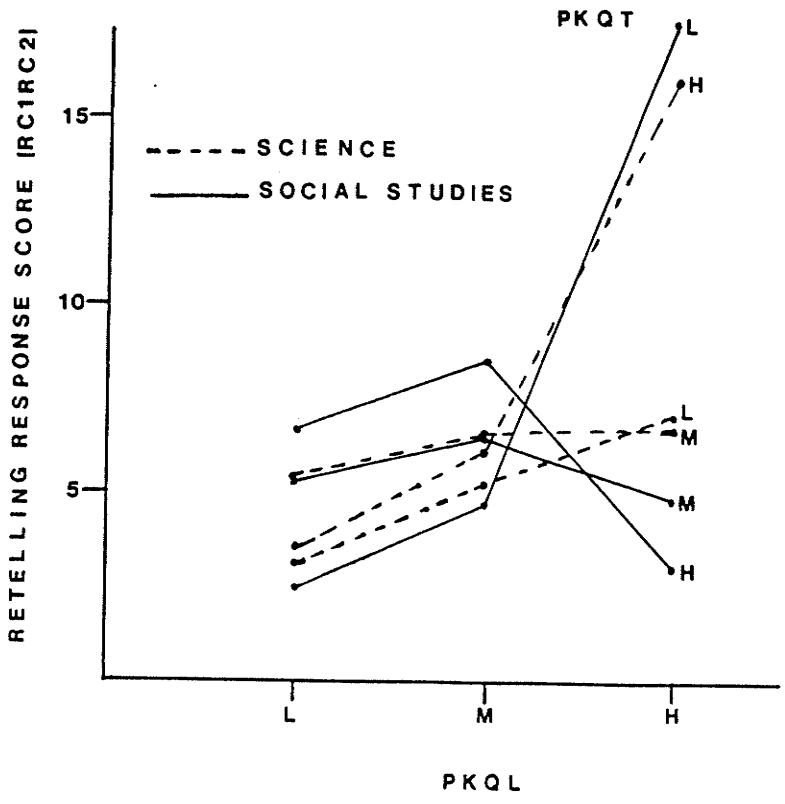


Figure 4.4. Three-way interactions among topic, quantity and quality of prior knowledge related to literal retelling response scores (RC1RC2) when topic were combined for grade six. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=Medium; L=low)

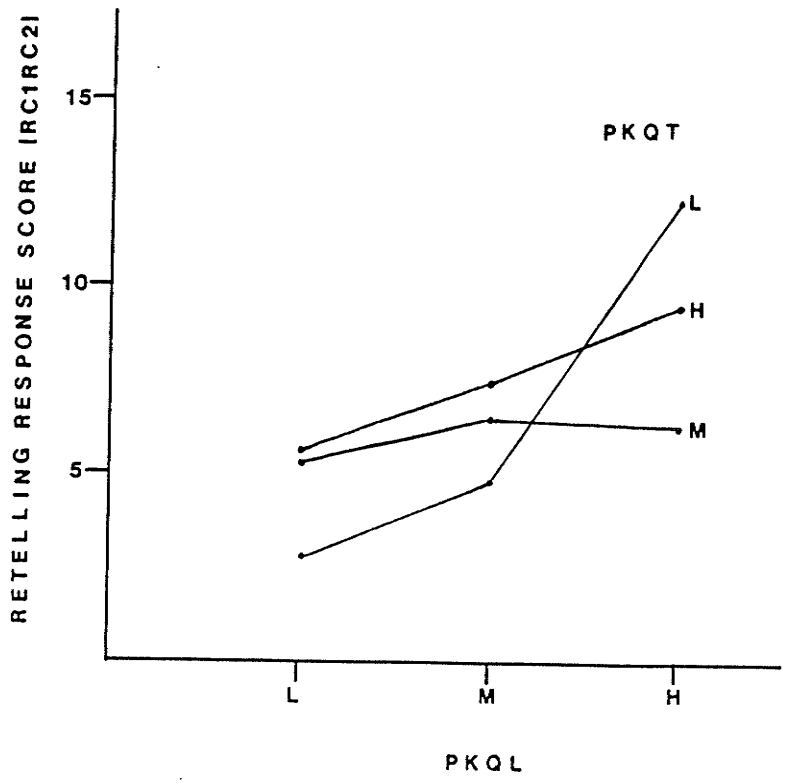


Figure 4.5. Interactions between quantity and quality of prior knowledge related to literal retelling response scores (RC1RC2) when topics were combined for grade six. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=Medium; L=low)

When the interactions were plotted, Figure 4.5, those subjects with low quantitative prior knowledge but high qualitative ratings scored higher on the literal retelling responses (RC1RC2) than medium and low quantity prior knowledge subjects, when one would expect low comprehension performance.

An examination of the box plots for literal comprehension performance on retelling responses (RC1RC2) when scores were combined across grade six topics, as discussed previously, revealed one subject in the low quantity prior knowledge group and two in the medium quality prior knowledge group whose scores were higher than expected (Figure 4.6).

No significant three-way interactions related to literal questions (QuesL) were revealed for grade six when scores were combined across passages. However, as on literal retelling responses (RC1RC2), significant interactions between quantity and quality of prior knowledge were evident for the literal questions (QuesL) $F(4,233)=2.85$, $p<.05$) (Figure 4.7). See Table 6.3, Appendix H for analysis of variance results.

As Figure 4.7 illustrates, for grade six when topics were combined, the pattern of the interaction was the same for literal questions (QuesL) as for retelling responses (RC1RC2). Comprehension scores were higher for those subjects with low quantitative/high qualitative prior knowledge ratings than for those with high and medium quantity with high quality prior knowledge ratings, when the reverse was expected.

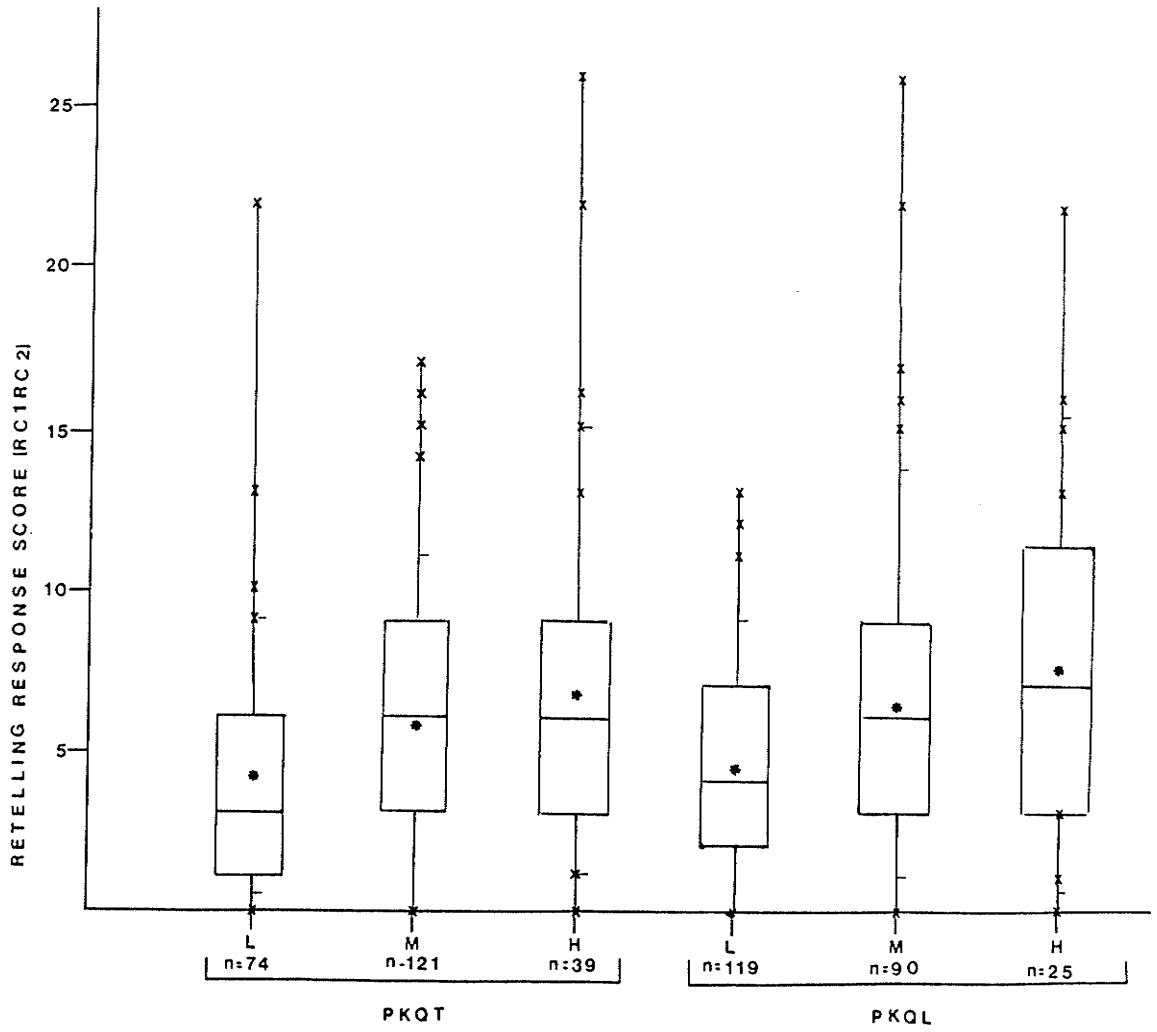


Figure 4.6. Box plots illustrating the range of literal retelling responses (RC1RC2) according to quantity and quality of prior knowledge (high, medium, low) for grade six when topics were combined. The middle 50% of subjects are shown within the box, with the remaining 50% represented by the vertical line, either above or below. The dash (-) indicates the 90% range. (PKQT=prior knowledge quantity; PKQL=prior knowledge quality; n=number; H=high; M=medium; L=low; *=mean; X=extreme scores)

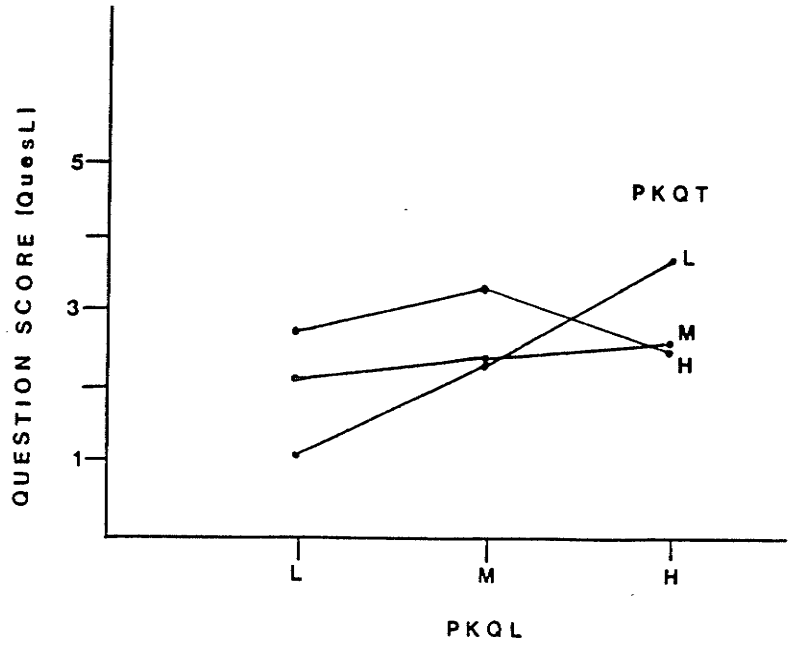


Figure 4.7. Interactions between quantity and quality of prior knowledge related to literal questions (QuesL) when topics were combined for grade six. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=Medium; L=low)

Grade Nine

Despite the pattern at the grade six level, there were no significant interactions related to literal comprehension indicated for the grade nine passages either within or across topics (Table 6.1, Appendix H).

Summary

For grade six, findings indicated significant interactions between quantity and quality of prior knowledge related to literal comprehension on both retelling responses (RC1RC2) and literal questions (QuesL) for the social studies passage. When scores were pooled across topics for grade six, significant interactions were evident between quantity and quality related to literal comprehension performance on both retelling and question measures. In addition, there was a significant three-way interaction among topic, quantity and quality of prior knowledge for grade six.

Among possible reasons advanced to explain these interactions were: 1) possession of highly organized prior knowledge, which would preclude the generation of a broad number of associations on the quantity prior knowledge task; 2) incorrect categorization, that is the assignment of a medium rather than a high prior knowledge level, because the procedure for designating qualitative prior knowledge requires that the three subtopic prior knowledge scores be averaged to arrive at an overall qualitative prior knowledge score for the topic; and 3) writing ability, which may have played a role in the low comprehension performance of some high quantity/high quality prior knowledge subjects. These factors seemed to be peculiar to social studies since the interactions involved social studies and not science topics.

In contrast to grade six, there were no significant literal level interactions for grade nine.

Effects for Quantity of Prior Knowledge on Inferential Comprehension

Quantity of Prior Knowledge and Inferential Retelling Responses.

Grade six. As indicated by Table 6.2, Appendix H, a different pattern was revealed when the effects of quantitative prior knowledge levels on inferential comprehension were examined by analysis of variance. Quantity of prior knowledge had a significant effect on inferential comprehension as measured by retelling responses (RC3RC4) for grade six science, $F(2,118)=15.56$, $p<.05$. No significant effect was revealed for quantity of prior knowledge on inferential comprehension on the retelling responses (RC3RC4) for social studies, however, $F(1,114)=0.84$, $p<.05$ (Table 6.2, Appendix H). Analysis across passages for grade six also indicated that effects for prior knowledge quantity on retellings (RC3RC4) were significant, $F(2,233)=6.29$, $p<.05$. Results are presented in Table 6.3, Appendix H.

Grade nine. For the grade nine science passage, the ANOVA indicated that the effects of quantity of prior knowledge on inferential comprehension reflected in retelling responses (RC3RC4) were nonsignificant,

$F(2,125)=3.01$, $p<.05$. For social studies, the effect was significant, however, $F(2,127)=10.07$ $p<.05$ (Table 6.5, Appendix H). When scores across passages were pooled, quantity of prior knowledge had a significant effect on inferential comprehension as measured by retelling responses (RC3RC4), $F(2,253)=8.03$, $p<.05$ (Table 6.6, Appendix H).

Quantity of Prior Knowledge and Inferential Questions.

Grade six. Results of the ANOVA revealed a significant effect for quantity of prior knowledge on inferential questions (QuesI) for science, $F(2,118)=5.82$, $p<.05$. In contrast, for social studies, the effect of quantity of prior knowledge on inferential questions (QuesI) was not significant $F(2,114)=0.25$, $p<.05$. Further, analysis across passages indicated that the effect of quantity of prior knowledge on inferential questions (QuesI) was nonsignificant, $F(2,233)=0.99$, $p<.05$. (See Table 6.2 and 6.3, Appendix H).

Grade nine. For grade nine, the partial sums of squares test, SAS TYPE III, indicated that the effect of quantity of prior knowledge on inferential comprehension, as measured by questions (QuesI), was not significant for either of the passages, with $F(2,125)=0.59$, $p<.05$ for science and $F(2,127)=2.69$, $p<.05$ for social studies (Table 6.5, Appendix H), although for social studies, sequential sums of squares analysis (SAS TYPE I), a less robust statistic, did show significance between prior knowledge

assessed quantitatively and performance on inferential level questions, $F(2,127)=3.35$, $p<.05$ (Table 6.5, Appendix H). With respect to across passage analysis, results indicated a nonsignificant effect for quantity of prior knowledge on comprehension as measured by inferential questions (QuesI), $F(2,253)=0,96$, $p<.05$ (Table 6.6, Appendix H).

Summary. For grade six, quantity of prior knowledge was shown to have a significant effect on inferential comprehension on both retelling and question measures for science, but a nonsignificant effect on both measures for social studies. For grade nine, a nonsignificant effect for quantity of prior knowledge on inferential comprehension was indicated on both retelling responses (RC3RC4) and questions (QuesI) for science. Further, results indicated a nonsignificant effect on the inferential questions but a significant effect for retellings (RC3RC4) for grade nine social studies.

With respect to across passage analysis, for both grades six and nine, results indicated a significant effect for quantity of prior knowledge on inferential comprehension as measured by retelling responses(RC3RC4) but not as measured by questions (QuesI).

Thus, there was an overall inconsistency in the effect for quantitative prior knowledge levels on inferential comprehension as measured both by text entailed and text evoked retelling responses (RC3RC4) and by inferential

questions (QuesI). Results were only significant for science at the grade six level which may have accounted for the effects when scores were pooled. Similarly, the significant effects for prior knowledge quantity and retellings (RC3RC4) for grade nine social studies quite likely influenced the results when topics were combined.

Effects for Quality of Prior Knowledge and Inferential Comprehension

Qualitative Prior Knowledge and Inferential Retelling Responses.

Grade six. Results of the analysis of variance conducted separately by grade and passage indicated a significant effect for quality of prior knowledge and inferential comprehension as seen by retelling responses for grade six science, $F(2,118)=15.56$, $p<.05$. A nonsignificant effect was evident for social studies, $F(2,114)=0.84$ (Table 6.2, Appendix H). Analysis by grade, when results were combined, indicated that there was a significant effect for quality of prior knowledge on inferential comprehension as measured by retelling responses (RC3RC4), $F(2,233)=13.45$, $p<.05$.

Grade nine. ANOVA results revealed that quality of prior knowledge had a significant effect on inferential comprehension as reflected in written retelling responses (RC3RC4) for science, $F(2,125)=9.65$, $p<.05$. Although

sequential sums of squares test results (SAS TYPE I) showed this effect to be significant for the grade nine social studies passage, $F(2,127)=5.45$, $p<.05$, results for SAS TYPE III indicated that qualitative ratings of prior knowledge were not significant inferential comprehension as measured by retelling responses (RC3RC4) for social studies, $F(2, 127)=2.38$, $p<.05$ (Table 6.5, Appendix H). Further, when results were combined by grade across passages, quality of prior knowledge was found to have a significant effect on inferential comprehension performance on written retelling responses (RC3RC4), $F(2,253)=9.68$, $p<.05$ (Table 6.6, Appendix H).

Qualitative Prior Knowledge and Inferential Questions.

Grade six. As with the retelling responses, a significant effect was seen for quality of prior knowledge levels on the comprehension of inferential questions (QuesI) for science, $F(2,118)=4.18$, $p<.05$, and a nonsignificant effect for social studies, $F(2,114)=1.88$, $p<.05$ (Table 6.2, Appendix H). Further, across passage analysis revealed a significant effect for quality of prior knowledge on inferential questions (QuesI).

Grade nine. Similarly, for the grade nine passages, findings indicated a significant effect for quality of prior knowledge on inferential questions (QuesI) for science, $F(2,125)=18.46$, $p<.05$. A nonsignificant effect was revealed for social studies, $F(2,127)=1.57$, $p<.05$ (Table

6.5, Appendix H). However, the sequential sums of squares test (SAS, TYPE I) results did indicate significant effects for quality prior knowledge levels on inferential on questions (QuesI) for grade nine social studies (Table 6.5, Appendix H). This is considered a less robust measure. When results were combined by grade across passages, quality of prior knowledge was found to have a significant efffect on comprehension performance on inferential questions (QuesI) for the grade nine, $F(2,253)=12.15$, $p<.05$ (Table 6.6, Appendix H).

Summary. In contrast to the inconsistent effects for quantitative prior knowledge ratings on inferential comprehension performance, initial ANOVA results indicated a consistent significant effect for prior knowledge quality ratings on inferential comprehension performance as measured by both retelling responses (RC3RC4) and questions (QuesI) for both grade six and grade nine science, and for both grades when comprehension performance was combined. A nonsignificant effect for qualitative prior knowledge ratings on inferential comprehension as measured both by retelling and question measures was indicated for both grade six and grade nine social studies, although sequential sums of squares analysis indicated a significant effect for grade nine social studies. Analysis of variance results are presented in Appendix H.

A summary of these results is presented in Table 4.10.

Table 4.10

Summary of the Effects of Prior Knowledge on Inferential Comprehension

Dependent Variable	Quantity Ratings		Quality Ratings	
	Grade Six	Grade Nine	Grade Six	Grade Nine
	Science			
Retelling (RC3RC4)	Significant	NS	Significant	Significant
Questions (QuesI)	Significant	NS	Significant	Significant
	Social Studies			
Retelling (RC2RC3)	NS	Significant	NS	NS
Questions (QuesI)	NS	NS	NS	NS
	Topics Combined			
Retelling (RC3RC4)	Significant	Significant	Significant	Significant
Questions (QuesI)	NS	NS	Significant	Significant

RC3RC4 = Inferential retelling responses
QuesI = Inferential questions
NS = Not significant

Interactions Between Quantity and Quality of Prior Knowledge Related to Inferential Comprehension

Grade Six

For the grade six science passage, findings of the analysis by grade and topic showed significant interactions between quantity and quality of prior knowledge in relation to inferential comprehension performance on retelling responses (RC3RC4), $F(4,118)=10.32$ $p<.05$ (Table 6.3, Appendix H).

As Figure 4.8 illustrates, although subjects with high quantity/low quality and high quantity/medium prior knowledge ratings should have comprehended better than middle quantity/low quality and medium quantity/medium quality prior knowledge subjects, the reverse was demonstrated. Further, the medium quantity/high quality prior knowledge subjects should have had better inferential comprehension on retelling responses (RC3RC4) than those with low quantity/high quality prior knowledge ratings.

With regard to the interaction for high and medium quantity with low quality prior knowledge and high and medium quantity with medium quality prior knowledge, an examination of box plots for the grade six science passages, as presented in Figure 4.9, revealed low retelling comprehension performance (RC3RC4) for the high quantity prior knowledge group. Three of the highest five scores for

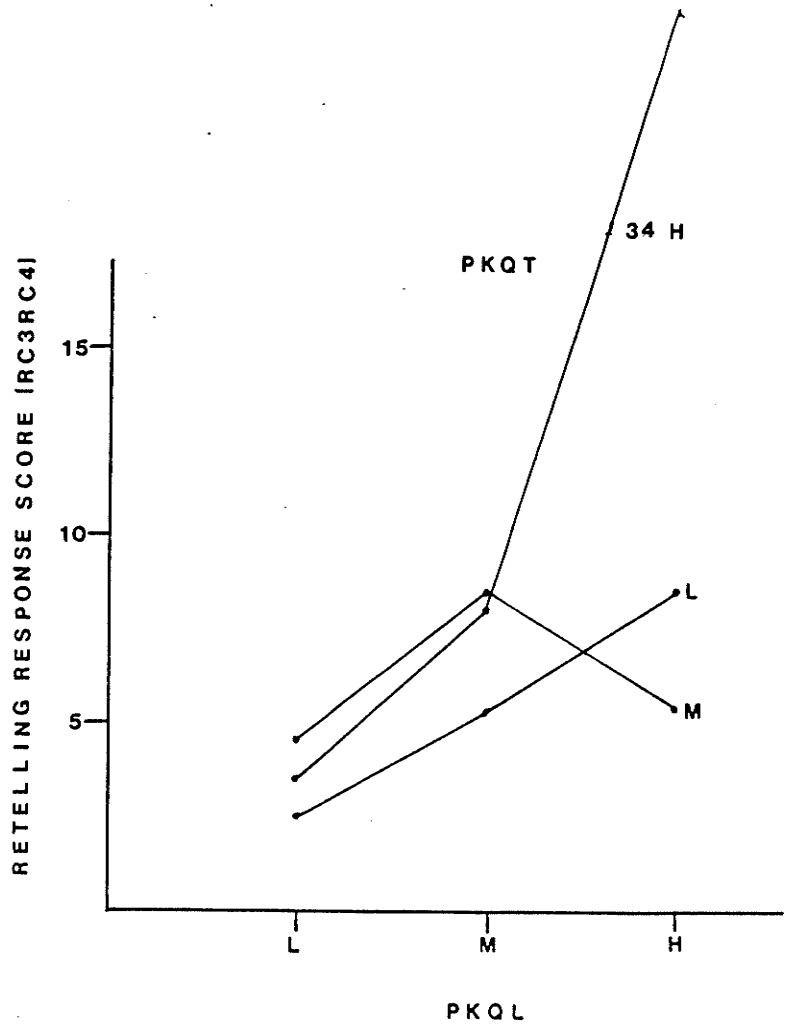


Figure 4.8. Interactions between quantity and quality of prior knowledge related to inferential retelling response scores (RC3RC4) for grade six science. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

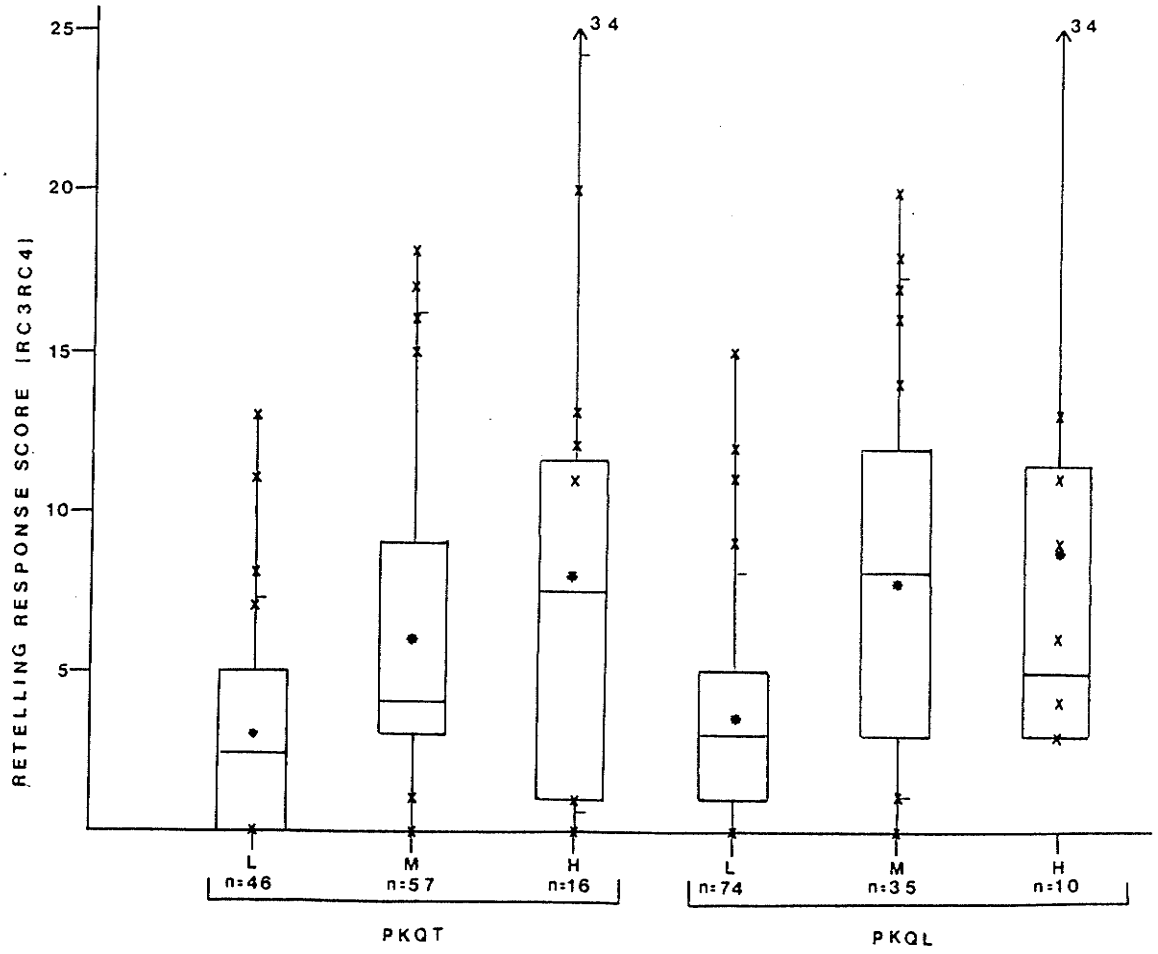


Figure 4.9. Box plots illustrating the range of inferential retelling responses (RC3RC4) according to quantity and quality of prior knowledge (high, medium, low) for grade six science. The middle 50% of subjects are shown within the box, with the remaining 50% represented by the vertical line, either above or below. The dash (-) indicated the 90% range. (PKQT=prior knowledge quantity; PKQL=prior knowledge quality; n=number of subjects; H=high; M=medium; L=low; *=mean; X=extreme scores)

those with high quantitative prior knowledge ratings were lower than the five highest scores for the medium quality and medium quantity prior knowledge groups.

Further, with regard to the interaction for medium quantity/high quality and low quantity/high quality prior knowledge groups, the box plots (Figure 4.9) indicated that the highest five scores for those with medium quantitative prior knowledge ratings were equal to the top five scores for those with medium quality prior knowledge. In addition, it was evident that the five highest scores for those with low quantitative prior knowledge ratings were equal to four of the five highest scores of those with high quality prior knowledge ratings. Hence, those with medium quantity/high quality prior knowledge had lower scores.

Because the criteria for determining qualitative prior knowledge ratings are based on an organizational hierarchy, subjects with high qualitative prior knowledge ratings may not always produce high quantity prior knowledge responses when completing a free association task. According to schema theory, the subordinate ideas would be subsumed within the highly organized responses. This may have been the case for those with medium or low quantity/high quality prior knowledge ratings, resulting in medium or low quantity ratings instead of high quantity ratings. If this were the case, it would seem that it is more important to measure quality of prior knowledge than quantity. It would appear,

however, that some subjects do provide subordinate information in free association tasks and thus have both high quantity and high quality prior knowledge ratings and correspondingly higher comprehension scores, as indicated in Figure 4.8.

Also, it may be that the prior knowledge of some medium quality prior knowledge subjects may have been incorrectly rated as medium rather than high. This is perhaps due to the averaging of the three subtopic association scores that is required in deriving the final quality prior knowledge score (ie. 2, 2, 3, = 2 - medium), as was suggested previously in connection with the interaction between quantity and quality prior knowledge found in the grade six social studies literal retelling responses.

A further factor that may have contribued to the interactions might have been the low number of subjects in the high quality prior knowledge group (n=10).

Similar to the retelling responses, the ANOVA indicated a significant interaction between quantity and quality of prior knowledge on inferential questions (QuesI), $F(4,118)=4.80$, $p<.05$, for grade six science (Table 6.3, Appendix H) (Figure 4.10).

As Figure 4.10 illustrates, those subjects with low quantitative/high qualitative prior knowledge ratings displayed unexpectedly better comprehension on inferential

questions (QuesI) compared to those with high and medium quantitative/high qualitative prior knowledge ratings.

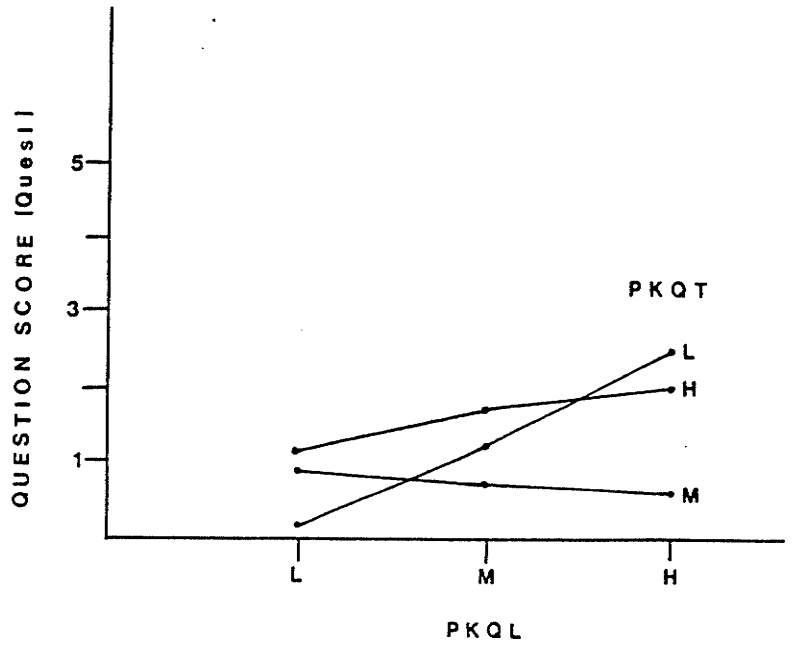


Figure 4.10. Interaction between quantity and quality of prior knowledge related to inferential questions (QuesI) for grade six science. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

Further it is evident, from an examination of box plots illustrating comprehension performance on the inferential questions (Ques I) by type and level of prior knowledge, Figure 4.11, that the five extreme performance scores were identical for the three qualitative prior knowledge groups. In contrast, the quartile ranges and highest and lowest five extreme scores were not the same on the inferential questions (QuesI) for the high, middle, and low quantitative groups. As was suggested in the discussion of the retelling

responses (RC3RC4), the low numbers in the high quality prior knowledge group (n=10) may account for the discrepancy. An alternative explanation in accounting for the phenomenon may be the overall low performance on inferential questions (QuesI) on the grade six science passage, suggesting that perhaps the inference level questions (QuesI) were either too difficult or required prior knowledge that was not subsumed in the highly organized free association responses.

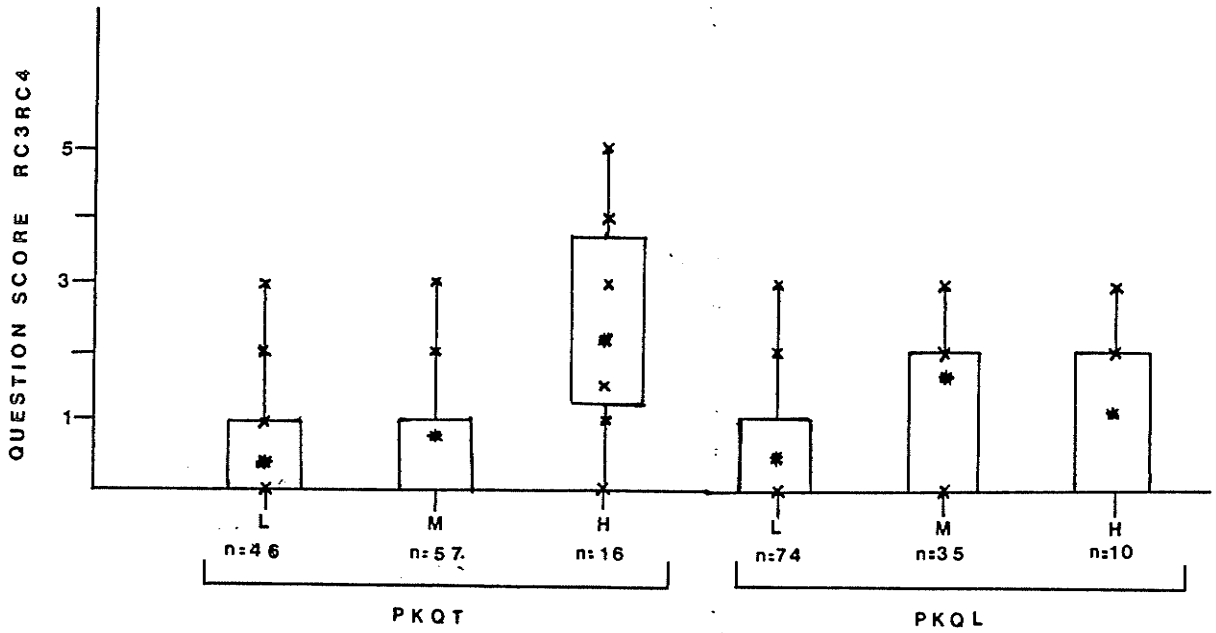


Figure 4.11. Box plots illustrating the range of inferential questions (QuesI) according to quantity and quality of prior knowledge (high, medium, low) for grade six science. The middle 50% of subjects are shown within the box, with the remaining 50% represented by the vertical line, either above or below. The dash (-) indicated the 90% range. (PKQT=prior knowledge quantity; PKQL=prior knowledge quality; n=number; H=high; M=medium; L=low; *=mean; X=extreme scores)

When results were pooled across topics for grade six, a significant interaction was evident between quantity and quality of prior knowledge related to inferential comprehension as measured by retelling responses (RC3RC4), $F(4,233)=2.64$, $p<.05$ (Table 6.3, Appendix H).

As presented in Figure 4.12, the interaction between medium quantity and medium quality prior knowledge across grade six topics is similar to the interaction related to retelling responses on the grade six science passage. Subjects with medium quantity/medium quality prior knowledge ratings displayed slightly higher inferential comprehension on retelling responses (RC3RC4) than those with high quantity/medium quality prior knowledge ratings.

As discussed earlier, it may be that the interaction was the result of failure to state subordinate ideas in the free association task because they are subsumed by superordinate responses. As a result, a medium rather than high quantity prior knowledge ratings were assigned in conjunction with medium quality ratings. On the other hand, it may be that the interactions indicate the need to refine the qualitative prior knowledge measure. Some quality prior knowledge subjects may have been incorrectly classified due to the averaging procedure which entails collapsing the three scores on the separate association tasks to arrive at a final quality prior knowledge score. Alternatively, some quality prior knowledge subjects may

have stated facets of high quality responses on separate lines because the directions requested that each though be put on a new line, resulting in medium rather than high quality ratings.

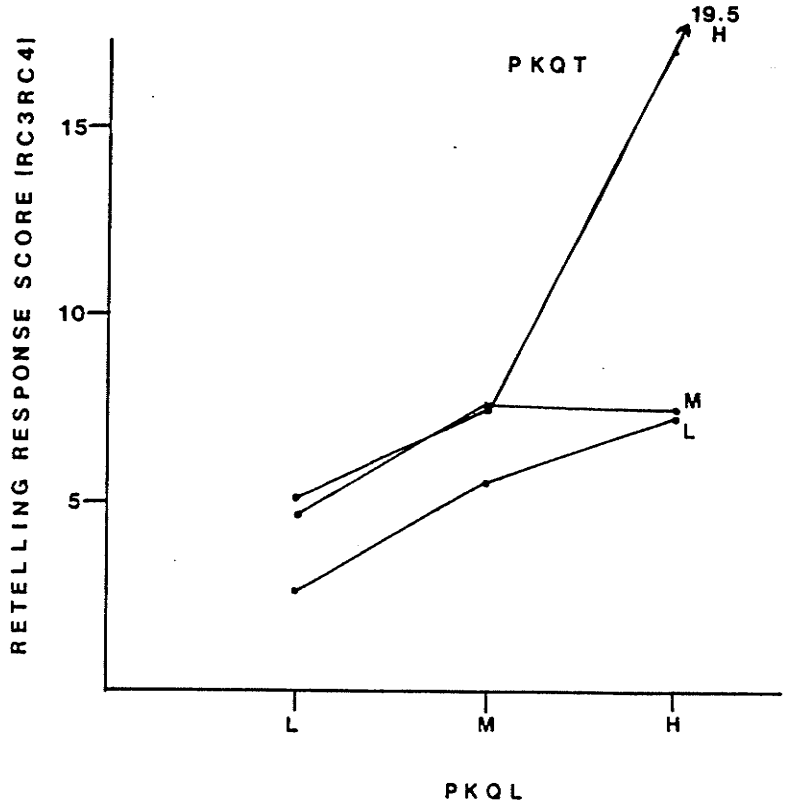


Figure 4.12. Interactions between quantity and quality of prior knowledge related to inferential retelling response scores (RC3RC4) when topics were combined for grade six. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

Further ANOVA results for grade six, when scores were combined across topics, indicated a significant interaction between quantity and quality of prior knowledge related to comprehension performance on the inferential questions (QuesI), $F(4,233)=4.24$, $p<.05$ (Table 6.3, Appendix H). As illustrated in Figure 4.13, those subjects with high and low quantitative prior knowledge ratings with high qualitative prior knowledge ratings were in reverse positions when comprehension performance was considered. One would expect those with high quantity/high quality prior knowledge ratings to have high comprehension scores as measured by inferential questions (QuesI).

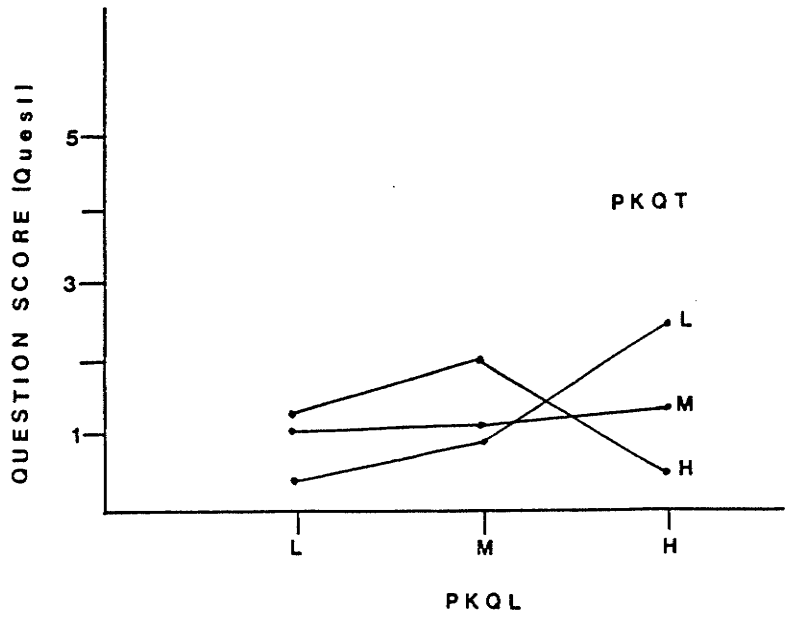


Figure 4.13. Interactions between quantity and quality of prior knowledge related to inferential questions (QuesI) when topics were combined for grade six. (PKQT=Quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

In addition, when results were pooled across grade six topics, there was a significant three-way interaction among topic, quantity and quality of prior knowledge in relation to inferential comprehension performance on retelling responses (RC3RC4), $F(4,233)=5.25$, $p<.05$), (Figure 4.14).

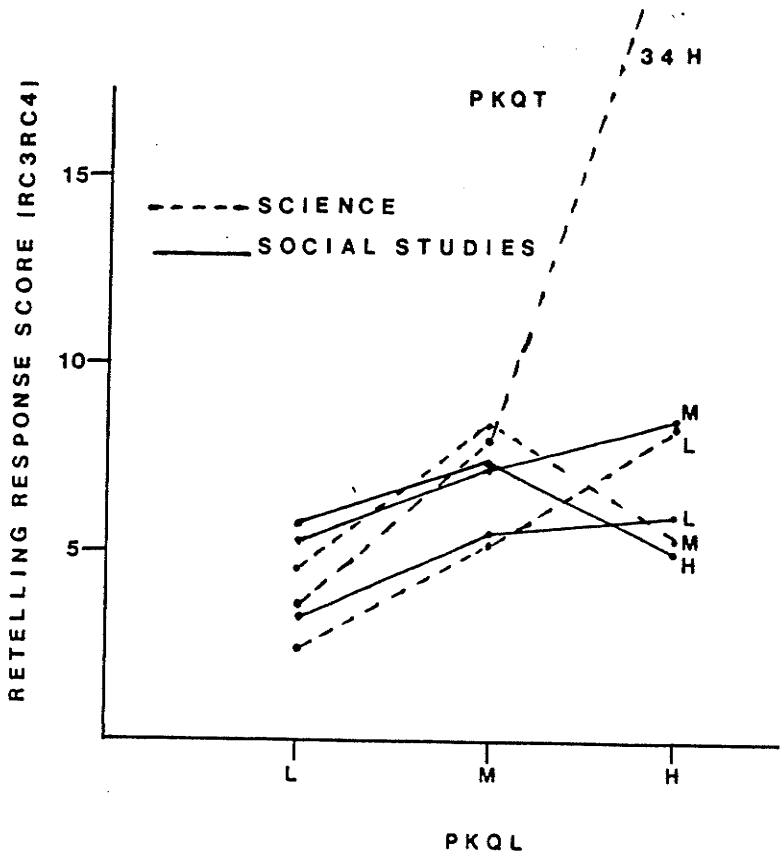


Figure 14. Three-way interactions among topic, quantity and quality of prior knowledge related to inferential retelling response scores (RC3RC4) when topics were combined for grade six. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

Grade Nine

For the grade nine science passage, ANOVA results showed a significant interaction between quantity and quality of prior knowledge in relation to inferential retelling responses, $F(4,1215)=3.33$, $p<.05$, but not in relation to inferential questions (Table 6.5, Appendix H).

When interactions were plotted, Figure 4.15, it was evident that interactions occurred for high and low quantitative prior knowledge groups with middle qualitative prior knowledge ratings and for those high and low quantitative prior knowledge subjects with high qualitativie prior knowledge ratings. Those subjects with high and low quantity but middle quality prior knowledge did not score as expected. Those with low quantity/middle quality prior knowledge ratings should have lower comprehension performance than high and middle quantity/middle quality prior knowledge subjects. In contrast, high quantity/middle quality prior knowledge subjects should have had the best inferential comprehension score compared to subjects with middle and low quantity/middle quality prior knowledge.

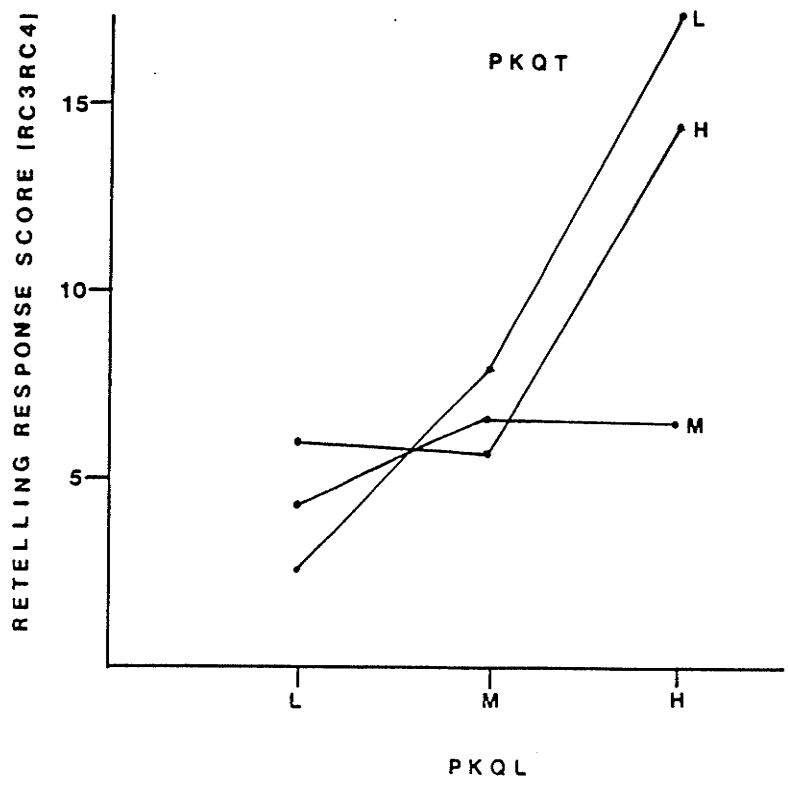


Figure 4.15. Interactions between quantity and quality of prior knowledge related to inferential retelling response scores (RC3RC4) for grade nine science. (PKQT=Quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

Box plots showing quartile ranges, mean and extreme performance on inferential retellings (RC3RC4) for grade nine science were constructed to explore the phenomenon further. An inspection of the box plots, Figure 4.16, revealed that ninety percent of the subjects fall in the appropriate direction, indicating a low to high hierarchy.

The exceptions to this pattern were four subjects (two in the low quantity and two in the medium quantity prior knowledge group) who embedded a high number of original text clausal ideas and experiential ideas (17 and 22, 23 and 25) in their inferential retelling statements as compared to other low and medium quantity prior knowledge subjects. The free associations of the two low quantity prior knowledge subjects received high quality ratings. These cases seem to provide further support for the hypothesis that those with high quality prior knowledge do not necessarly provide a large number of subordinate ideas. Subordinate ideas are likely subsumed by higher order knowledge. Quantitative scoring thus fails to capture an essential element of prior knowledge, its level.

The free associations of the identified middle quantity prior knowledge subjects were given middle quality prior knowledge ratings. As proposed for the grade six science passage, Figure 4.8, the prior knowledge of these grade nine subjects may have been incorrectly rated as medium rather than high due to the averaging of the three separate associations. This suggests that the qualitative prior knowledge measure may need to be refined.

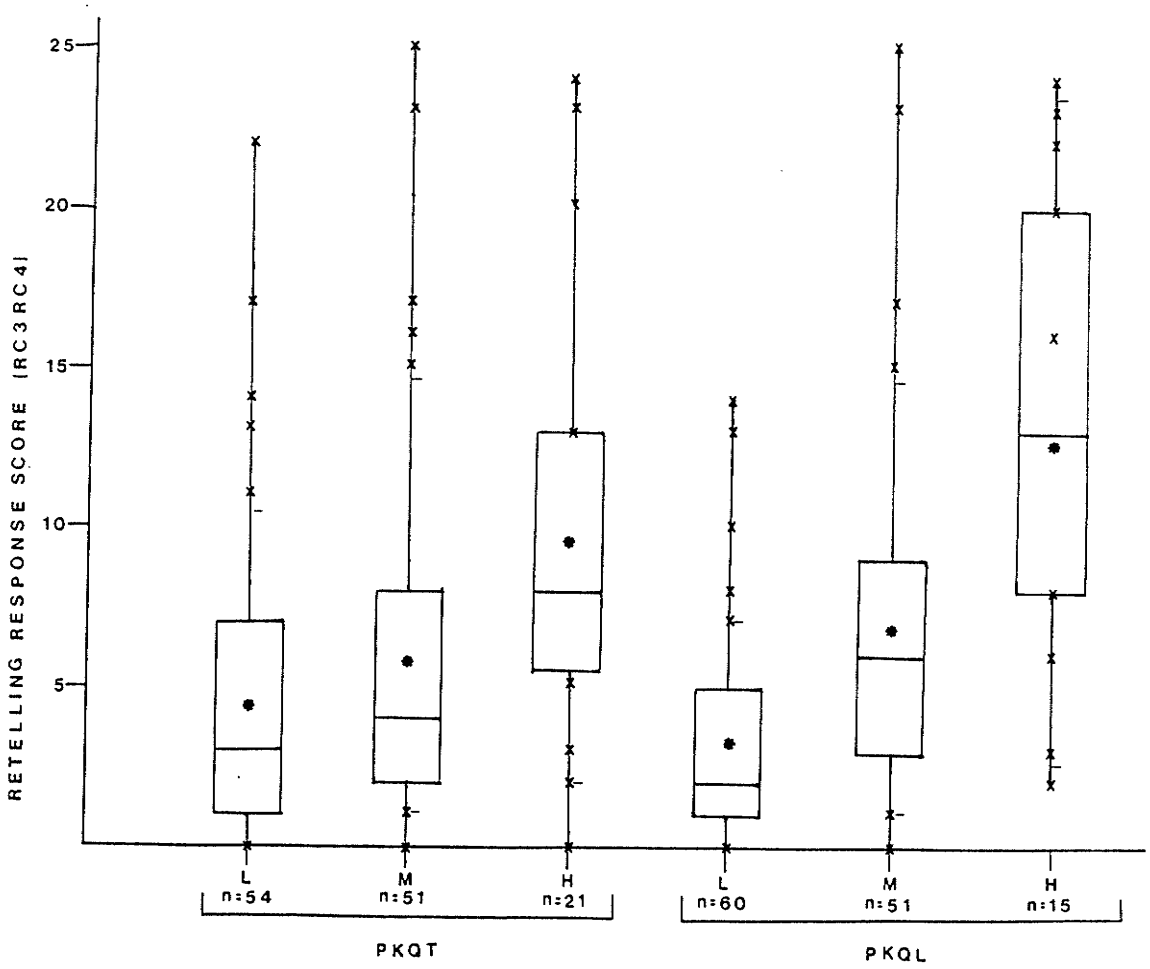


Figure 4.16. Box plots illustrating the range of inferential retelling responses (RC3RC4) according to quantity and quality of prior knowledge (high, medium, low) for grade six science. The middle 50% of subjects are shown within the box, with the remaining 50% represented by the vertical line, either above or below. The dash (-) indicated the 90% range. (PKQT=prior knowledge quantity; PKQL=prior knowledge quality; n=number; H=high; M=medium; L=low; *=mean; X=extreme scores)

When results were combined across topic for grade nine, the analysis indicated a significant three-way interaction among topic, quantity and quality of prior knowledge related to inferential comprehension on retelling responses (RC3RC4), ($F(4,253)=3.11$, $p<.05$) (Table 6.2, Appendix H). See Figure 4.17 for the plotted interaction.

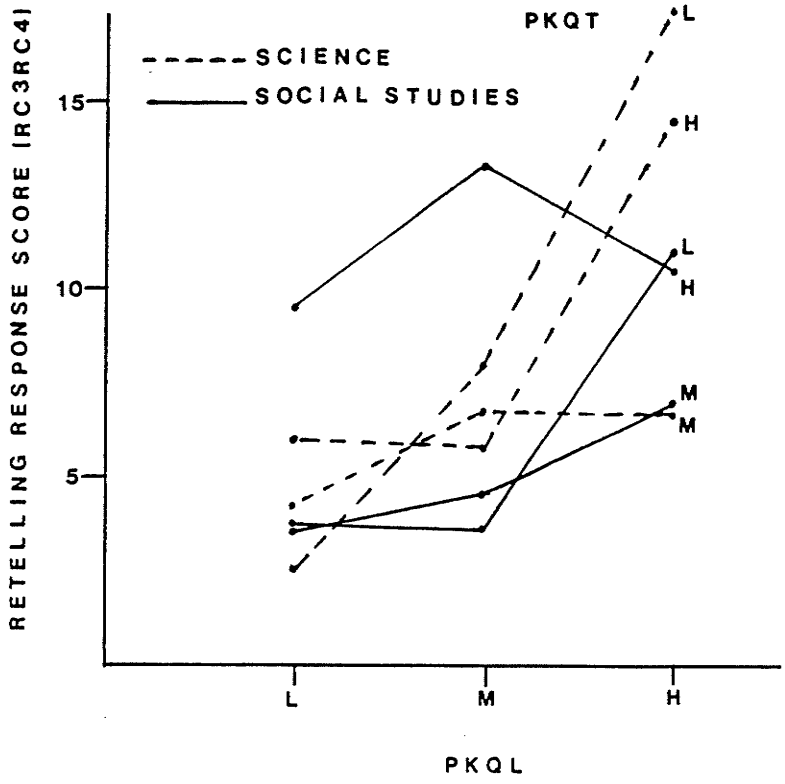


Figure 4.17. Three-way interactions among topic, quantity and quality of prior knowledge related to inferential retelling response scores (RC3RC4) when topics were combined for grade nine. (PKQT=Quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low)

Given the previous interactions, this three-way interaction was expected. Small numbers of subjects in the high prior knowledge category and scoring problems with the quantity and quality prior knowledge measures are among the variables that may account for the interactions.

There were no significant interactions for the social studies passages in either grade. (See ANOVA Tables, Appendix H.)

Overall Summary of Effects of Prior Knowledge on Comprehension -- Question One

Prior Knowledge Effects on Literal Comprehension

Despite the expectation that the quantity of prior knowledge would influence the literal comprehension performance of both sixth and ninth grade able readers, initial findings derived from analysis of variance by grade and topic, indicated that quantity of prior knowledge did not significantly affect literal comprehension performance as measured either by retelling responses (RC1RC2) or by questions (QuesL) for either science or social studies.

With respect to quality of prior knowledge, a consistent significant effect for literal comprehension as measured by both retelling responses (RC1RC2) and questions (QuesL) was found for grade six and grade nine science, and for both grades when content areas were combined. For both grade six

and nine social studies, the effects for qualitative prior knowledge ratings on literal comprehension were nonsignificant.

Interactions. Also related to literal comprehension for grade six, analysis by content area topic indicated significant interactions between quantity and quality of prior knowledge on both retelling responses (RC1RC2) and questions (QuesL), but only for social studies. When scores were combined across content area topics, there were significant interactions between quantity and quality of prior knowledge on both literal comprehension measures. Findings further indicated significant three-way interactions among topic, quantity and quality of prior knowledge related to literal written retellings (RC1RC2). No significant three-way interactions were evident for literal level questions (QuesL) for grade six, however.

There were no significant interactions related to literal comprehension within or across the grade nine passages.

A summary of the results of the analysis of variance for prior knowledge and literal comprehension is presented in Table 4.11.

Table 4.11

Summary of Analysis of Variance for Prior Knowledge and Literal Comprehension

	PKQT	PKQL	PKQT *PKQL	Topic* PKQT*PKQL
	Grade Six			
Science				
Retellings	NS	.0008*	NS	--
Questions	NS	.0070*	NS	--
Social Sudies				
Retellings	NS	NS	.0037*	--
Question	NS	NS	.0159*	--
Topics Combined				
Retellings	NS	.0002*	.0137*	.0077*
Questions	NS	.0044*	.0225*	NS
	Grade Nine			
Science				
Retellings	NS	.0047*	NS	--
Questions	NS	.0066*	NS	--
Social Studies				
Retellings	NS	NS	NS	--
Questions	NS	NS	NS	--
Topics Combined				
Retellings	NS	.0013*	NS	NS
Questions	NS	.0102*	NS	NS

NS = Not Significant
* = Significant $p<.05$
PKQT = Quantity of Prior Knowledge
PKQL = Quality of Prior Knowledge

Prior Knowledge Effects on Inferential Comprehension

Initial results of the analysis revealed an inconsistent effect for quantity of prior knowledge on inferential comprehension both within and across passages. For grade six, quantity of prior knowledge had a significant effect on inferential comprehension on both retelling (RC3RC4) and question (QuesI) measures for science and on the retelling responses when scores were combined across topics. Quantity of prior knowledge did not significantly effect inferential comprehension on either retelling or question measures for social studies. Pooling scores across topics had no effect on comprehension as measured by inferential questions (QuesI).

For grade nine, quantity of prior knowledge had a significant effect on inferential retelling responses (RC3RC4) for social studies and across passages when scores were combined, but not on inferential level social studies questions (QuesI), nor on either retelling or question measures in science.

Similar to qualitative prior knowledge and literal comprehension, there was a consistent significant effect for qualitative prior knowledge on inferential comprehension performance on both retelling responses (RC3RC4) and questions (QuesI) for both grade six and nine science and for both grades on both measures when comprehension

performance was combined. For grade six and grade nine social studies on both retelling (RC3RC4) and question (QuesI) measures, however, there were no significant effects for qualitative prior knowledge ratings as related to inferential comprehension.

Interactions. Significant interactions were evident between quantity and quality of prior knowledge on written retellings (RC3RC4) for both grade six and grade nine science, but not for social studies. There was also a significant interaction between prior knowledge quantity and quality for inferential level questions on science at the grade six but not the grade nine level. While there were interactions when scores were pooled at the grade six level, there were no interactions for pooled scores for grade nine. There were, however, significant interactions among topic, quantity and quality of prior knowledge related to inferential comprehension as measured by retelling responses (RC3RC4) but not questions (QuesI) at both grade levels.

A summary of the analysis of variance results for prior knowledge and inferential comprehension is presented in Table 4.12.

Table 4.12

Summary of Analysis of Variance for Prior Knowledge and Inferential Comprehension

	PKQT	PKQL	PKQT *PKQL	Topic* PKQT*PKQL
	Grade Six			
Science				
Retellings	.0001*	.0001*	.0001*	--
Questions	.0040*	.0178*	.0013*	--
Social Studies				
Retellings	NS	NS	NS	--
Questions	NS	NS	NS	--
Topics Combined				
Retellings	.0022*	.0001*	.0206*	.0005*
Questions	NS	.0126*	.0042*	NS
	Grade Nine			
Science				
Retellings	NS	.0001*	.0127*	--
Questions	NS	.0001*	NS	--
Social Studies				
Retellings	.0001*	NS	NS	--
Questions	NS	NS	NS	--
Topics Combined				
Retellings	.0004*	.0001*	NS	.0161*
Questions	NS	.0001*	NS	NS

NS = Not Significant
* = Significant $p<.05$
PKQT = Quantity of Prior Knowledge
PKQL = Quality of Prior Knowledge

Locating Sources of Difference

Where the ANOVA indicated significant effects for quantity or quality of prior knowledge, subsequent examination of the differences in mean comprehension performance between high and middle, high and low, and middle and low prior knowledge groups was undertaken to pinpoint significant differences in comprehension. The use of statistical tests involving mean comparisons to determine where these differences occurred were rejected because small differences between most mean performance levels would not be educationally important regardless of statistical significance. However, the highest differences in mean performance were deemed to have possible educational significance as well as statistical significance. The differences in mean performance on literal and inferential comprehension measure are presented next. Those mean difference which were small, hence not important educationally, are not discussed.

Significant Differences on Literal Comprehension

Grade six. ANOVA results indicated a significant effect for quality of prior knowledge on literal retelling responses (RC1RC2) and questions (QuesL) for grade six science. As presented in Table 4.7, p. 87, the difference in mean performance was greatest between those subjects with high and low quality prior knowledge ratings, ($\overline{X}$ = 7.8 and

4.03, respectively for retellings and $\bar{X}$ = 2.3 and 1.4 for questions). Hence for grade six, the mean performance on literal retelling responses (RC3RC4) was significantly greater for those with high compared to low quality prior knowledge. There did not seem to be an educationally important difference for retelling scores between high and medium ($\bar{X}$ = 7.8 and 6.2, respectively) or medium and low ($\bar{X}$ = 6.2 and 4.03, respectively) prior knowledge ratings. Similarly, for literal level questions, there didn't seem to be any significant difference between those rated high and those rated medium ($\bar{X}$ = 2.3 and 2.46, respectively).

A significant effect for quality prior knowledge on literal retellings (RC1RC2) and questions (QuesL) was also indicated for grade six when content areas were combined. An examination of the differences in mean performance showed that the largest difference occurred between those with high and low quality prior knowledge ratings. A two-way interaction between prior knowledge and both literal comprehension measures was evident for social studies. An interaction between the two prior knowledge measures also occurred when topics were combined. Moreover, a significant three-way interaction among topic, quantity and quality prior knowledge confounded the significant effects for quality of prior knowledge still further. Thus, when topics were combined for grade six, the significant differences in literal comprehension performance among those with high,

medium, and low quality prior knowledge ratings seemed to be influenced not only by quantitative prior knowledge levels, but also by content area.

Grade nine. For grade nine, the ANOVA indicated a significant effect for quality of prior knowledge on both literal retelling responses (RC1RC2) for science and when topics were combined. An examination of mean performance for science on both measures seemed to indicate significantly greater performance for those with high compared to low quality prior knowledge ratings ($\bar{X}$ = 8.47 and 3.2 for science retellings; $\bar{X}$ = 3.27 and 1.13 for science questions; $\bar{X}$ = 7.67 and 3.47 for pooled retellings; and $\bar{X}$ = 3.26 and 1.7 for pooled questions) (Table 4.7. p. 87). These differences seem to be educationally important especially when one thinks in terms of percentages for questions. There were no significant interactions for grade nine to confound the significant effect for quality of prior knowledge on literal comprehension as measured by retelling and questions responses.

Summary. Thus, for both grade six and nine science, mean performance on literal retelling responses (RC1RC2) was significantly greater for those subjects with high compared to low quality prior knowledge ratings. When topics were combined, there was also significantly higher mean performance for those with high than those with low quality prior knowledge. Interactions confounded the effects of

quantity and quality prior knowledge with content area at the grade six but not the grade nine level. This effect seemed to be due to the social studies passage.

Significant Differences on Inferential Comprehension

Grade six. For grade six science, the ANOVA indicated significant effects for both quantity and quality of prior knowledge on inferential comprehension as measured by retelling responses (RC3RC4). As presented in Table 4.8, p. 89, the largest differences in mean performance on inferential retelling responses (RC3RC4) were evident between those with high ($\bar{X}$ = 8.25) and low ($\bar{X}$ = 3.07) quantity prior knowledge ratings (5.18) and between those with high ($\bar{X}$ = 8.9) and low (3.43) quality prior knowledge ratings (5.47). However, the ANOVA indicated a significant interaction between quantity and quality of prior knowledge, confounding the significant effect. Thus, the significantly greater mean performance of those with high quantity prior knowledge ratings was confounded by their quality ratings. Similarly, the significantly greater mean performance of those with high quality prior knowledge was confounded by their quantity prior knowledge ratings. Hence, significant differences in inferential comprehension performance on retelling responses (RC3RC4) for grade six science were not the effect of either quantity or quality of prior knowledge alone.

When topics were combined for grade six, the same pattern occured. Also, for grade six science and for grade six when scores were combined across topics, the results indicated interactions between quantity and quality of prior knowledge related to inferential comprehension on questions (QuesI). There was also an interaction between topic and prior knowledge quantity and quality for retellings when scores for content areas were combined. This seemed to be caused by the science passage.

Grade nine. For grade nine science, the ANOVA indicated a significant effect for quality of prior knowledge on inferential retelling responses (RC3RC4). Although differences in mean performance between subjects with high and medium, and high and low quality prior knowledge ratings were large ($\bar{X}$ = 12.87, 6.9; and 12.87 and 3.17 respectively, see Table 4.8, p. 89), the interaction between quantity and quality of prior knowledge confounded the effect of quality of prior knowledge on inferential retelling responses. Hence, as was the case with grade six science, for grade nine the significant differences occurred among high, medium, and low quality prior knowledge groups identified by their correspondingly high, medium, or low quantity prior knowledge ratings. While there didn't seem to be an educationally practical distinction between medium and low quantity prior knowledge groups ($\bar{X}$ = 4.42 and 4.0, respectively), there seemed to be a significant difference

between these two groups and the high prior knowledge group ($\bar{X}$ = 11.43), suggesting that the quantity prior knowledge measure was inappropriate because it failed to discriminate among all three groups equitably.

When topics were combined, a three-way interaction for topic, quantity and quality of prior knowledge related to inferential retellings (RC3RC4) confounded the significant effect for quality of prior knowledge. It may have been that the high quantity prior knowledge group had recently studied the topic.

For grade nine social studies, a different pattern emerged. The ANOVA indicated a significant effect for quantity of prior knowledge related to inferential comprehension as measured by retelling responses (RC3RC4) with no significant interaction. An examination of the differences in mean performance (Table 4.8, p.89) revealed a significantly greater mean score on retelling responses (RC3RC4) for those with high rather than medium quantity prior knowledge ratings ($\bar{X}$ = 11.43 and 4.42) and for those with high rather than low quantity prior knowledge ratings ($\bar{X}$ = 4.43 and 4.0). The differences in mean scores seemed disproportionate.

Related to inferential questions (QuesI), both for science and pooled content area scores but not for social studies, findings indicated a significant effect for quality of prior knowledge on inferential comprehension. An

examination of the differences in mean performance (Table 4.8, p. 89) among the high, medium, and low quality prior knowledge groups revealed a significantly greater mean performance for those with high compared to low quality prior knowledge for science ($\bar{X}$ = 2.93 and .73, respectively) and when topics were combined ($\bar{X}$ = 2.63 and 2.92, respectively). These difference appear to be educationally important since there were only five inference questions.

Summary. Thus, for grade six and nine science and across content area topics, significant differences in mean performance on inferential retelling responses (RC3RC4) among high, medium and low prior knowledge groups were difficult to pinpoint and not educationally practical due to the interactions. Differences in inferential comprehension on retelling responses (RC3RC4) of those with high, medium, and low quality of prior knowledge ratings depended also on the quantitative prior knowledge levels and topic. This same pattern held true for significant differences on inferential question performance for grade six.

However, for grade nine social studies, mean performance on inferential retelling responses (RC3RC4) was significantly better for subjects with high compared to those with medium or low quantity prior knowledge ratings, supporting perhaps that quantity prior knowledge levels do not discriminate enough between medium and low prior knowledge subjects, particularly at the grade nine level.

For grade nine science and across content area topics, mean performance on inferential questions (QuesI) was significantly greater for those with high compared to low quality prior knowledge. Scores were low, although the means seemed to indicate an adequate progression from low to medium to high ratings.

Results related to Question Two are presented next.

Similarities and Differences in Comprehension Processing

Question Two

Based upon an analysis of written retelling protocols obtained from social studies and science material prompts, what similarities and differences are evident on the explicit (literal level) and implicit (inferential level) comprehension processing of sixth and ninth grade able readers? The questions were addressed through an examination of mean performance scores and analysis of variance results.

Mean Performance

The following overall trends are evident from an examination of mean retelling responses for explicit literal level text processing (RC1RC2) and implicit inferential level processing (RC3RC4). Mean scores are analyzed: first,

within grades across topics, and second, across grades within topics.

For grade six science, there did not seem to be any significant differences between the number of explicit and implicit ideas recalled ($\bar{X}$ = 4.98 RC1RC2; 5.18 RC3RC4, Table 4.3 and 4.5, p.83, 85). The same pattern seemed to hold true for social studies ($\bar{X}$ = 5.97 RC1RC2 and 6.23 RC3RC4). The case was similar for grade nine, both in science and in social studies (science $\bar{X}$ = 4.79 RC1RC2, 5.83 RC3RC4, and for social studies $\bar{X}$ = 4.3 RC1RC2 and 5.06 RC3RC4).

Students in both grades seemed to recall about the same number of explicitly stated as implict ideas, regardless of topic. An examination of mean scores across processing levels seemed to confirm this trend. That is, there didn't seem to be any significant differences for literal level processing between grade six and nine students either for science ($\bar{X}$ = 4.98 RC1RC2 grade six; $\bar{X}$ = 4.79 RC1RC2 for grade nine) or for social studies ($\bar{X}$ = 5.97 RC1RC2 grade six; $\bar{X}$ = 4.31 RC1RC2 grade nine).

When means for implicit processing (RC3RC4) were examined, the same pattern seemed to be true. Grade nine students, on average, did not recall more implicit ideas than grade six students either in science ($\bar{X}$ = 5.18 RC3RC4 grade six; $\bar{X}$ = 5.83 RC3RC4 grade nine), or in social studies ($\bar{X}$ = 6.23 RC3RC4 grade six; $\bar{X}$ = 5.06 RC3RC4 grade nine). A

more indepth analysis, examining performance in terms of levels of prior knowledge seemed in order.

Analysis of Variance

Similarities and differences in comprehension processing for grade six and nine readers were next examined in relation to ANOVA results: first, by topic when grades were combined; and second, by grade and topic and when topics were combined.

Literal Comprehension

For science, the ANOVA by topic when grades were combined indicated a significant three-way interaction among grade, quantity and quality of prior knowledge related to literal retelling responses (RC1RC2), $F(4,244)=3.77$, $p<.05$ (Table 6.7, Appendix H). Similarly, for social studies, the results showed a significant three-way interaction among grade, quantity and quality of prior knowledge, $F(4,243)=3.32$, $p<.05$.

Figures 4.18 and 4.19 plot mean literal retelling responses for science and social studies for each grade and illustrate the three-way interactions. These complexities make it difficult to isolate the similarities and differences in the effects of prior knowledge on explicit comprehension processing as measured by retellings, although it seems that for grade six science there were incongruities between the actual literal comprehension performance

(RC1RC2) of subjects rated medium and low by the quantitative prior knowledge measure and rated high qualitatively. They scored about the same which is contrary to predictions (Figure 4.18). Similarly, for grade nine, subjects rated as having medium prior knowledge by the quantity measure were rated differently by the qualitative measure and actually scored higher than those rated high quantitatively.

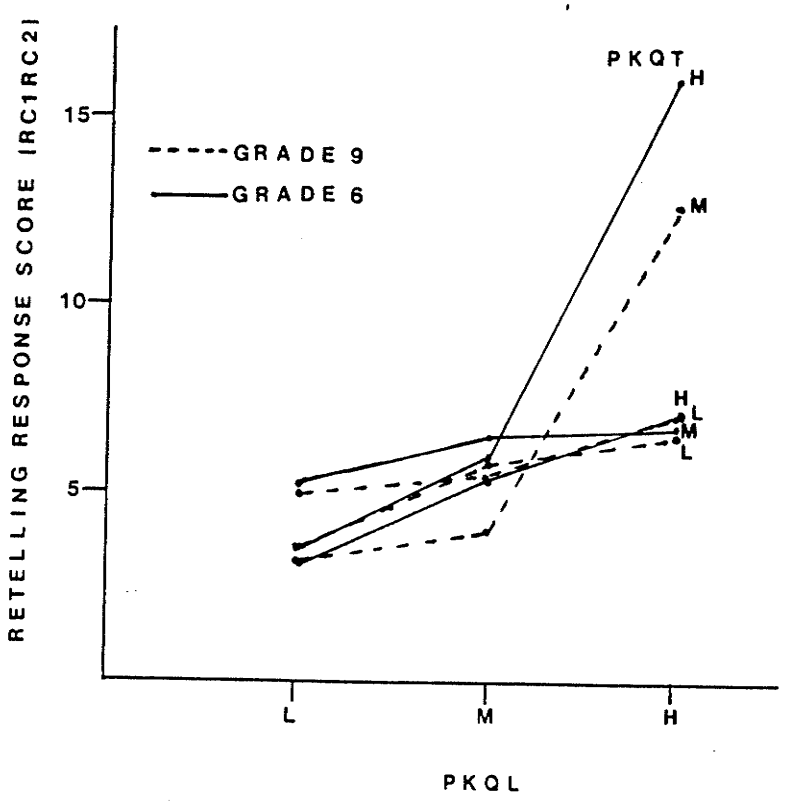


Figure 4.18. Three-way interactions among grade, quantity and quality and prior knowledge related to literal retelling response scores (RC1RC2) across grades for science. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low).

For social studies (Figure 4.19), results were even more spurious. It was evident that at the grade six level, those rated low by the quantitative prior knowledge measure (and rated high qualitatively) scored inordinately high (RC1RC2). while those rated high quantitatively scored lower than would be expected.

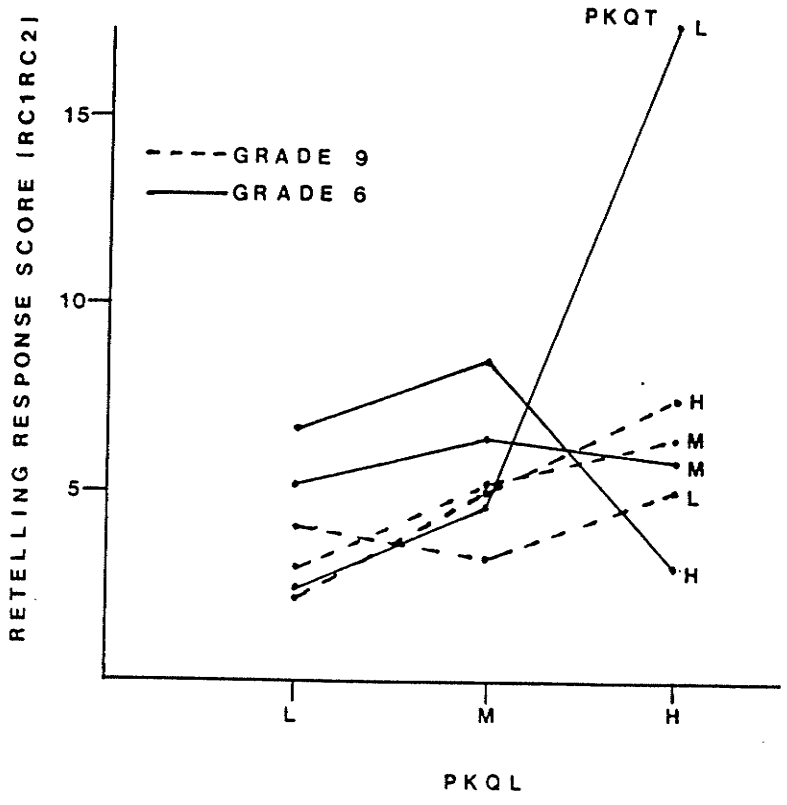


Figure 4.19. Three-way interactions among grade, quantity and quality of prior knowledge related to literal retelling responses (RC1RC2) across grades for social studies. (PKQT=quantity of prior knowledge; PKQL=quality of prior knowledge; H=high; M=medium; L=low).

Similarities and differences in ANOVA results by grade and topic and by grade across content area topics seemed to confirm these observations.

For science, at both grade levels, there were no significant main effects for quantity of prior knowledge on literal comprehension (RC1RC2). In contrast, for both grades quality of prior knowledge had a significant main effect ($F(2,118)=7.61$, $p<.05$ for grade six; $F(2,125)=5,61$, $p<.05$ for grade nine). There were no significant interactions between quality and quantity of prior knowledge, suggesting that for science there were no differences in processing in relation to quality prior knowledge and literal comprehension as assessed by written retelling responses for either grade six or grade nine.

For social studies, however, there was a significant interaction between quantity and quality of prior knowledge for grade six only ($F(4,114)=4.14$, $p<.05$). As suggested earlier (Figure 4.9), this seems to be due to the spuriously high comprehension performance of those rated low in terms of their quantitative prior knowledge. There were three-way interactions among topic, quantity and quality of prior knowledge only at the grade six level. The significant effects for science and the interactions between the two prior knowledge measures for social studies would seem to suggest that quantity was unreliable as a measure of prior knowledge for social studies for grade six students, and

that there were inconsistencies in the number of ideas students generated in relation to the social studies topic and their eventual comprehension performance. Those with low quantitative prior knowledge eventually processed more explicit clausal units. These incongruities seem peculiar to topic and to the prior knowledge measure, and lend support to the thesis advanced earlier that if the topic is highly familiar, lower level ideas may be subsumed by higher level superordinate ideas.

Inferential Comprehension

While for social studies, there was no significant three-way interaction among grade, quantity and quality of prior knowledge, for science, the results of the analysis of variance by topic across grades indicated a significant three-way interaction among grade, quantity and quality of prior knowledge as reflected in retelling responses (RC3RC4), $F(4,242)=4.86$, $p<.05$ (Table 6.8, Appendix H). The three-way interactions, as plotted in Figure 4.20, illustrate the difficulties in identifying where the significant differences in implicit processing occurred. For grade six, those rated low quantitatively (but high qualitatively) scored higher than those rated low quantitatively (but high qualitatively). For grade nine, those rated low quantitatively (but high qualitatively) scored much higher than those rated medium (but high qualitatively. Those rated medium quantitatively (and high

qualitatively) scored lowest of all. These patterns were unexpected.

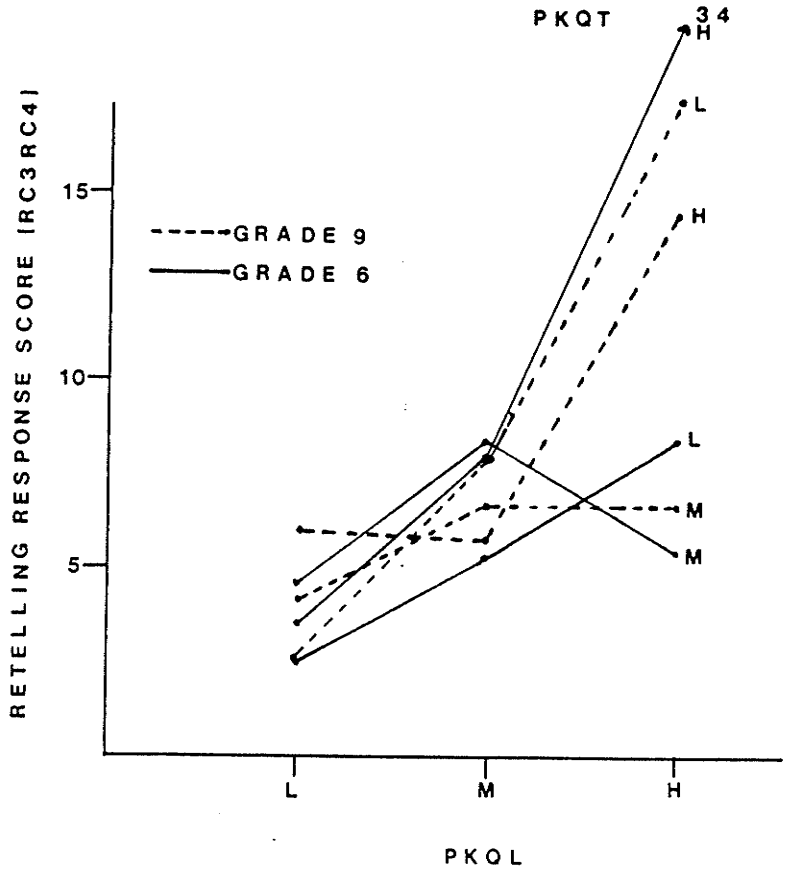


Figure 4.20. Three-way interactions among grade and quantity and quality and prior knowledge related to inferential comprehension performance on retelling responses (RC3RC4) for science across grades. (PKQT=quantitative prior knowledge; PKQL=qualitative prior knowledge; H=high; M=medium; L=low).

An examination of ANOVA results (Table 4.12, p. 138) revealed that while there were no significant differences for inferential level comprehension as measured by written retellings (RC3RC4) for grade six social studies, either for

prior knowledge quantity or quality, there were significant effects for quantity prior knowledge at the grade nine level for social studies. These effects were stable, with no ensuing interactions.

For science, however, there was a significant interactions between quantity and quality of prior knowledge for both grade six and grade nine inferential level retellings (RC3RC4), $F(4,118)=10.32$, $p<.05$ for grade six; and $F(4,125)=3.33$, $p<.05$ for grade nine.

When topics were pooled, there was a significant three-way interaction among topic and quantity and quality of prior knowledge and inferential comprehension (RC3RC4), $F(4,233)=5.25$, $p<.05$ for grade six; and $F(4,253)=3.11$, $p<.05$ for grade nine. Since there were no main effects for social studies, it would seem that the topic confounding was due to the relationship between the prior knowledge measures at the grade six level. When quantity of prior knowledge was examined, there was significance at the grade six, but not the grade nine level $F(2,118)=15.56$, $p<.05$). This would suggest that the interactions of quantity and quality of prior knowledge are not the same for grade six and nine readers. That is, the significant differences in the number of clausal units processed to produce implicit retelling responses (RC3RC4) for grade six and nine do not depend on the same combination of quantity and quality of prior knowledge ratings. Since quality ratings were significant

at both levels, it would seem that quality of prior knowledge is a more stable indication of cognitive processing when compared to quantitative ratings.

Summary of Results

Following correlations, analysis of variance procedures were conducted on the dependent variables to compare the effects of quantity and quality of prior knowledge on the literal and inferential comprehension grade six and grade nine able readers.

Literal Comprehension

Quantity of prior knowledge was found to have a consistent nonsignificant effect on literal comprehension as measured by explicit processing for literal retelling responses (RC1RC2) and questions (QuesL) for grade six and nine both within science and social studies and across content area topics. (Refer to Table 4.11.)

In contrast, quality of prior knowledge was found to have a consistent significant effect on literal comprehension on both measures for both grade six and nine science and when scores were combined across topics. No significant effect was evident for quality of prior knowledge for social studies at either grade level.

Related to literal comprehension on both measures, analysis further revealed significant interactions for grade six: 1) between quantity and quality of prior knowledge for

grade six social studies and across topics; and 2) among topic, quantity and quality when content area topic were combined. No significant interactions reelated to literal comprehension were revealed for grade nine (Table 4.11).

Examination of differences in mean literal comprehension performance, where interactions did not confound effects for prior knowledge, revealed the difference in mean performance on literal retelling responses (RC1RC2) was significantly greater for subjects with 1) high compared to low quality prior knowledge ratings for science for grade six; 2) high compared to low quality for science for grade nine; and 3) high compared to low quality across content area topics for grade nine (Table 4.7).

Although significant effects for quality of prior knowledge on literal questions were evident for science and across topics for both grades, the low mean performances were deemed not significant educationally. Hence, significant differences related to literal questions among those with high, medium and low quality of prior knowledge ratings were not examined.

Inferential Comprehension

Analysis by grade and topic indicated inconsistent effects for both quantity and quality of prior knowledge on inferential comprehension on both retelling responses (RC3RC4) and questions (QuesI). For science for grade six,

significant effects for both quantity and quality of prior knowledge on both inferential measures were evident. For grade nine, there were significant effects for quality of prior knowledge on both inferential retelling responses (RC3RC4) and questions (QuesI) for science, but not for quantity of prior knowledge on either retelling responses or questions.

For social studies for grade six, there were no significant effects for quantity or quality of prior knowledge on either inferential retelling responses (RC3RC4) or questions (QuesI). For grade nine social studies, no significant effects were indicated for quality of prior knowledge on retelling responses (RC3RC4) or for quantity or quality of prior knowledge on questions (QuesI). However, there was a significant effect for quantity of prior knowledge on social studies inferential retelling responses (RC3RC4).

Analysis further revealed significant interactions related to inferential comprehension for grade six: 1) between quantity and quality of prior knowledge related to both measures for grade six science and when topics were combined; 2) between quantity and quality of prior knowledge on retelling responses (RC3RC4) for grade nine science; and 3) among topic, quantity and quality of prior knowledge related to retellling responses (RC3RC4) for both grades when content area topics were combined.

For grade six, significant differences in inferential comprehension performance on both retelling responses (RC3RC4) and questions (QuesI) were confounded by interactions when scores from the two content areas were combined.

For grade nine, examination of differences in mean inferential comprehension performance where interactions did not confound the effects of prior knowledge, revealed that the mean score on inferential retelling responses (RC3RC4) was significantly greater for subjects with 1) high quantity compared to medium quantity prior knowledge ratings for social studies; and 2) high quantity compared to low quantity prior knowledge ratings for social studies. Related to differences in mean inferential comprehension performance on questions (QuesI), for grade nine the mean score was significantly greater for those with high quality than with low quality prior knowledge ratings for science and across content area topics.

It was hypothesized that significant interactions were possibly due to the: 1) inability of the quantitative measure to adequately identify quantity of prior knowledge for subjects who failed to state subordinate ideas which are likely subsumed by highly organized knowledge structures; 2) incorrect categorization of subjects according to qualitative prior knowledge due to the averaging of the three subtopic association tasks; 3) incorrect scoring of

quality of prior knowledge due to rating separate items which collectively rate high but separately rate medium; and 4) writing ability which prevents expression of retained information for some subjects.

Comprehension Processing

While examination of mean scores did not seem to indicate any differences in the comprehension processing of grade six and nine able readers, analysis of variance revealed complex interactions between quantitative and qualitative measures of prior knowledge and content topic. In terms of explicit processing, the quantitative measure of prior knowledge had no significant effect at either grade six or grade nine levels on literal level comprehension, while the qualitative measure seemed to be an effective predictor of literal comprehension at both grade levels for science, although there was confounding at the grade six level among content area and the two prior knowledge measures. For implicit processing, there was confounding among content area and quantitative and qualitative prior knowledge ratings at both grade levels, especially in relation to retelling responses on science material.

Chapter IV presented the results and findings of the analysis. A summary of the study and its conclusions in relation to each research question will be presented in Chapter V, together with relevant educational implications and research recommendations.

Chapter V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The purpose of this study was to determine the efficacy of a qualitative as opposed to a quantitative measure of prior knowledge for use in estimating sixth and ninth grade able readers' literal and inferential comprehension of expository text. The study also explored how students at differing grade levels process explicit and implicit text information. Students' quantitative and qualitative prior knowledge were assessed through the administration of a free association task. The effectiveness of the prior knowledge measures estimating literal and inferential comprehension was evaluated by analyzing retelling and question responses related to expository reading passages.

A common observation by teachers and reading researchers is that students vary both in their experience related to topics of study and in their comprehension of text related to those topics. It is generally accepted by theorists, researchers, and teachers that prior knowledge influences comprehension. As a consequence, an important instructional objective is to help students develop strategies to build and activate background knowledge in order to enhance their comprehension of informational text. Little is known, however, about how prior knowledge functions during comprehension. The aim of this

investigation, in the broadest sense, was to test two prior knowledge measures as predictors of different levels of comprehension to help teachers and students assess and build prior knowledge in order to increase their literal and inferential comprehension of content area text.

The present study was designed to overcome the methodological shortcomings of past prior knowledge research. These shortcomings included lack of control for individual topic prior knowledge, use of prior knowledge measures that may have cued comprehension prior to reading, assessment of prior knowledge effects using a different measure for literal than inferential comprehension, and use of either: unnatural text not representative of the type of text used in the classroom, or only one reading passage, thereby limiting generalizability.

Theoretical assumptions supported by empirical research underlie this study. The first is that comprehension occurs as a result of the interaction between newly acquired information and knowledge already stored in memory (Spiro, 1980), with the text providing the direction for readers as they use previously acquired knowledge to construct new meaning (Rumelhart, 1980). The second, is that there is a relationship between a person's prior knowledge and the comprehension of text content (Anderson, Spiro, & Anderson, 1978; Bransford & Johnson, 1972; Dooling and Lachman, 1971;

Dooling & Mullet, 1973; Schallert, 1976; Sulin & Dooling, 1974).

Research suggest that readers who demonstrate prior knowledge of the topic generally remember more of what they have read (Hare, 1982; Holmes, 1983; Pearson et al., 1979;). Moreover, this appears to hold true for both good and poor readers (Taylor, 1979). Further, when recalls are compared to text propositions and labelled textual or scriptal, a greater number of the recall responses are textual (Marr & Gormley, 1982).

Children have also been found to make more inferences as measured in follow-up probe questions, than information in their recall protocols would indicate. Pearson et al. (1979) found that prior knowledge had a profound effect on the ability to answer implicit questions, while Marr and Gormley (1982) discovered that literal probes result in the generation of more scriptal responses. Hare (1982), however, did not find that either a quantitative or qualitative measure of prior knowledge related to inferential comprehension on open-ended questions.

Researchers have used a variety of methods to control for prior knowledge. Some researchers have contolled prior knowledge by externally manipulating or assigning prior knowledge (Bransford & Johnson, 1972; Brown et al., 1976 Dooling & Lachman, 1971; Dooling & Mullet, 1972; Schallert, 1976). Other researchers assessed individual topic

familiarity using either quantitative (Hare; 1982; Holmes, 1983; Marr & Gormley, 1982; Pearson et al., 1979; Stevens, 1980, Zakaluk et al., 1986) or qualitative (Hare, 1982; Langer, 1982; Langer, 1984; Langer & Nicholich, 1981) measures of prior knowledge.

To overcome some of the design and methodological weaknesses of past prior knowledge research, the present study compared the effect of quantitative and qualitative measures of prior knowledge on literal and inferential comprehension as measured by both written retelling responses, scored for both explicit and implicit processing, and open-ended literal and inferential questions. In two sessions, subjects' individual topic knowledge was assessed as a group prior to reading, and literal and inferential comprehension on both written retellings and open-ended questions measured after reading. Seven classes each, for grades six and nine, as opposed to adult or single classes, were targeted as subjects. Naturally ocurring passages from both science and social studies texts were used as reading materials. Individual topic familiarity was rated quantitatively and qualitatively from free associations produced in response to three key concept words or phrases selected from the passages.

To explore the role that topic familiarity played in the comprehension of expository text of sixth and nine grade

able readers, the specific questions addressed were as follows:

1. Compared to a quantitative measure of topic prior knowledge, is a qualitative measure more effective in predicting sixth and ninth grade able readers' a) literal and b) inferential comprehension performance on science and social studies materials as evident in responses to 1) written retelling prompts and 2) literal and inferential open-ended questions?

2. Based upon an analysis of written retelling scores obtained from science and social studies material prompts, what similarities and differences are evident in the comprehension processing of sixth and ninth grade able readers?

From these questions the following hypotheses were examined.

First, regarding quantity of prior knowledge and literal comprehension: For sixth and ninth grade able readers of high, medium, and low quantitative prior knowledge, there are no differences in literal comprehension performance as measured by the 1) text specific and text embedded clauses found in written retellings and 2) responses to text explicit questions on a) science and b) social studies material.

Second, regarding quality of prior knowledge and literal comprehension: For sixth and ninth grade able

readers of high, medium, and low qualitative prior knowledge there are no differences in literal comprehension as measured by the 1) text specific and text embedded clauses found in written retellings and 2) responses to text explicit questions on a) science and b) social studies materials.

Third, regarding quantity of prior knowledge and inferential comprehension: For sixth and ninth grade able readers of high, medium, and low quantitative knowledge, there are no differences in inferential comprehension performance as measured by the 1) text entailed and text evoked clauses found in written retellings and 2) responses to text implicit questions on a) science and b) social studies material.

Fourth, regarding quality of comprehension and inferential comprehension: For sixth and ninth grade able readers of high, medium, and low qualitative prior knowledge there are no differences in inferential comprehension performance as measured by the 1) text entailed and text evoked clauses found in written retellings and 2) responses to text implicit questions on a) science and b) social studies materials.

Fifth, regarding quantity and quality of prior knowledge: There are no differences between prior knowledge measures (qualitative and quantitative) in predicting

literal and inferential comprehension performance within and across grades.

In order to address these questions, 123 sixth and 138 ninth grade able readers read two 400-450 word passages, one on science and one on a social studies topic, recalled in writing what they remembered, and answered open-ended questions based on the passages. Prior to reading the passages, the students indicated what they already knew about the topic by making free associations in relation to concepts words or phrases that were used as prompts. Subjects were tested in two sessions of approximately 45 minutes.

Free associations were scored and rated according to quantitative (Zakaluk et al., 1986) and qualitative (Langer, 1981) prior knowledge. Written retelling protocols were parsed into clausal units that were scored and categorized (text specific, text embedded, text entailed, text evoked, text erroneous, and text extraneous responses) according to the number of template units processed (Drum & Lantaff, 1978; Malicky, 1985). Open ended questions were scored for the number of literal and inferential questions answered correctly.

The following is a summary and discussion of the results pertaining to the hypotheses.

Summary of Research Findings

Differences Between Quantitative and Qualitative Prior Knowledge Measures

The primary purpose of this study was to compare the effectiveness of the quantitative and qualitive prior knowledge measures for use in estimating literal and inferential comprehension. The analysis of the students' written retelling and open-ended question responses revealed mixed findings.

Correlations indicated no clear pattern for quantity of prior knowledge and literal or inferential comprehension across either grade level or content area. In contrast, correlations for grade six and nine seemed to indicate a more substantial relationship between the quality of prior knowledge and inferential comprehension, particularly for grade nine science.

Regarding literal comprehension. For both grade six and nine able readers, there were no significant differences in literal comprehension performance on either retelling responses (RC1RC2) or questions (QuesL) among those with high, medium, or low quantity prior knowledge ratings for science, social studies, or across content area topics.

In contrast, the number of explicitly processed clausal units required to produce literal retelling responses was significantly greater for those in grade six and nine with

high as compared to low quality prior knowledge ratings for science, and for grade nine only when topics were combined. There were significant effects for quality of prior knowledge on literal questions for both grades in science. However, the differences in mean performance among high, medium, and low quality prior knowledge groups were too low to be considered educationally important.

The results reject the hypothesis that there are no differences between prior knowledge measures in predicting literal comprehension performance. That is, the results favoured quality of prior knowledge as a predictor of literal comprehension as measured by retelling responses and questions for grade six and nine able readers of science and across content area topics.

These results validate Langer's qualitative meaure of prior knowledge as a reliable predictor of overall recall. However, the findings contradict those of Hare which favoured the use of a quantitive over a qualitative scoring system.

These findings support the theoretical notions that a) people store information in the most inclusive levels possible (Collins and Quillian, 1969); b) reading is an interactive process where parts activate the whole that in turn activates other parts of the schema (Carrel, 1983; Rumelhart, 1980); and c) interpretation of wholes and parts takes place simultaneously (Neisser, 1976).

Regarding inferential comprehension. First, for grade nine able readers of social studies, those with high quantity prior knowledge ratings embedded more implicitly processed clausal units in inferential retellings (RC3RC4) than those with low prior knowledge ratings. Also for grade nine, there was evidence to suggest that those with high quality prior knowledge answered more inferential questions than those with low quality prior knowledge ratings for science and across content area topics.

However, for grade six, there was no evidence to suggest that either quantity or quality of prior knowledge alone, would facilitate significant differences in inferential comprehension on either retelling responses or questions for either topic.

Although the results suggest that neither quantity nor quality of prior knowledge consistently predicted inferential comprehension as measured by retelling responses and questions, the findings reject the hypothesis that there are no differences between the prior knowledge measures in predicting literal and inferential comprehension performance. That is, for grade six able readers, neither quantity nor quality of prior knowledge was an independent predictor of inferential comprehension performance because results were confounded by significant interactions between quantity and quality of prior knowledge or among content area and the two types of prior knowledge. However, for

able readers: a) quantity was an effective predictor of inferential comprehension as measured by retelling responses (RC3RC4) for social studies, but not for science nor when topics were combined; and b) quality of prior knowledge was an effective predictor of inferential comprehension performance as measured by questions (QuesI) for science and when topics were combined, but these effects were confounded by topic and quantity of prior knowledge when inferential retelling responses (RC3RC4) were examined.

The results reported above might be explained in the following way. Whether or not significant differences between prior knowledge classifications were found was dependent upon type of prior knowledge measure, passage, and comprehension assessment mode.

That the qualitative prior knowledge measure did and the quantity measure did not predict literal comprehension may be explained by schema theory. It is possible that the quantitative measure did not adequately identify the quantity of prior knowledge for subjects who possessed highly organized knowledge structures. According to schema theory, subordinate ideas would be subsumed within the stated superordinate responses in the free association task. If this were the case, some subjects may have been assigned medium or low quantity prior knowledge ratings instead of high quantity ratings.

Because the qualitative prior knowledge ratings are based on an organizational hierarchy, they reflect the level of topic familiarity better regardless of the number of associations and hence better predict literal comprehension performance. It is possible that those with high quality prior knowledge ratings and highly organized superordinate associations, performed better on literal comprehension measures because activation of one part of the schema during reading in turn activated other parts (Rumelhart, 1980). This would result in greater encoding during reading and greater comprehension and recall on post reading measures for those students compared to those with low quality lower order prior knowledge ratings.

According to this theoretical rationle, one would expect that those with high quality prior knowledge levels would perform better on inferential comprehension measures in addition to literal comprehension measures. Correlations between quality prior knowledge for inferences on retellings were substantial for both grades for science and across content area. The results, however, indicated interactions between quality and quantity, confounding the significant effects indicated for quality of prior knowledge on inferential retellings. The fact that some subjects with high quality prior knowledge did not perform as would be expected may be due to their inability to maintain schema

(Spiro, 1980) or to inflexible relationships between levels of available schema (Anderson & Pearson, 1984).

Inability of the quality prior knowledge measure to consistently predict inferential comprehension may be attributed to the need for refining either the measure or the task directions. Some subjects who performed well on inferential comprehension as measured by written retellings may have been incorrectly categorized as medium or low prior knowledge subjects rather than high due to the averaging of the three subtopic scores. Others may have subdivided aspects of higher order knowledge into separate association items as a result of the directions, which required that each association be written on a separate line. Collectively the items rated high; separately they rated medium.

It should be noted that some of the variation in the results may be attributed to the comprehension measures. The retelling response categories were adapted from those employed for oral recalls by Drum and Lantaff (1978) and Malicky (1985). In this investigation, correlations which indicated substantial relationships between combined text specific and text embedded responses (RC1RC2) and literal questions (QuesL), and combined text entailed and text evoked responses (RC3RC4) and inferential questions (QuesI), support the application of the recall categories for the assessment of literal and inferential comprehension as reflected in written retellings. However, findings

regarding the relationship between the prior knowledge measures and literal and inferential comprehension may have been influenced by combining the text specific and text embedded responses to reflect explicit processing and the text entailed and text evoked to reflect implicit processing. Results may have been more definitive for single categories.

Another reason for poor comprehension performance on inferential retelling responses for some high quality subjects may be writing ability that for some subjects may have interfered with the expression of retained information.

A further explanation for the varied findings may lie in the use of questions. As Johnston (1984) pointed out, although questions may be created to elicit either textually implicit or scriptally implicit information (Pearson & Johnson, 1978), when creating and classifying questions one does not know for certain the source of the answer information (text or prior knowledge). In this study, inferential comprehension, as reflected in the implicit processing required to produce retelling responses, was not constrained by the researchers preconceptions. This may account for the significant effects for quantity of prior knowledge on inferential comprehension as measured by retelling responses for grade nine social studies that was not found on questions by both this investigator and Hare.

Another reason, as Hare (1982) suggests, may be questions that are too difficult or too few in number.

Similarities and Differences Between the Processing of Sixth and Ninth Grade Readers

The mean number of explicitly and implicitly processed units to produce retelling responses was similar for grade nine and grade six able readers. The effects for quantity and quality of prior knowledge on retelling responses (the processing variable) were not consistently similar for both grades.

For science and social studies, the effects for prior knowledge on explicit processing to produce literal retelling responses (RC1RC2) were similar for grade six and nine able readers. Quantity of prior knowledge did not have significant effects on explicit processing for either grade six or grade nine readers on science or social studies materials. In contrast, for science, those with high quality prior knowledge explicitly processed a significantly greater number of clausal units than those with low quality prior knowledge. There was no significant difference for social studies as a result of prior knowledge quality.

When topics were combined, effects for prior knowledge on explicit processing for retelling responses (RC1RC2) were not the same for grade six and nine readers. For grade six readers, differences in performance on literal retelling

responses (RC1RC2) depended upon topic and quantity in conjunction with quality prior knowledge levels. For grade nine readers, the number of explicitly processed clausal units was greater for those with high compared to low quality prior knowledge ratings and did not depend upon quantity levels of prior knowledge.

Effects for prior knowledge on the implicit processing required to produce inferential retelling responses (RC3RC4) were not similar for grade six and nine able readers. For science, there were significant interactions confounding the effects for the two types of prior knowledge. Correlations, however, indicated a substantial relationship between prior knowledge quality and inferential retellings (RC3RC4), but a small relationship between prior knowledge quantity and inferential retellings for science for both grade levels.

For social studies, there were no significant differences attributed to quantity or quality of prior knowledge for grade six. In contrast for grade nine, the number of implicitly processed ideas embedded in inferential retellings were significantly greater for those with high compared to medium or low quantity ratings and did not depend upon quality levels of prior knowledge.

When topics were combined, a significant three-way interaction confounded the effects of prior knowledge with topic. Because there was a significant interaction between quantity and quality of prior knowledge for grade six and

not grade nine, it appears that the implicit processing required to generate retelling responses for younger and older readers depends upon differing combinations of high, medium and low quantity and quality topic prior knowledge. However, it seems that quality as compared to quantity of prior knowledge is a more stable predictor of cognitive processing, since quality ratings were significant at both grade levels.

It is important to note that these findings are based on combined a) text specific (RC1) and text embedded (RC2) and b) text entailed (RC3) and text evoked retelling (RC4) responses. Differences may occur between the two grade levels for individual categories of explicitly and implicitly produced retelling responses. In addition, the scores reflect the number of units processsed to produce the retelling responses and not the number of retelling responses produced in each category. It may be that younger and older readers differ in terms of the total number of retelling responses produced for each category, and hence differ in the number of processed units per written response unit. This analysis was beyond the scope of this study.

Conclusions

In conclusion, the results of this study seem to suggest that a qualitative measure of prior knowledge is an effective predictor of literal comprehension as measured by

retelling responses and open-ended questions, compared to a quantitative measure of prior knowledge. This conclusion needs to be qualified in that neither the quantitative nor qualitive prior knowledge measure was found to be a consistently reliable predictor of inferential comprehension as measured by retelling responses and questions. While for more mature grade nine readers, quantity of prior knowledge had significant effects on retellings for social studies, quality of prior knowledge had significant effects on inferential questions for science and across topics. For younger grade six readers, interactions confounded the effects of quantity and quality of prior knowledge.

A second conclusion is that for able readers, the effects of prior knowledge differ depending upon whether science or social studies materials are being processed. While quality, not quantity, of prior knowledge appears consistently to affect the processing of science materials, neither type of prior knowledge consistently affected the processing of social studies materials. The differential effects found for social studies text may relate to the nature of the selections themselves. At the grade six level, the topic was historical and related in a concrete way to the settlement of the community in which the subjects live. In contrast, at the grade nine level, the topic was philosophical and involved complex renaissance responses to the feudal system in Europe of the middle ages.

A third conclusion is that for younger and older able readers, prior knowledge has similar effects for literal comprehension processing. For both grade six and nine able readers, the mean number of clausal units explicitly processed to produce text specific and text embedded retelling responses (RC1RC2) was significantly greater for those with high, as compared to low quality prior knowledge ratings. Quantity prior knowledge ratings had no significant effects on literal comprehension for either grade six or nine able readers.

Another conclusion is that there appear to be some developmental factors operating in relation to prior knowledge and the explicit and implicit processing of content area information. As reflected in the greater number of interactions between quantity and quality of prior knowledge for grade six as compared to grade nine able readers, younger readers tended to be less efficient in processing text in relation to prior knowledge.

Educational Implications

This study has implications for middle years students and their teachers.

1. Teachers need to assess students' organization of topic knowledge before beginning units of study or assigning independent content area reading. For maximum comprehension and retention of information, appropriate instructional

planning must be made in regard to: choices of prereading teaching strategies, the institution of independent as opposed to guided reading activities, and levels of reading materials. All of these depend on the quality of students' topic familiarity.

2. To facilitate greater literal comprehension of content area text, teachers must institute activities that help students: 1) activate or build prereading knowledge, 2) organize the ideas, and 3) determine the relationships between and among the ideas in the text and the ideas they already possess.

3. Teachers of younger students may need to provide instruction and guidance to help students establish relationships between and among topic ideas in order to facilitate more efficient storage and retrieval. Younger grade six readers tend to be less efficient in organizing knowledge as reflected in the greater number of interactions between quantity and quality of prior knowledge for literal and inferential comprehension at that grade level.

Limitations of the Study

The following limitations are acknowledged when interpreting the findings of this research. Generalizability of findings is limited due to:

1. The inclusion of only two passages, one science and one social studies for each grade level.

2. The analysis of only written retelling responses and open-ended questions using 123 grade six and 138 grade nine able readers.

3. Subjects being from seven grade six (n=123) and seven grade nine (n=138) classrooms in suburban elementary and junior high schools.

4. Only able readers participated.

5. It was not possible to determine the reliability and validity of the written retellings as measures of the amount of information the students remembered. It was impossible to determine whether subjects wrote all that they recalled. It also was not possible to determine the degree to which writing ability may have affected the scores.

6. The scoring of the written retellings is a somewhat subjective task. Detailed scoring guidelines were established to minimize this effect.

7. The order of questions may not have been synonymous with the order in which the information was presented in the text in all cases.

8. While differences and similarities in relation to prior knowledge as measured quantitatively and qualitatively indicated possible developmental differences in text processing between grade six and nine readers, it was not

within the scope of this study to establish specific descriptions of the processing.

Recommendations for Further Research

Suggestions for further research based on the results of this study are as follows:

1. It would be preferable to employ more than one passage for each content area. This would facilitate greater generalizability. The use of more passages would increase the likelyhood that findings by content area may not be so topic dependent.

2. In this study, the quantitative measure of prior knowledge scores was based on assigned levels (Zakaluk et al., 1986). Hare (1982) found that Langer's association measure, scored for total prior knowledge associations, reliably predicted overall recall. This measure is deserving of further study, to compare results using the quantity levels and frequency counts. A quantity measure is more efficient and easier for researchers to use than a quality measure. It would thus be beneficial to ascertain whether the differences between the results of this study and that of Hare are due to the classification of quantitative scores. This might result either in establishing a revised quantitative scoring system that would reflect a more reliable relationship to comprehension

or in providing further insight into the value of qualitative over the quantitive prior knowledge scoring.

3. Further research should examine alternate approaches to measuring prior knowledge. Langer's procedure for choosing stimulus words, which is based on Meyer (1975), should be examined more closely. It may be that the choice of stimulus words interferes with or inhibits the generation of associations.

4. It was hypothesized that the directions for the free association task may have influenced the accuracy of the qualitative prior knowledge scoring system. Further investigation would be valuable to refine the directions for eliciting free association responses. This may result in associations that more accurately reflect the organizational knowledge hierarchy.

5. Able readers served as subjects in this study. However, less able comprehenders may not subsume subordinate ideas within superordinate categories. They may list a large number of ideas, in which case a quantitative prior knowledge measure would suffice. Further study is needed using less able readers as subjects in order to discover whether a quantitative prior knowledge measure is sufficient for estimating the comprehension performance of less competent readers.

6. Research should be carried out at different grade levels to investigate further the age affects of prior knowledge use.

7. In this study, comprehension was assessed using written retellings and questions. Further research could investigate the use of oral recalls and questions responses, thus eliminating possible writing ability effects.

8. Retelling categories were combined to provide one score for literal and one score for inferential comprehension. Further research could investigate the effects of prior knowledge on comprehension by comparing the effects of quantitative and qualitative prior knowledge on each separate retelling category. An alternative would be to compare results using both separate and combined retelling categories.

9. This study examined the number of units processsed to produce retelling responses and did not examine the number of retelling responses produced. Studies designed to examine the relationship among quantity and quality of prior knowledge and both the number of units processed and the number of units produced may provide further insight into how readers use prior knowledge to process expository text.

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APPENDIX A

Qualitative Prior Knowledge Measure: Categorization System

1) MUCH prior knowledge (3):
   superordinate concepts--higher class category
   definitions--precise meaning
   analogies--substitution or comparison for a literal concept or expression
   linking--connecting one concept to another

2) SOME prior knowledge (2):
   examples--equal class, but more specific
   attributes--subordinate to larger concept
   defining characteristics--define a major aspect of the concept

3) LITTLE prior knowledge (1):
   associations--peripheral cognitive links
   morphemes--echoes smaller unit of meaning such as prefixes, suffixes or root words
   sound alikes--similar phonemic units
   first hand experiences--peripheral responses based on recent experiences

(Langer & Nicolich, 1981)

APPENDIX B

Retelling Response Categories

1. Text Specific Responses

This category include clausal units that correspond to the text in exact form or that have specific references within a single unit of text. These units are restatments of text propositions and reflect explicit processing. They include: verbatim recall, partial recall, acceptable syntactic paraphrases, substitution of pronouns, and synonymy of elements.

2. Text Embedded Responses

The information in this category is specific to the text but the retrieved clausal unit includes information from more than one unit of text. These units reflect explicit processing.

3. Text Entailed Responses

This category includes reconstructed clausal units that integrate information. Specific elements from across the text are combined into one, put together in new ways. The units in this category may also include statements which have been added by the reader to fill in the gaps or elaborate on the author's ideas. These additions of information are derived from knowledge schemas, are constrained by the text, and are correct according to a content expert. This category includes unit of synthesis and inference and reflect implicit processing.

4. Text Evoked Responses

The clausal units in this category are not constrained by text. They are elaborations or embellishments which include experiential intrusions and story line additions and reflect the ability of the reader to use background knowledge when interacting with print.

5. Text Erroneous Responses

Units in this category contain incorrect specific text information, inaccurate or incorrect syntheses, or faulty inferences.

6. Text External Responses

Units in this category have no relationship to the text. They include recall conventions, self report statements, and repetitions.

adapted from Drum (1978); Lantaff, (1978); & Malicky, (1985).

APPENDIX C

Dear Parent or Guardian,

I am undertaking a study as a graduate student at the Faculty of Education, University of Manitoba. The purpose of this study is to examine the role prior knowledge (what the reader already knows about the topic) plays in the comprehension of materials that teachers use for instruction in social studies and science.

This study requires students to carry out a task similar to the kind of tasks they are required to do frequently in school. Students will read two 400-450 word passages, one on a social studies topic and the other on a science topic, recall in writing what they remember, and answer short-answer questions based on the passages. Prior to reading the passages, the students will indicate what they already know about the topic by making vocabulary associations. This will require two 40 minute sessions. Students will have the option to discontinue participation in the study at any point. The only personal information required from the student will be grade level placement.

All information gathered will be confidential and reporting will be done on a group basis, therefore anonymity is assured. After the study is completed, a summary of the study and the major findings will be given to the principal and classroom teacher.

Please indicate your consent by your signature below. If you require further information regarding the study, please call me at the following number: 261-7096.

Thank you.

Yours truly,

Barbara J. Wynes

Signature of Consenter

_____

APPENDIX D

Reading Passages

The Red River Colony

In 1811, a group of 100 nervous travellers from the Scottish highlands and the Irish countryside were bound for Hudson Bay. From the bay, they would head south to start a colony at Red River.

They had heard rumours that Red River was a terrible place. They had been told that the Indians were savages who would burn the settlers' houses and scalp their children. They heard that there was no food at Red River, that it was terribly cold, that no one could live at Red River.

Yet staying at home seemed little better. Many of the travellers were small farmers from Scotland. They had farmed small, rented plots of land. Now the landowners had thrown them off the land, so that large flocks of sheep could be raised instead. The farmers could go only to the noisy crowded cities---or move to another country.

One of the owners of the Hudson's Bay Company, Lord Selkirk, had obtained a grant of land from the company. He was going to start a colony on the land. The Scots and Irish farmers had decided to go to that colony.

Not everyone was pleased with Lord Selkirk's plan. The North West Company did not want settlers interfering with the fur trade. They tried to scare the settlers away by telling them how horrible the country was. But this group

of settlers, and others after them, would not be frightened away.

There were problems along the way: poor weather, delayed sailings, the difficult journey overland from Hudson Bay to Red River. Once at Red River, food was scarce, the wrong farming tools were sent, sheep were killed by wolves. The North West Company and the Metis tried to chase the settlers away. The Metis were descended from the sons and daughters of European fur traders and their Indian wives. They felt that the land around Red River belonged to them and wanted no settlers taking it away.

The Hudson's Bay Company tried to stop the Metis from hunting as they wished. The company tried to keep them from trading furs and pemmican as they wanted. In return, the Metis tried to frighten the settlers away and burned their houses.

Yet the settlers were stubborn. Driven away again and again, they always returned. More settlers arrived and the Hudson's Bay Company brought in Swiss Soldiers to protect them.

Finally, in 1821, the Hudson's Bay Company and the North West Company decided to join together as one company. The battle was over.

The problems of the colony were not over, however. Grasshoppers, floods, drought and disease all came over the next years. Yet the colony survived.

Classifying Living Things

Like all living things, animals are made of cells. Some animals are only one-celled. More complicated animals are made of many millions of cells.

When scientists study living things, they usually study one particular group at a time. To group living things, scientists observe characteristics such as appearance, special cells or living habits, or eating habits. Some of the first scientists classified all living things as either plants or animals. This classification works well for complex living things like a tree or a squirrel. However, it is not always practical to call a very simple living thing a plant or animal.

Some living things are only one cell. It is hard to say if these living things are plants or animals. For this reason some scientists call all one-celled living things protist (pro tists). Protists are not divided into plant and animal groups.

According to other scientists, one-celled living things with animal characteristics belong in a group called protozoans (pro te zo enz). The name protozoan comes from the word 'protos' meaning first, and the word 'zoan' meaning animal. Some scientists think that these were the very first animals to live on earth.

The amoeba (a me bu), which is often found in pond water, is a protozoan or protist. The whole amoeba is only one cell. It is a tiny bit of material which looks like clear gelatin. The dark spot in the cell is the nucleus. Around the cell is a very thin cover, called a cell membrane.

An amoeba has no particular shape. As an amoeba moves, it flows in a certain direction. To get food the amoeba flows around a speck of plant or animal material. When an amoeba grows to a certain size, it divides in half, producing two amoebas. When each new amoeba grows, it divides into two more amoebas.

Most kinds of animals have bodies made of many cells. A many-celled animal may have special cells for getting food. Other cells may enable it to get oxygen. Still other cells may be used for getting rid of wastes or for moving about in search of food.

Most cells of many-celled animals grow and divide like an amoeba cell. In this way, many-celled animals grow to adult size. During the adult animals's life, some kinds of cells get old and die. These cells are passed off with other wastes while new cells are being produced in their place. After an animal is fully grown, new cells are formed only to replace those that die or are destroyed, or worn away.

The Renaissance

The people who lived during the Renaissance thought of their period as a time of rebirth of classical art and learning. The word renaissance means rebirth. The Renaissance began in the prosperous trading cities of Italy around 1300 and spread slowly northward over all of Europe. With the Renaissance came a discovery of the classical art, literature, philosophy, and science that had seemed to die out with the fall of Rome in 476. Increased wealth produced such a demand for art and literature that the Renaissance became one of the most productive periods in all history. We are still feeling its effect today.

Gradually those conditions which made feudalism possible, and even necessary, ceased to exist. More and more of the people whose influence was felt came from the middle class. In the new universities, students might study law or medicine in order to become professional leaders in the rising towns and cities. Business needed educated people. So did many of the governments if the emerging nations were to succeed.

In some of the towns, schools of another kind appeared. These were trade schools. By learning various kinds of businesses at such schools, boys and young men were able to learn a trade without spending years of work under a master craftsman. On the other hand, fewer of the people who were trained in this way could ever expect to become master craftsmen.

The fact that money was much more important in middle class life than it had been in the early Middle Ages brought

about many changes. Successful merchants could afford luxuries that their ancestors had never dreamed of. Many of them became patrons of artists and writers. This greatly affected art and literature. Many of the writers and the artists within the monasteries had been nameless, as were many of the people who contributed to the artistic success of the great cathedrals. They were not concerned with their names being known to other men. Artists and writers of this period, however, were looking for worldly success and wanted their names to be known.

The Renaissance brought a great change in the attitude of the people. In the Middle Ages, people generally accepted their lot, doing the bidding of the nobles and the Church. With the Renaissance came a rebirth of the ideals of the Greeks. Man had a new nobility, and each man had his own rights and values. Each person now believed he had some control over his own future - and that future looked brighter than ever before.

Mutations

"Like tends to beget like". This means that organisms have traits found in their parents, grandparents, or earlier ancestors. However, sometimes a trait appears which was not present in the ancestors of an organism. Let us explain. All of the red-eyed fruit flies kept in a laboratory and bred generation after generation had red eyes. Then a white-eyed fly resulted from a mating between two red-eyed flies. The fruit fly with the white eyes is a mutant (myoot-ent), and the change in the trait is called a mutation (myoo tae shen).

Mutations are caused by chemical changes in DNA. Chemical changes in the DNA code of the gene result in changed "information" carried by messenger RNA to the ribosomes. Thus, there is a change in the enzymes in the cell and a change in the cell chemistry. In the case of the white-eyed fruit fly, the DNA in the genes for eye color was changed chemically in some way. As a result, white eyes instead of red eyes were formed in theoffspring.

Changes in a gene occur by chance, or probability (prob e bil et ee). This means that occasionally mutations occur spontaneously (sphn tae nee es lee), without any known cause. It is not possible to predict when a mutant will appear. Nor is it possible to predict which trait will be changed. Genes for some traits mutate as often as one

mutation in 2000 sex cells. Genes for other traits are so stable that they fail to mutate during millions of cell divisions. It is known that X-rays, nuclear radiation, cosmic radiation, and some chemicals may increase the number of mutations. Fruit flies exposed to X-rays are thought to change the DNA molecules in genes in some way.

There are many kinds of mutations including color, size and shape. Albinos (al bie nohz) have color mutations. In an albino, the genes for color are changed so that no color is produced in the individual. Albinos are white, and they have pink eyes. The pink color of the eyes is produced by red blood cells in the capillaries of the iris.

In general, mutations are recessive traits which are masked by normal genes for dominant traits. The genes for a mutant trait must be pure. If the mutation is to appear, all the genes controlling the trait must be of the mutant type. Only when the pairing of two mutated genes occurs will the mutation be present in an organism.

In general, mutations are harmful to an organism. Organisms survive because their traits adapt them to their environment. A change in traits usually makes an organism less adapted to its environment and less likely to survive.

Appendix E

Prior Knowledge Measure

WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

Red River colony _____

WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

settlers _____

WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

fur trade _____

WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

cells _____

WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

classifying _____

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

amoeba _____

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

trades _____

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

patrons of art _____

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

mutation _____

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

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WRITE ANYTHING THAT COMES TO YOUR MIND WHEN YOU HEAR THESE WORDS.

PUT EACH THOUGHT ON A NEW LINE.

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Appendix F

Comprehension Measures

Written Retelling Task

WRITE DOWN AS MUCH OF THE PASSAGE AS YOU CAN REMEMBER AND EVERTHING THAT IT MADE YOU THINK OF.

The Red River Colony

1. Who decided to go to Lord Selkirk's colony?

2. What were their reasons for coming to the Red River area?

3. What rumours did the settlers hear about the Red River area?

4. Who were the Metis?

5. How did the Metis feel about a group of newcomers settling in their midst? Why?

6. What did the Hudson's Bay Company do to protect the settlers?

7. Why do you think the Hudson's Bay Company helped the settlers?

8. Why do you think the Hudson's Bay Company and the North West Company decided to join together as one company?

9. What kind of problems did the settlers face after the two companies joined together?

10. Why do you supppose the colony survived even though they had many problems?

Classifying Living Things

1. What characteristics do scientists observe in order to group things?
2. What are protists?
3. Why did some scientists call one-celled living things protozoans?
4. Where do you think protozoans first developed?
5. Describe what an amoeba looks like?
6. How does an amoeba move?
7. What is the thin cover of a cell called?
8. The author says that an amoeba gets food by flowing around a speck of plant or animal material. How do you think this food gets into the amoeba?
9. How do you think more blood is produced in our bodies after we bleed or donate blood?
10. Why don't adult animals continue to grow larger and larger?

The Renaissance

1. What does the term "renaissance" mean?

2. The Renaissance was a productive period. Exactly what was in demand?

3. What class of people had the most influence in society during the Renaissance?

4. What did the students study at university to become leaders during the Renaissance?

5. What is the major advantage of trade schools?

6. Who would expect to become more skilled, apprentices or students at the trade schools? Why?

7. Who became patrons of artists and writers during the Renaissance?

8. Tell how the artists and writers of the Middle Ages were different from the artists and writers in the Renaissance.

9. The authors state that the Renaissance brought man a "new nobility". What do you think they mean by a "new nobility"?

10. The authors state that we are still feeling the effects of the Renaissance today. Tell how or in what way.

Mutations

1. What kind of changes in DNA cause mutations?

2. Name some of the agents that cause mutations.

3. What are some of the kinds of mutations?

4. What does the author mean when he says that changes in a gene occur by chance?

5. What conditions must be present if a mutation is to appear?

6. Why does a mutation usually make an organism less adapted to its environment?

7. Tell why a person might have blond hair when both parents have dark-colored hair?

8. Explain why the red blood cells make the eyes of an albino a pink color and not red.

9. Why are more mutations not seen in the animal world, even though organisms today are exposed to increasingly greater numbers of mutation causing agents?

10. When a Black Labrador dog and a German Shepherd mate, will all members of the next generations look alike? Explain why?

APPENDIX G

Means and Standard Deviations for Comprehension Performance

Means and Standard Deviations for Comprehension Performance for Grade Six

Variable	N	Mean	Standard Deviation
Grade Six Science			
RC1RC2	119	4.98319328	3.81563064
RC3RC4	119	5.18487395	5.28824470
QuesL	119	1.80672269	1.45134252
QuesI	119	0.79831933	0.87894228
RCTL	119	10.16806723	7.80082495
QuesTL	119	2.60504202	2.01770577
Grade Six Social Studies			
RC1RC2	115	5.97391304	4.86927508
RC3RC4	115	6.22608696	5.36404677
QuesL	115	2.68695652	1.45918276
QuesI	115	1.38260870	1.23247440
RCTL	115	12.20000000	8.13935641
QuesTL	115	4.06956522	2.15911669
Grade Six Across Passages			
RC1RC2	234	5.47008547	4.38407702
RC3RC4	234	5.69655812	5.33972772
QuesL	234	2.23931624	1.51756283
QuesI	234	1.08547009	1.10459555
RCTL	234	11.16666667	8.01674749
QuesTL	234	3.32478632	2.20934053

RC1RC2 = Text Specific + Text Embedded Retelling Responses (Literal Comprehension)
RC3RC4 = Text Entailed + Text Evoked Retelling Responses (Inferential Comprehension)
QuesL = Literal Questions (n = 5)
QuesI = Inferential Questions (n = 5)
RCTL = RC1RC2 + RC3RC4
QuesTL = Total Questions (QuesL = QuesI) (n=10)

Means and Standard Deviations for Comprehension Performance for Grade Nine

Variable	N	Mean	Standard Deviation
Grade Nine Science			
RC1RC2	126	4.79365079	3.74660905
RC3RC4	126	5.83333333	5.66356778
QuesL	126	1.83333333	1.50598805
QuesI	126	1.21428571	1.23681619
RCTL	126	10.62608413	7.83911641
QuesTL	126	3.4761905	2.43263526
Grade Nine Social Studies			
RC1RC2	128	4.30468750	3.52841914
RC3RC4	128	5.06250000	4.87763658
QuesL	128	2.52755906	1.15350929
QuesI	128	1.32283465	1.31463214
RCTL	128	9.3618750	6.64377169
QuesTL	128	3.85039370	2.04349040
Grade Nine Across Passages			
RC1RC2	254	4.54724409	3.63933988
RC3RC4	254	5.44488189	5.28579585
QuesL	254	2.18181818	1.38238161
QuesI	254	1.26877470	1.27510242
RCTL	254	9.99212598	7.27440264
QuesTL	254	3.45059289	2.27707032

RC1RC2 = Text Specific + Text Embedded Response (Literal Comprehension)
RC3RC4 = Text Entailed + Text Evoked Retelling Responses (Inferential Comprehension)
QuesL = Literal Questions
QuesI = Inferential Questions
RCTL = RC1RC2 + RC3RC4
QuesTL = Total Questions (QuesL = QuesI) (n=10)

APPENDIX H

Analysis of Variance Tables

Table 6.1

Analysis of Variance of Literal Comprehension Measures by Topic for Grade Six

Dependent Measure	Variable	df	SS	F	P
			Grade 6 Science n = 119		
Literal Uncued Retelling	PKQL	2	186.56746261 (198.82044061)	7.61 (8.10)	.0008 * (.0005)*
	PKQT	2	52.6894268 (79.39550276)	2.15 (3.24)	.1216 (.0431)*
	PKQT*PKQL	4	90.50740290	1.84	.1254
Literal Questions	PKQL	2	18.85672340 (27.60674540)	5.19 (7.60)	.0070 * (.0008)*
	PKQT	2	3.13812531 (7.97357547)	0.86 (2.19)	.4245 (.1163)
	PKQT*PKQL	4	13.09829365	1.80	.1335
			Grade 6 Social Studies n = 115		
Literal Uncued Retelling	PKQL	2	112.30532097 (93.79850681)	2.74 (2.29)	.0689 (.1061)
	PKQT	2	65.73944380 (100.28009876)	1.61 (2.45)	.2056 (.0912)
	PKQT*PKQL	4	338.95286938	4.14	.0037 *
Literal Questions	PKQL	2	4.30621020 (6.78296004)	1.26 (1.98)	.2884 (.1429)
	PKQT	2	0.56162656 (32.60908978)	0.16 (9.53)	.8489 (.0002)*
	PKQT*PKQL	4	21.90941579	3.20	.0159 *

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.2

Analysis of Variance of Inferential Comprehension Measures by Topic for Grade Six

Dependent Measure	Variable	df	SS	F	P
		Grade 6 Science n = 119			
Inferential Uncued Retelling	PKQL	2	787.28206646 (606.89918238)	23.28 (18.04)	.0001 * (.0001)*
	PKQT	2	525.18305316 (131.90689387)	15.56 (3.90)	.0001 * (.0231)*
	PKQT*PKQL	4	698.16882141	10.32	.0001 *
Inferential Questions	PKQL	2	4.94086586 (6.11140132)	4.18 (5.17)	.0178 * (.0072)*
	PKQT	2	6.88118825 (8.66768574)	5.82 (7.33)	.0040 * (.0010)*
	PKQT*PKQL	4	11.34962443	4.80	.0013 *
		Grade 6 Social Studies n = 115			
Inferential Uncued Retelling	PKQL	2	82.74725000 (150.56214317)	1.44 (2.63)	.2408 (.0771)
	PKQT	2	48.25109055 (73.59844073)	0.84 (1.28)	.4339 (.2813)
	PKQT*PKQL	4	17.17945101	0.15	.9627
Inferential Questions	PKQL	2	5.04384839 (6.04198507)	1.88 (2.25)	.1574 (.1100)
	PKQT	2	0.66953408 (13.34048525)	0.25 (4.98)	.7794 (.0086)*
	PKQT*PKQL	4	11.70962871	2.18	.1757

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.3

Analysis of Variance of Comprehension Measures Across Topics for Grade Six

Dependent Measure	Variable	df	SS	F	P
Literal Uncued Retelling	Topic	1	0.34504095 (57.40247261)	0.02 (3.52)	.8844 (.0619)
	PKQL	2	287.97713244 (281.76895059)	8.84 (8.65)	.0002 * (.0002)*
	Topic*PKQL	2	9.76634440 (10.84999682)	0.33 (0.33)	.4710 (.7172)
	PKQT	2	24.61800349 (144.63431596)	0.76 (4.44)	.4710 (.0129)*
	Topic*PKQT	2	91.47773146 (35.04128556)	2.81 (1.08)	.0626 (.3430)
	PKQT*PKQL	4	200.32267026 (197.23086128)	3.07 (3.03)	.0173 * (.0186)*
	Topic*PKQT*PKQL	4	232.22941100	3.56	.0077 *
Literal Questions	Topic	1	2.42822760 (45.31323397)	1.38 (25.67)	.2422 (.0001)*
	PKQL	2	19.64819792 (27.82323397)	5.57 (7.88)	.0044 * (.0005)*
	Topic*PKQL	2	4.48362356 (6.56647146)	1.27 (1.86)	.2829 (.1582)
	PKQT	2	1.79589420 (34.30521797)	0.51 (9.72)	.6020 (.0001)*
	Topic*PKQT	2	2.08881028 (6.27744728)	0.59 (1.78)	.5543 (.1714)
	PKQT*PKQL	4	20.54788659 (20.14891381)	2.91 (2.85)	.0225 * (.0247)*
	Topic*PKQT*PKQL	4	14.85879564	2.10	.0813

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05
n = 234

Table 6.3 (continued)

Dependent Measure	Variable	df	SS	F	P
Inferential Uncued Retelling	Topic	1	157.99415771 (63.40275272)	6.97 (2.80)	.0089 * (.0960)
	PKQL	2	606.93164828 (678.71272634)	13.45 (14.96)	.0001 * (.0001)*
	Topic*PKQL	2	274.48756316 (81.74859920)	6.05 (1.80)	.0028 * (.1674)
	PKQT	2	285.23114625 (190.38355807)	6.29 (4.20)	.0022 * (.1630)
	Topic*PKQT	2	15.12177653 (312.87960145)	0.33 (6.90)	.7169 (.0012)*
	PKQT*PKQL	4	269.02927938 (239.19198529)	2.97 (2.64)	.0206 * (.0350)*
	Topic*PKQT*PKQL	4	476.15628712	5.25	.0005 *
Inferential Questions	Topic	1	0.22145249 (19.96571703)	0.23 (20.82)	.6313 (.0001)*
	PKQL	2	8.55250304 (11.94123442)	4.46 (6.23)	.0126 * (.0023)*
	Topic*PKQL	2	0.89917606 (0.21215196)	0.47 (0.11)	.6263 (.8953)
	PKQT	2	1.89233608 (20.56467434)	0.99 (10.72)	.3744 (.0001)*
	Topic*PKQT	2	6.16729624 (1.44349664)	3.22 (0.75)	.0420 (.4723)
	PKQT*PKQL	4	15.10598820 (16.25314662)	3.94 (4.24)	.0042 * (.0025)*
	Topic*PKQT*PKQL		6.80610653	1.77	.1350

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05
n = 234

Table 6.4

Analysis of Variance of Literal Comprehension Measures by Topic for Grade Nine

Dependent Measure	Variable	df	SS	F	P
			Grade 9 Science n = 126		
Literal Uncued Retelling	PKQL	2	127.44133402 (309.29080299)	5.61 (13.61)	.0047 * (.0001)*
	PKQT	2	25.40753772 (9.51175948)	1.12 (0.42)	.3305 (.6590)
	PKQT*PKQL	4	106.06549774	2.33	.0597
Literal Questions	PKQL	2	18.63190918 (68.45686275)	5.24 (19.24)	.0066 * (.0001)*
	PKQT	2	0.59003928 (3.24761640)	0.17 (0.91)	.8474 (.4043)
	PKQT*PKQL	4	3.62585046	0.51	.7289
			Grade 9 Social Studies n = 128		
Literal Uncued Retelling	PKQL	2	63.04431668 (128.59448738)	2.71 (5.53)	.0707 (.0051)*
	PKQT	2	4.16562337 (0.12611565)	0.18 (0.01)	.8363 (.9946)
	PKQT*PKQL	4	68.10007653	1.46	.2176
Literal Questions	PKQL	2	1.16862495 (7.48631872)	0.46 (2.94)	.6334 (.0569)*
	PKQT	2	4.25499885 (3.68435770)	1.67 (1.45)	.1928 (.2398)
	PKQT*PKQL	4	6.07666198	1.19	.3180

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.5

Analysis of Variance of Inferential Comprehension Measures by Topic for Grade Nine

Dependent Measure	Variable	df	SS	F	P
Grade 9 Science n = 126					
Inferential Uncued Retelling	PKQL	2	411.50453673 (1226.92352941)	9.65 (28.76)	.0001 * (.0001)*
	PKQT	2	128.46637464 (2.97598017)	3.01 (0.07)	.0530 (.9326)
	PKQT*PKQL	4	284.30543839	3.33	.0127 *
Inferential Questions	PKQL	2	39.68300582 (58.39075630)	18.46 (27.17)	.0001 * (.0001)*
	PKQT	2	1.27698089 (0.62311771)	0.59 (0.29)	.5537 (.7489)
	PKQT*PKQL	4	6.46610814	1.50	.2054
Grade 9 Social Studies n = 128					
Inferential Uncued Retelling	PKQL	2	89.08426033 (203.45698925)	2.38 (5.45)	.0965 (.0055)*
	PKQT	2	376.34239176 (508.00878025)	10.07 (13.60)	.0001 * (.0001)*
	PKQT*PKQL	4	87.20200828	1.17	.3289
Inferential Questions	PKQL	2	4.94080312 (13.64159450)	1.57 (4.33)	.2128 (.0143)*
	PKQT	2	8.48028394 (10.54719478)	2.69 (3.35)	.0720 (.0386)*
	PKQT*PKQL	4	7.64047365	1.21	.3093

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.6

Analysis of Variance of Comprehension Measures Across Topics for Grade Nine

Dependent Measure	Variable	df	SS	F	P
Literal Uncued Retelling	Topic	1	36.71916559 (15.18096273	3.19 (1.32	.0752 (.2517)
	PKQL	2	157.59845820 (422.02101605)	6.85 (18.35)	.0013 * (.0001)*
	Topic*PKQL	2	8.71024748 (15.86427432)	0.38 (0.69)	.6852 (.5027)
	PKQT	2	22.80702634 (4.69773202)	0.99 (0.20)	.3725 (.8154)
	Topic*PKQT	2	6.16517927 (4.94014311)	0.27 (0.21)	.7651 (.8069)
	PKQT*PKQL	4	66.68917236 (70.08986259)	1.45 (1.52)	.2184 (.1960)
	Topic*PKQT*PKQL	4	104.07556368	2.26	.0632
Literal Questions	Topic	1	1.07655274 (30.48282033)	0.71 (19.98)	.4018 (.0001)*
	PKQL	2	14.28231908 (58.90060804)	4.68 (19.30)	.0102 * (.0001)*
	Topic*PKQL	2	5.34479989 (17.04257342)	1.75 (5.58)	.1758 (.0043)*
	PKQT	2	3.05533684 (6.91048530)	1.00 (2.26)	.1758 (.1061)
	Topic*PKQT	2	2.71189621 (0.02148880)	0.89 (0.01)	.4126 (.9930)
	PKQT*PKQL	4	1.48513011 (2.25865357)	0.24 (0.37)	.9135 (.8298)
	Topic*PKQT*PKQL	4	7.44385888	1.22	.3031

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05
n = 254

Table 6.6 (continued)

Dependent Measure	Variable	df	SS	F	P
Inferential Uncued Retelling	Topic	2	6.25926994 (37.72834646)	0.31 (1.89)	.5763 (.1708)
	PKQL	2	387.22750144 (1241.08499633)	9.68 (31.04)	.0001 * (.0001)*
	Topic*PKQL	2	61.75984252 (189.29552233)	1.54) (4.73)	.2155 (.0096)*
	PKQT	2	321.20626097 (278.31611521)	8.03 (6.96)	.0004 * (.0012)*
	Topic*PKQT	2	75.96844331 (232.66864522)	1.90 (5.82)	.1519 (.0034)*
	PKQT*PKQL	4	129.87238749 (122.79515424)	1.62 (1.54)	.1689 (.1926)
	Topic*PKQT*PKQL	4	248.71229243	3.11	.0161 *
Inferential Questions	Topic	2	0.10602523 (0.74525492)	0.08 (0.56)	.7776 (.4542)
	PKQL	2	32.22826012 (65.95700186)	12.15 (24.87)	.0001 * (.0001)*
	Topic*PKQL	2	8.13932452 (6.07534894)	3.07 (2.29)	.0484 (.1035)
	PKQT	2	2.55225796 (7.67995536)	0.96 (2.90)	.3835 (.0573)
	Topic*PKQT	2	5.00636298 (3.49035713)	1.89 (2.25)	.1538 (.2702)
	PKQT*PKQL	4	11.09507283 (11.95841751)	2.09 (2.25)	.0827 (.0640)
	Topic*PKQT*PKQL	4	2.14816429	0.40	.8050

Note. Type I test results are in parentheses.
PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05
n = 254

Table 6.7

Analysis of Variance on Literal and Inferential Comprehension Measures Across Grades By Topic

Dependent Measure	Variable	df	SS	F	P
Science Passages Across Grades n = 245					
Literal Uncued Retelling	Grade	1	6.68072116	0.57	.4526
	PKQL	2	272.41742359	11.54	.0001 *
	Grade*PKQL	2	3.05388492	0.13	.8787
	PKQT	2	47.03751910	1.99	.1387
	Grade*PKQT	2	34.57227003	1.46	.2333
	PKQT*PKQL	4	34.59743527	0.73	.5704
	Grade*PKQT*PKQL	4	177.79506554	3.77	.0055 *
Literal Questions	Grade	1	0.02548496	0.01	.9063
	PKQL	2	29.74880401	8.27	.0003 *
	Grade*PKQL	2	0.79756168	0.22	.8012
	PKQT	2	3.17740241	0.88	.4146
	Grade*PKQT	2	0.48898116	0.14	.8729
	PKQT*PKQL	4	12.70228141	1.77	.1365
	Grade*PKQT*PKQL	4	3.66167404	0.51	.7290

PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.7 (continued)

Dependent Measure	Variable	df	SS	F	P
	Social Studies Across Grades				
Literal Uncued Retelling n = 243	Grade	1	89.96931846	5.70	.0178 *
	PKQL	2	167.83643991	5.31	.0056 *
	Grade*PKQL	2	2.22354726	0.07	.9321
	PKQT	2	11.74220100	0.37	.6900
	Grade*PKQT	2	43.50464586	1.38	.2544
	PKQT*PKQL	4	118.24901100	1.87	.1164
	Grade*PKQT*PKQL	4	209.47249109	3.32	.0116 *
Literal Questions n = 242	Grade	1	0.14369495	0.10	.7558
	PKQL	2	3.14565244	1.08	.3476
	Grade*PKQL	2	1.45840451	0.49	.6119
	PKQT	2	4.27909447	1.44	.2381
	Grade*PKQT	2	1.27989740	0.43	.6498
	PKQT*PKQL	4	10.63966407	1.80	.1307
	Grade*PKQT&PKQL	4	21.63820058	3.65	.0066 *

PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.8

Analysis of Variance of Inferential Comprehension Measure Across Grades by Topic

Dependent Measure	Variable	df	SS	F	P	
Science Passages Across Grades						
Inferencial Uncued Retelling n = 243	Grade	1	14.36241880	0.75	.3878	
	PKQL	2	1047.73058518	27.30	.0001	*
	Grade*PKQL	2	33.32706636	0.87	.4210	
	PKQT	2	417.48597651	10.88	.0001	*
	Grade*PKQT	2	257.32204393	6.63	.0016	*
	PKQT*PKQL	4	876.78230539	11.42	.0001	*
	Grade*PKQT*PKQL	4	373.26021221	4.86	.0009	*
Inferential Questions n = 242	Grade	1	3.15514465	3.75	.0539	
	PKQL	2	29.85168706	17.76	.0001	*
	Grade*PKQL	2	7.99390384	4.76	.0095	*
	PKQT	2	5.13870265	3.06	.0490	*
	Grade*PKQT	2	2.70630233	1.61	.2021	
	PKQT*PKQL	4	10.61949588	3.16	.0149	*
	Grade*PKQT*PKQL	4	5.73955620	1.71	.1492	

PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05

Table 6.8 (continued)

Dependent Measure	Variable	df	SS	F	P	
	Social Studies Passages Across Grade					
Inferential Uncued Retelling n = 243	Grade	1	41.61109063	1.78	.1836	
	PKQL	2	145.69089573	3.12	.0463	*
	Grade*PKQL	2	15.86522945	0.34	.7127	
	PKQT	2	118.37927187	2.53	.0818	
	Grade*PKQT	2	214.25878215	4.58	.0112	*
	PKQT*PKQL	4	62.46270785	0.67	.6150	
	Grade*PKQT*PKQL	4	41.47168677	0.44	.7772	
Inferencial Questions n = 242	Grade	1	2.90265307	1.98	.1605	
	PKQL	2	7.93633226	2.71	.0687	
	Grade*PKQL	2	1.23521491	0.42	.6564	
	PKQT	2	2.22139282	0.76	.4696	
	Grade*PKQT	2	5.24092032	1.79	.1694	
	PKQT*PKQL	4	14.10369146	2.41	.0503	
	Grade*PKQT*PKQL	4	4.65044268	0.79	.5302	

PKQL = Qualitative prior knowledge
PKQT = Quantitative prior knowledge
*p < .05